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PHOTO-INTERPRETATION OFWAVE HILL, VICTORIA RIVER DOWNS, AND DELAMERE. NORTHERN TERRITORY.

by

W.J. Perry

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PHOTO-INTERPRETATION OF WAVE HILL, VICTORIA RIVER DOWNS AND DELAMERE NORTHERN TERRITORY

SUMMARY

Proterozoic rocks occupy roughly the western half of DELAMERE and VICTORIA RIVER DOWNS, and form a smaller inlier in the west of WAVE HILL. The widespread Antrim Plateau Volcanics, regarded as of Middle Cambrian age, overlie the Proterozoic rocks unconformably, and extend in a broad zone from the south-west to the north-east of the studied area. In the east of WAVE HILL and VICTORIA RIVER DOWNS the Volcanics are overlain by Middle Cambrian Montejinni Limestone; round Top Springs on VICTORIA RIVER DOWNS a possible sedimentary bed between the Volcanics and the Montejinni Limestone has been delineated. The Mullaman Beds of Cretaceous age are exposed in a narrow strip in the east of DELAMERE, and in the north-east and south-east of VICTORIA RIVER DOWNS. To the east is sand plain, which also covers the eastern part of WAVE HILL.

In places the older Proterozoic rocks, namely, the "Skull Creek Limestone" and "Timber Creek Formation" have been sharply folded, but the overlying "Coolibah Formation" and "Jasper Gorge Sandstone" are generally sub-horizontal. Important fault zones have been observed in the Proterozoic rocks, but the younger rocks are, by comparison, little affected. The Phanerozoic rocks are in general flat-lying.

INTRODUCTION

Photo-interpretation (of WAVE HILL, VICTORIA RIVER DOWNS and DELAMERE) has been carried out with the purpose of assisting in the planning and execution of the field work scheduled for the 1966-67 seasons.

The photographs have a nominal scale of 1:50,000 and were taken by the R.A.A.F. in 1948. Contrast generally is low as can be seen by comparison with two gap-filling runs of 1:85,000 scale photography on WAVE HILL flown in 1962.

J. C. Rivereau, of the Institut Francais du Petrole, interpreted the north-east quarter of DELAMERE.

Transparent overlays of alternate photographs were annotated and the annotations compiled on overlays of National Mapping photo-scale planimetric sheets. After editing, letter symbols were added and the resulting photogeological compilations were reduced photographically to 1:250,000 scale; the negatives assembled, a film positive made, and the latter combined with the National Mapping 1:250,000 scale planimentric compilation to produce a composite print.

Geological work prior to 1955 is summarized by Traves (1955). Other documents consulted include unpublished reports by Laing and Allen (1956) and Barclay and Hays (1965), unpublished maps dated 1958 at a scale of 4 miles to an inch of WAVE HILL and VICTORIA RIVER DOWNS compiled by N.J. Mackay; and the results of investigations on adjoining sheets by Randal (1961) and Milligan and others (1966).

PHYSIOGRAPHY

Traves (1955) in describing the topography of the Ord-Victoria Region, uses the morphological divisions recognised by Paterson (1954). Those relevant to the area described in this report are Victoria River Plateau, Victoria River Plains and Terraces, and Sturt Plateau (Traves, op.cit., Fig. 6). The Sturt Plateau refers to the flat relatively elevated sand plain in the south and east of WAVE HILL, in the far east of VICTORIA RIVER DOWNS and the east of DELAMERE.

The altitude of the plain ranges from 600' east of Willeroo up to 1000' in the south of WAVE HILL, and its western boundary follows approximately the Cretaceous scarp.

The Victoria River Plains and Terraces occupy a large part of VICTORIA RIVER DOWNS and WAVE HILL; they include the rolling downs topography of the Antrim Plateau Volcanics and the low lying alluviated areas along the Wickham and Victoria Rivers.

The Victoria River Plateau is composed of mainly sub-horizontal Proterozoic sediments that have been dissected by numerous rivers, with the formation of deep gorges; plateau levels range from 600' in the north to 1000' in the south. The Plateau occupies the western half of DELAMERE, and small parts in the west of VICTORIA RIVER DOWNS and WAVE HILL.

A. WAVE HILL

Stratigraphy (Table I)

Proterozoic

Undifferentiated sediments B

This is not a distinctive unit, but rather a term applied to a medium toned area of low relief round Blackgin Hill; on Run 5 Photo 5010 it appears to be stratigraphically below Bu and is therefore older than the Wave Hill Beds. On Mackay's compilation it is referred to Jasper Gorge Sandstone.

A narrow zone associated with a north-west trending fault in the west of the sheet, and a folded inlier near Wyalong Yard are referred to B.

Timber Creek Formation But

This name was given by Laing and Allen (1956) to a sequence dominantly of siltstone, with minor limestone, sandstone and chert. On Mackay's map of WAVE HILL (First edition, 1958) the unit is shown in five separate places in the west and north but in the map accompanying this report the undivided unit is shown only in two places along the northern boundary of the sheet where it is medium toned, bedded and jointed. Elsewhere the areas shown by Mackay as But have not been referred to it, because in the Farquharson Gap area they can be divided into several units (B_1, to B_7), that from air photo evidence seem to be older than Mackay's But in the Blackfellow Knob area (Bu3).

The oldest units are exposed in an anticline near Farquharson Gap; these are the divisions B_1 to B_7 which have been made on the

WAVE HILL

Table 1

Photogeological Character		Possible Geological Equivalent			
	Qa	Alluvium	QUATERNARY	CAINOZOIC	
	Qs	Sand			
Light grey tone, soft appearance	Qt	Terrace deposits			
Dark toned	Czw	Slope wash	UNDIFFERENTIATED		
Medium grey toned	Czs	Soil, sand			
Light toned, forms treeless plain	Czb	Older alluvium			
Dark toned, mesa-form	Cz	Laterite			
Light grey toned, forms low scarp	€me	Merrina Beds	MIDDLE		
Light and dark toned, forms low scarp; jointed in places	€mm	Montejinni Limestone			
Dark toned, steep sided small hills surrounded by paler toned areas	€	?Silicified sediments		CAMBRIAN	PALAEOZOIC
Medium toned, smooth surface, characteristic mottled texture where soil covered	€la	Antrim Plateau Volcanics			
Medium toned, flat lying	Buu				
Light and dark toned interbedded units	Bu9	"Wave Hill Beds"			
	Bu8				
	Bu7				
	Bu6				
Soft, light toned, well bedded	Bu5				
Medium to dark toned, bedded; jointed in places	Bu4				
Medium to dark toned, bedded; forms distinctive scarp in places	Bu3	Bedded sedimentary rocks			
Medium to dark toned, bedded; jointed	Bu2				
Medium grey toned, hard	Bu1				
	Bu	Undifferentiated			
Scarp forming; dendritic drainage pattern	B7			PROTEROZOIC	PRECAMBRIAN
Medium to dark toned; more resistant than B5	B6	Bedded sedimentary rocks			
Soft light toned massive unit	B5				
Medium grey toned, scarp forming	B4				
Soft light toned unit, bedding not distinct	B3				
Striated pattern with generally lighter tone than B1	B2				
Medium to dark toned, bedded; fairly resistant	B1				
Light to medium toned, bedded; very well jointed in places	Buj	"Jasper Gorge Sandstone"			
Medium toned, bedded, jointed	But	"Timber Creek Formation"			
Medium toned, low relief	B	Undifferentiated sediments			

(Formation names in inverted commas are unpublished - Laing & Allen, 1956, Mackay, 1958)

basis of lithology, as reflected in differences in photographic tone, relative resistance to erosion and other photogeological characters.

Jasper Gorge Sandstone Buj

This unit was also named by Laing and Allen (1956); it is unconformable on the Timber Creek Formation on VICTORIA RIVER DOWNS. The photogeological map follows Mackay's map where the northern outcrops are concerned but not for those in the west. In the north Buj is a light to medium toned unit, bedded and very well jointed in places.

Bedded sedimentary rocks B1 to B7

The oldest unit B_1 is a medium toned, bedded, fairly resistant unit exposed in the core of an anticline near Farquharson Gap; successively younger units B2 to B7, apparently conformable, have been distinguished on the basis of their lithology, as reflected in their photogeological character. B7? is a medium toned unit without obvious bedding; it is probably of carbonate lithology because sink holes have been observed on R8/5127.

Bedded sedimentary rocks Bu1 to Bu4; Undifferentiated Bu

This is a conformable sequence starting with the lowest unit Bu1 in the core of an anticline on R9/5009; the relationship of the unit Bu1 to units in the sequence B1 to B7 is uncertain. On R8/5127 it can be seen that B7? is stratigraphically beneath Bu2, but photocharacter does not suggest that B7? is the same as Bu1. There is also some doubt about the correlation of Bu2 across the strong north-north-east trending fault on R8/5127, but it seems likely. Bu2 is a medium to dark toned, bedded, jointed unit conformably above Bu1 from which it is separated by a soft thin interval. Bu3 has a soft interval at the base with a hard bed at the top, giving rise to a fairly distinctive sharp-edged scarp. Another soft thin interval separates Bu3 from Bu4, a medium to dark toned unit, well jointed in places, particularly on R8/5129.

Bu is applied to rocks of uncertain affinity but thought to be related to the general Bu1 to Bu9 sequence. On Run 10A/5087 a light toned bedded unit is referred to Bu; it occupies a syncline within Bu3 and therefore should be Bu4 but its appearance is more like that of Bu5.

Also referred to Bu are rocks in a faulted anticline on R11/5168; and associated with an north-trending fault zone (R7/5115; R6/5171;

R5A/5010); and associated with a faulted anticline north of Mount Deakin (R9/5016; 10A/5098).

Wave Hill Beds Bu5 to Bu9

The Wave Hill Beds, as shown on Mackay's map, have been subdivided into five units. Bu5 the basal unit, has a distinctive light toned, well bedded appearance; it overlies apparently conformably unit Bu4. Barclay and Hays (1965, p.8) report limestone in the Wave Hill Beds opposite Wave Hill Police Station. The units Bu6 to Bu9 are light and dark toned interbedded units, that are found in an inlier in the Antrim Plateau Volcanics to the east of and separate from the Bu5.

Buu

This symbol is given to a medium toned unit with an uneven surface resting unconformably on Bu2 and Bu3; bedding is not apparent but the unit forms a low scarp and is probably flat lying.

Cambrian

Antrim Plateau Volcanics €la

This formation has a characteristic medium grey toned smooth appearance and is widespread; in places it is soil covered but generally the soil has not been shown, except for an area west of Camfield Creek (R5/5090; R6/5185). The volcanics rest unconformably on the Proterozoic units, and are overlain in the east by the Montejinni Limestone and in the far south west by the Merrina Beds (Milligan, et al., 1966). In the south-west the Volcanics are capped with dark toned laterite, and at the eroded edges of this there is a pale toned layer that at first was regarded as a separate formation overlying the €la; however, field evidence (Milligan, pers.comm.) from WINNECKE CREEK, the adjoining sheet to the south suggests that the pale layer is weathered volcanics. On R5/5008 it is difficult to distinguish €la from B because of the poor quality of the photos.

On R1/5094 the sediments surrounded by volcanics are shown as But?, but it is possible, though not considered likely, that they are associated with the volcanics.

?Silicified sediments €

Numerous small steep sided hills north of Biri Hill and round Barry Knob are thought to be silicified sediments or chert from within the volcanics.

Montejinni Limestone ϵmm

The formation overlies the Antrim Plateau Volcanics east of Camfield Creek. On R2/5048 it is reasonably well exposed, and at the base is a dark soft bed overlain by a thin light toned bed; this is followed by a dark toned well jointed layer (probably limestone) capped in places by soft pale toned material.

Further north, on VICTORIA RIVER DOWNS, the main two divisions, i.e., the lower dark toned bed and the upper probable limestone bed, are well developed, and have been mapped as ϵm_1 and ϵm_2 respectively.

Merrina Beds ϵme

This unit comes on to the extreme south west of the sheet from WINNECKE CREEK where it has been mapped by Milligan, Smith, Nichols and Doutch (1966). It is light grey toned and forms a low scarp.

Cz Laterite

This is well developed on the Antrim Plateau Volcanics in the south-west, and scattered patches are found on the Proterozoic rocks in the west.

Older Alluvium Czb

The main development is west of Cattle Creek Outstation where the Czb forms a light toned treeless plain.

Slope wash Czw

This refers to a dark toned material probably deriving from erosion of the ferruginous zone of the laterite profile.

II Structure

In general the Proterozoic rocks are folded and faulted, whereas the Antrim Plateau Volcanics and younger rocks are subhorizontal and little disturbed.

Of two anticlines recognised within the Proterozoic in the west of the Sheet the more northerly is in the Farquharson Gap area (R4A/5176); the axis trends north-west, and the east flank has been cut off by a somewhat sinuous fault possibly a low angle reverse type; the west flank is gently dipping. The core of the other anticline is observed on R9/5010 and the axis also trends north-west.

On R11/5068 four miles west of the Victoria River, a narrow anticline with a north-trending axis is cut by an important north-trending fault; the fault zone, and subsidiary splays, extends from this area to the north for 28 miles, and to the south probably for 12 miles. A probable extension further north is concealed by Antrim Plateau Volcanics, but faulted inliers of B on R3/5182 are on the same trend, and on R1/5098 other faults on the same trend cut But and Bu1 at the boundary of the Sheet with VICTORIA RIVER DOWNS. East of the fault zone the sediments Bul to B4 and the "Wave Hill Beds" form a moncline that dips gently to the east-south-east.

On R9/5016 a fault about 8 miles long cuts Bu9 and the movement associated with it probably has been responsible for the structure in the beds labelled Bu further south. A few miles to the north a small dome in Bu? within the Antrim Plateau Basalt lies on the fault trend.

B. VICTORIA RIVER DOWNS

I. Stratigraphy (Table 2)

Proterozoic

"Timber Creek Formation" But

This unit is found in the south-west of the Sheet. Laing and Allen (1956, p.13 state that it is a lateral variation of the "Skull Creek Limestone", being of mainly siltstone lithology. The boundary between But and Bus is placed south of the Humbert River following Mackay's 1958 compilation.

West of Gibbie Creek (R15/5085-7) the formation has been subdivided into five conformable units Ba to Be on the basis of lithology as expressed in airphoto character, the latter being shown on the reference (Table 2). The base of the formation is not exposed, and it is overlain unconformably by the "Jasper Gorge Sandstone". Well-bedded sediments are exposed north of Depot Creek R12/5077 and this appears to be a suitable locality for measuring a section.

"Skull Creek Limestone" Bus

The principal areas of outcrop are north and west of Victoria River Downs Homestead, south and west of Humbert River and in the north-west of the Sheet. The formation typically has a light toned thin-bedded appearance except where massive chert becomes important in the section, where the unit takes on a hard appearance, e.g. on R3/5054; 4/5106.

VICTORIA RIVER DOWNS

TABLE 2

Photogeological Character			Possible Geological Equivalent		
	Qa	Alluvium	QUATERNARY	CAINOZOIC	
	Qs	Sand			
Light grey toned, soft appearance	Qt	Terrace deposits			
Medium grey toned	Czs	Soil, sand	UNDIFFERENTIATED		
Dark toned, mesa-form	Cz	Laterite			
Soft, light toned, with white patches	K	Mullaman Beds	CRETACEOUS	MESOZOIC	
Light and dark toned, forms low scarp	ϵm_2	Montejinni Limestone	Lower	CAMBRIAN	PALAEOZOIC
Light and dark toned, forms scarp at lower level than Em_2	ϵm_1	Sediments			
Medium toned, smooth surface	ϵla	Antrim Plateau Volcanics	Middle		
Light to medium toned, bedded; very well jointed in places	Buj	"Jasper Gorge Sandstone"			
Medium toned, bedded; soft, with prominent hard bed near base	Bj				
Soft, dark toned on steep slopes light toned in gently sloping areas	Buc	"Coolibah Formation"			
Dark toned, forms low scarp	Buc_1	Marker bed			
Light toned, thin bedded	Bus	"Skull Creek Limestone"	Lateral Equivalents	PROTEROZOIC	PRECAMBRIAN
Medium to light toned, thin bedded	But	"Timber Creek Formation"			
Dark toned, with smooth surface	Be				
Dark toned with dendritic drainage pattern	Bd				
Soft, light toned, well bedded	Bc				
Medium toned, well bedded	Bb				
Medium toned, hard appearance	Ba				

(Formation names in inverted commas are unpublished - Laing & Allen, 1956)

On R8/5111 the position of the boundary of Bus and Buc is uncertain although Laing and Allen (1956) report a slight angular unconformity between them. On R8/5107 the boundary between Bus and Buc is placed at the base of a light toned bed east of the principal point.

An inlier within the Antrim Plateau Volcanics on R8/5096 shows a striated pattern typical of thin-bedded rocks, and it is interpreted as Bus; in this map the differs from that of Laing and Allen, and from Mackay's compilation, on both of which it is shown as Buj.

"Coolibah Formation" Buc, Bucl

Laing and Allen (1956) gave this name to a sequence mainly of siltstone and shale, the type section of which is in the Coolibah Homestead area. The formation is soft, dark toned on steep slopes and light toned in gently sloping areas; in most places the contact with the overlying "Jasper Gorge Sandstone" appears conformable. The contrast in tone between steep and gentle slopes is well shown on R6/5028; on the map both steep and gentle slopes are included within the formation, but a boundary has been placed at the foot of the steep slope, in case a separation is thought desirable after field checking.

Within the Buc a dark toned bed, Bucl forming a low scarp, has been differentiated as a marker; it may be followed from R8/5105 to the east and north of the Fitzgerald Range. An isolated outcrop doubtfully assigned to Buc_1 is found on R10/5183, the stratigraphy of the general area R10/5186-84 requires checking in the field, as does also R6/5018-20 where bedded light and dark toned sediments are included in the Buc. On R9/5123 the boundary between But on the west and Buc on the east can be seen on the photos, but in the gorges to the south the position is somewhat arbitrary. Buc appears to lens out on R7/5044 bringing the Buh into unconformable contact with Bus.

In the north of the Sheet round Jasper Creek (R1/5014-16-18) a prominent hard bed appears in the Buc; the soft interval below the Buj and this bed has been differentiated from the Buc and designated Bj. It is restricted to the northern part of the Sheet.

Buj "Jasper Gorge Sandstone"

Laing and Allen's (1956) type section for this formation is at the eastern end of Jasper Gorge where they report about 600 feet of sandstone overlying shale of the Coolibah Formation. The Buj

is a medium toned bedded unit with very well developed jointing in places; in general it is flat lying, and forms the high country of much of the western part of the Sheet. In some areas e.g. R10/5188 and further west it would be possible to subdivide the Buj and a boundary is indicated on the overlays, but not shown on the map.

On R11/5202 a jointed sandstone similar in appearance to Buj seems to overlie the Antrim Plateau Volcanics and is included in the €la. Also on R11/5028, R12/5067 and R13/5099 sandstones surrounded by €la should be checked in the field to decide whether they belong to Buj, or are associated with the volcanics.

In most places Buj overlies Buc and is structurally conformable; however in the south-west it rests directly on But, and near the Humbert River in the west, and also on R7/5064 it is in contact with the Bus.

On Victoria River Downs no Proterozoic unit overlies the Buj, but it is overlain unconformably by €la.

Cambrian

€la Antrim Plateau Volcanics

€la occupies a broad belt extending from the north-east to the south central border of the Sheet with outliers in the southwest; it is medium toned and has a smooth surface and rests unconformably on all Proterozoic units. In places e.g. on R3/5068 three or four flows make up the section. Some sediments labelled Buj may be associated with the volcanics, as indicated in the previous section. These sediments commonly trend north-west.

€m_1 Sediments; €m_2 Montejinni Limestone

The €la is overlain on the west by the Montejinni Limestone. Along the Armstrong River north of Montejinni Homestead €m_1 forms a small scarp at a lower level than €m_2 which is the Montejinni Limestone proper. On R10/5172 a shale interval seems to be present between the lower hard bed €m_1 and the €m_2; if in fact €m_1 is a Cambrian sedimentary formation, the threefold lithological divisions are akin to those in the Negri Group (Traves, 1955) 130 miles to the west, or possibly to those in the Daly River Group (Randall, 1961) 100 miles to the north. Possibly however the layer referred to as €m_1 may be related only to the volcanic rocks.

Cretaceous

K Mullaman Beds

Rocks of this sequence (Randall, 1961) are found in the north-east and south-east of the Sheet where they rest unconformably on Montejinni Limestone. They are exposed in a relatively narrow strip where streams draining generally west have removed the cover of laterite and sand that conceals them further east. On R1/5046 K is observed in a light-toned west-facing scarp at the foot of which is dark toned material that extends west for one to two miles where there is a low bench. The whole of this is included in the K. In the south-east (R13, 14, 15) a broad area of low relief below the main scarp is referred to as K?.

Cainozoic

Cz Laterite

Scattered patches of laterite are present on the Buj in the west of the Sheet and on the Cretaceous in the east. On R10/5160 some areas apparently with trend lines showing through have been interpreted as questionable Cz.

Czs Sand, Soil

Czs applies to soil, sand and colluvial deposits found in many areas in gentle slopes between the river alluvium and rock outcrops.

Quaternary

Qt Terrace deposits

These are flat lying pale toned areas adjacent to the main rivers; they are at a higher level than present streams, and appear to be being eroded at present. In places e.g. R8/5103 their surface has an unusual dark tone as though it has been affected by laterit̃ization.

II. Structure

The older rocks But and Bus are exposed in several anticlines, the largest of which is in the Victoria River Downs Homestead area, the core being in the Fitzgerald Range. The eastern flank of this anticline is well outlined by Buc, but on the west the structure is complicated by a fault trending north-north-west through Burt Hill, that separates a second but narrow anticline, with the same axial trend as the fault, from the main broad fold. Possibly this western anticline continues to the south past Station Hill and south of the Wickham River.

South of Mt. Warburton is a small dcme in the Bus and to the south-east of this a much faulted anticlinal fold. Possibly both these culminations are on a north-west trend that continues in narrow faulted anticlines north of the Humbert River.

In the far north-west two anticlines have been mapped in the Bus; the axis of the more northerly trends north-north-west and the other axis trends north-north-east (R5/5121). On R6/5036 the axis of a small faulted anticline in the Bus trends west-north-west; this fold may be related to the long faulted anticline north of the Humbert River referred to above.

Within the Antrim Plateau Volcanics in the Waterbag Creek area (R8/5096) a narrow north-trending anticline is exposed in sediments interpreted as Bus.

On the western edge of the Sheet the Wickham River is probably near the axis of an anticline that plunges gently east.

As indicated under Stratigraphy the But in the south-west is divided into five units, the lowest of which is the core of an anticline on R15/5086; this fold has a sinuous axis trending generally north-east. A small anticline in the But with a north axial trend is visible on R13/5098.

Within the Buh on R15/5069 a small narrow anticline with a north-north-west trend is exposed. North of this on R12/5061 is an anticline referred to as the Pigeon Hole Anticline by Laing & Allen (1956) with a steeply dipping fault trending north-west; this trend lines up with a straight stretch of the Victoria River some 18 miles long. Just to the east of this trend, on R11/5210, a dome about 1½ miles across is probably a culmination on the same anticlinal structure.

The north-west trend is present also in jointing in the Buj in the south-west but joints with an east-north-east trend are more numerous. Also trending approximately north-west are the inliers of Buj ? in the Antrim Plateau Volcanics.

Coolibah Creek and the Armstrong River form a prominent lineament trending north-east, as also does Five Mile Creek.

Two important periods of folding have taken place, one after the deposition of the Bus/But and the other after the deposition of the Buj. Characteristic of the style of folding particularly with respect to the Buj is the narrowness of the anticlines in contrast to the generally flat-lying nature of the formation; probably this is due to basement faulting.

similar hard bed can be observed in places; however it is not continuous, and the whole interval is undifferentiated and represented by the symbol Bj, Buc; furthermore, the Buc as mapped in the north-west of VICTORIA RIVER DOWNS can be followed towards the north-east in the scarp below the Buj to the Victoria River where it meets with the undifferentiated Bj, Buc.

Buj "Jasper Gorge Sandstone"

This formation is the most widespread of the Proterozoic units on DELAMERE; it extends north from the southern boundary of the Sheet on either side of the Victoria River; north of the big west bend in the river at its junction with Matt Wilson Creek, the Buj continues and seems to become somewhat softer; however it was not possible to draw a boundary, and at the northern Sheet border the unit joins with the Palm Creek Beds on FERGUSSON RIVER (Randal, 1961). In the west of DELAMERE, in the vicinity of the Ikymbon River, the Buj dips beneath the Angalarra Siltstone.

The "Jasper Gorge Sandstone" is structurally conformable with the underlying Buc, Br and Bj, Buc, but Laing and Allen (1956) report a disconformable relationship south of Coolibah Homestead. This is supported by an observation on R10/5130 that the prominent hard bed within the Bj, Buc dips moderately, whereas the overlying Buj is sub-horizontal.

On R5/5184 the contact of Buj with the overlying Angalarri Siltstone ("Auvergne Shale" of Laing & Allen (1956) is apparently conformable.

Bua Angalarri Siltstone

Outcrops of this unit are restricted to the north-west of DELAMERE on both sides of the Angalarri River. North of Crocodile Yard it has been possible to divide the unit into three parts Bua, of medium grey tone and low relief, Bua_2 dark toned and forming a low scarp, and Bua_3 light toned and soft; elsewhere the formation is light to medium toned, fairly soft, and bedding is observed in places.

In the far north-west of the Sheet Bua is overlain probably conformably by a scarp-forming sandstone belonging to the Yambarra Beds of Randal (1961). On R2/5051 Bua is overlain unconformably by lateritised Cretaceous rocks, and on R1/5026 by a rough looking sandstone probably associated with the Antrim Plateau Volcanics.

C. DELAMERE

I. Stratigraphy (Table 3)

Proterozoic

"Skull Creek Limestone"

This formation continues from the north-west of VICTORIA RIVER DOWNS to the south-west of DELAMERE and thence northward to the vicinity of the Victoria River. On their map (Sheet 1) Laing & Allen (1956) show a gradational boundary with the "Timber Creek Formation", which could not be recognised on the air photos. The type section is in the faulted anticline crossed by the old Timber Creek-Jasper Gorge road. Where chert is present in the sequence, a hard appearance can be observed e.g. Run 11 Photo 5187.

North of Mt. Sellars the "Jasper Gorge Sandstone" Buj rests directly on the "Skull Creek Limestone" Bus (Auvergne R11/5088) but some seven miles further east (Del. R11/5189) a soft unit Br, the probable equivalent of the "Coolibah Formation" intervenes between Buj and Bus.

Br

This symbol is given to a soft medium toned unit overlying the "Skull Creek Limestone" and beneath the "Jasper Gorge Sandstone" in the general area of Coolibah Homestead. Although this is the location of Laing and Allen's type sections of the "Coolibah Formation", the unit Br is distinguished from the Coolibah Formation Buc, because about three miles north of Coolibah Homestead it underlies a lower split Buja of the "Jasper Gorge Sandstone". Thus it underlies the extension of the Bj, Buc from the northern part of VICTORIA RIVER DOWNS, the photogeology of which was completed before that of DELEMERE.

Buja

This is recognised only near Coolibah Homestead, where the Bj, Buc soft interval below the "Jasper Gorge Sandstone" lenses out. It is a light to medium toned bedded sandstone indistinguishable in photo character from the Buj proper.

Buc "Coolibah Formation"; Bj

The "Coolibah Formation" is a soft dark toned unit, underlying the "Jasper Gorge Sandstone". In the north of VICTORIA RIVER DOWNS in the Jasper Creek area an upper part Bj was separated on the basis of a prominent hard bed in the sequence. This differentiation was carried north on DELAMERE as far as Delamere Creek, where a

Photogeological Character		Possible Geological Equivalent		
	Qa Alluvium			
	Qs Sand		QUATERNARY	CAINOZOIC
Light grey toned, soft appearance	Qt Terrace deposits			
	Cp Clay pan			
Medium grey toned	Czs Sand, soil			
Medium toned, poorly bedded	Czd Consolidated detritus		UNDIFFERENTIATED	
Dark toned, forms low scarp	Cz Laterite			
Light toned, soft	K Mullaman Beds		CRETACEOUS	MESOZOIC
Mottled pattern, flat lying	$\mathcal{C}m$ Daly River Group		MIDDLE CAMBRIAN	PALAEOZOIC
Mottled pattern	$\mathcal{C}m_2$ Montejinni Limestone			
Light to medium toned, smooth surface	$\mathcal{C}la$ Antrim Plateau Volcanics		LOWER CAMBRIAN	
Medium toned, rough surface	$\mathcal{C}l$ Sediments associated with Cla?		LOWER CAMBRIAN?	
Medium toned, bedded; scarp forming	Buy Yamparra Beds ("Pinkerton Beds")			PROTEROZOIC PRECAMBRIAN
Light to medium toned, soft, bedded	Bua Angalarri Siltstone ("Auvergne Shale")			
Light toned, soft	Bua3			
Dark toned, forms low scarp	Bua2			
Medium toned; low relief	Bual			
Light to medium toned; bedded; well jointed in places, forms prominent scarp	Buj "Jasper Gorge Sandstone"			
Dark toned, soft, bedding visible in places	Bj Soft sediments	Bj, Buc where undifferentiated		
Soft, dark toned on steep slopes	Buc "Coolibah Formation"			
Light to medium toned, bedded, scarp-forming	Buja Sandstone			
Medium toned, soft	Br Soft sediments			
Light toned, thin bedded	Bus "Skull Creek Limestone"			

(Formation names in inverted commas are unpublished - Laing & Allen, 1956)

Buy Yambarra Beds

In the far north-west of the Sheet, a medium toned, bedded unit forming a prominent scarp overlies the Bua apparently conformably. This unit, probably a sandstone, is referred to the Yambarra Beds that have been mapped on FERGUSSON RIVER. They are probably equivalent to the "Pinkerton Beds" of Laing & Allen (1956).

Cambrian

Cla Antrim Plateau Volcanics; Cl Sediments

This formation extends in a broad belt trending roughly north-north-west from the southern to the northern boundary of the Sheet. The Volcanics lie unconformably on all the Proterozoic units except the Yambarra Beds. On R4/5026 the Cla can be observed overlying the Angalarri Siltstone, and there are scattered outliers on Buj, Bj, and Bj, Buc.

A rough surfaced medium toned unit designated Cl, interpreted as sandstone, can be observed here and there within the volcanics and in some places at or near the base of the formation (e.g. R1/5024; R4/5126, 28; R11/5171). On R1/5024 this sandstone is apparently unaffected by folding in the underlying Buj, and therefore it is considered to be associated with the Cla rather than with the Proterozoic rocks.

Cm_2 Montejinni Limestone

This formation with a mottled pattern is found only in the extreme south-east at the border with VICTORIA RIVER DOWNS.

Cm Daly River Group

The Tindall Limestone and the Jinduckin Formation extend on to the north-east of DELAMERE from FERGUSSON RIVER, but they cannot be separately distinguished on the air photos, and are therefore shown as undifferentiated Daly River Group.

Cretaceous

Klm Mullaman Beds

Cretaceous rocks are exposed in a narrow strip extending from Willeroo to the southern border of the Sheet; to the east of this they are covered with laterite and sand. Elsewhere outliers of lateritised Cretaceous are found on Cla, Bua and possibly on the Yambarra Beds in the north-west, though only laterite has been indicated here.

Cz Laterite

Besides being well developed on the Klm, laterite is found in scattered patches on the "Jasper Gorge Sandstone" particularly in the Stokes Range and on the Yambarra Beds in the north-west.

Cd Consolidated detritus

This term has been applied to two areas in the north of the Sheet where medium toned poorly bedded material is observed in contact with Buj, to which it is quite similar in appearance. On Fergusson River R8/5196 the Czd can be seen to overlie the Antrim Plateau Volcanics; also on Delamere R2/5061 the Czd rests on Cla and seems to be at a lower elevation than nearby lateritised Cretaceous rocks, from which it is therefore distinguished.

Quaternary Qt Terrace Deposits

These are extensive near Coolibah Homestead. Present river level is well below that of the terraces, and on R10/5126 the dark tone of the Qt requires field checking.

Czs Sand, Soil

Czs applies to soil, sand and colluvial deposits found in many areas in gentle slopes between the river alluvium and rock outcrops.

Qs Sand

This refers to the widespread sand on the plain on the east side of the Sheet which is considered to be transported principally by wind action.

II. Structure

The Proterozoic rocks are in general sub-horizontal except for isolated steeply dipping zones and small folds such as the narrow faulted anticline in the "Skull Creek Limestone" in the south-west (R15/5204); in this structure both the axis and the fault trend north-west, and a small horizontal displacement in the sinistral sense appears to have taken place along this fault. On R15/5198 a small north-trending anticline in the Bu has warped the overlying Buj. On R1/5024 an anticline in the Bu, Buc trends west-south-west. Within the Buj there is an interesting circular dome some 3 miles across on R8/5058.

A narrow zone dipping steeply to the north is observed on R2/5062; this is interpreted as being in the Buj and if this is so it forms the south limb of an assymetric syncline with its axis trending west.

Four miles east of Coolibah Homestead a prominent zone of discontinuous faulting trending north-north-west is observed; this extends almost to the northern boundary of the Sheet and for about 18 miles south-south-east of Coolibah. An isolated fault on R15/5188 on the continuation of the fault trend may be associated with the same system.

On R8/5053 a fault of this system cuts the Buja but is not apparent in the soft Bj, Buc above though it seems to have affected the overlying Buj.

On R1/5016 and on R2/5059 two faults trending east-north-east are observed. Faults with the same trend are present also on R6/5200 and on R8/5045 and within the "Skull Creek Limestone" in the south-west. This direction is also one of two important directions of jointing, the other being north-north-west. Jointing is well developed in the "Jasper Gorge Sandstone" and is present in the Antrim Plateau Volcanics but of relatively less importance.

The Phanerozoic rocks are flat lying; on Fergusson River R8/5196 a probable fault affects the €la, but in general, faulting appears to be unimportant in these and younger rocks.

The sediments labelled €l have a north-west trend that requires explanation. It is different from the jointing and fault directions in the Proterozoic, but is parallel to the direction of the edges of probable flows on the Antrim Plateau Volcanics round Price and Aroona Creeks.

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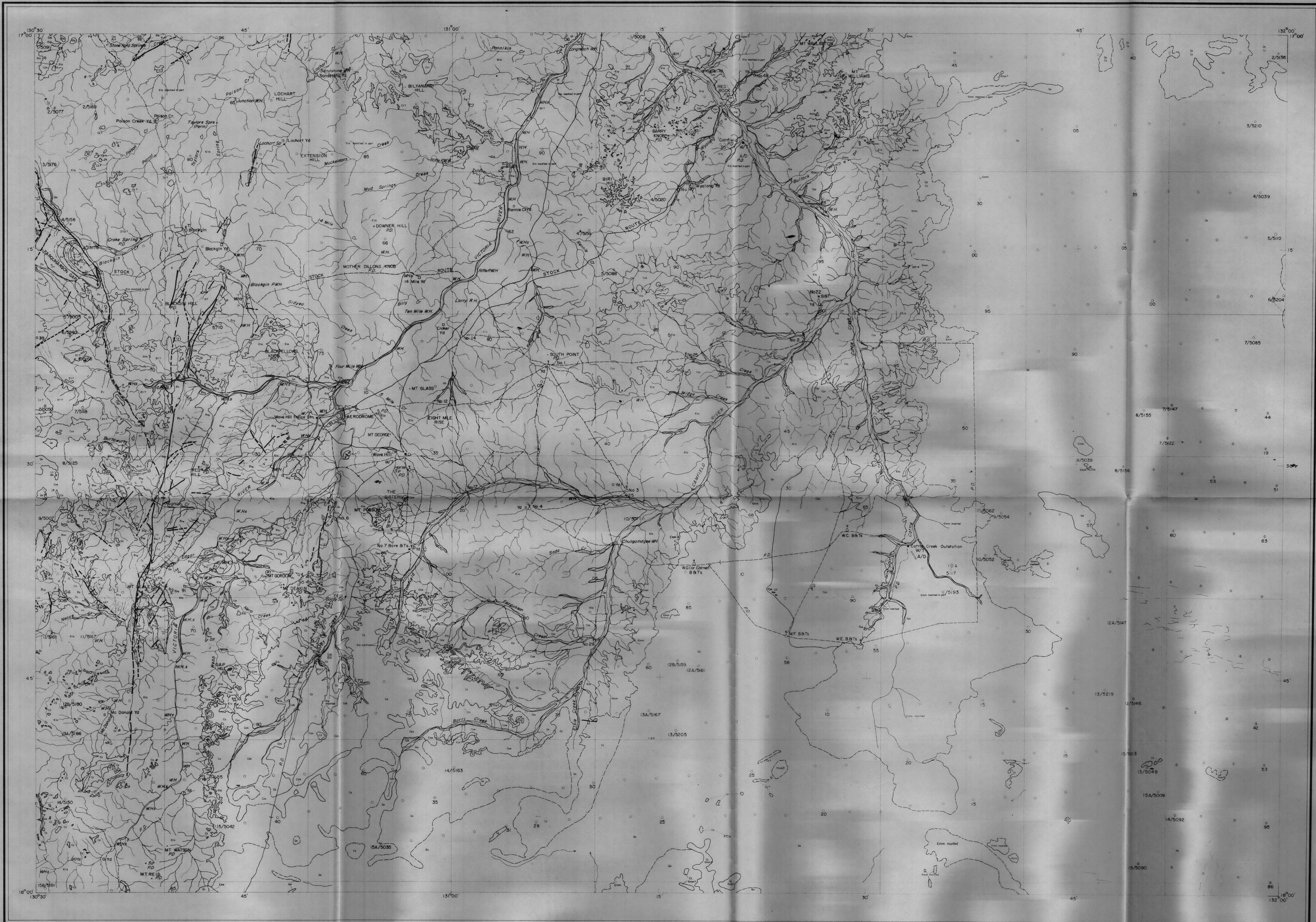
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

WAVE HILL

NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SE52-8



REFERENCE

Photogeological Character	Symbol	Possible Geological Equivalent		
	Qa	Alluvium	QUATERNARY	CAINOZOIC
	Qs	Sand		
Light grey toned, soft appearance	Qt	Terrace deposits		
Dark toned	Czw	Slope wash	UNDIFFERENTIATED	
Medium grey toned	Czs	Soil, sand		
Light toned, forms treeless plain	Czb	Older alluvium		
Dark toned, meso-form	Cz	Laterite		
Light grey toned, forms low scarp	€me	Merrina Beds	CAMBRIAN MIDDLE	PALAEOZOIC
Light and dark toned, forms low scarp, jointed in places	€mm	Montejinni Limestone		
Dark toned, steep sided small hills surrounded by paler toned areas	€	? Silicified sediments		
Medium toned, smooth surface, characteristic mottled texture where soil covered	€la	Antrim Plateau Volcanics	LOWER	
Medium toned, flat lying	Puu		PROTEROZOIC	PRECAMBRIAN
Light and dark toned interbedded units	Pu9	Wave Hill Beds		
	Pu8			
	Pu7			
	Pu6			
Soft, light toned, well bedded	Pu5			
Medium to dark toned, bedded; jointed in places	Pu4	Bedded sedimentary rocks		
Medium to dark toned, bedded; forms distinctive scarp in places	Pu3			
Medium to dark toned, bedded, jointed	Pu2			
Medium grey toned hard unit	Pu1			
	Pu	Undifferentiated		
Scarp forming; dendritic drainage pattern	P7	Bedded sedimentary rocks		
Medium to dark toned; more resistant than P5	P6			
Soft, light toned massive unit	P5			
Medium grey toned, scarp forming	P4			
Soft, light toned unit, bedding not distinct	P3			
Striated pattern with generally lighter tone than P1	P2			
Medium to dark toned, bedded; fairly resistant	P1			
Light to medium toned, bedded; very well jointed in places	Puj	Jasper Gorge Sandstone		
Medium toned, bedded, jointed	Put	Timber Creek Formation		
Medium toned, low relief	P	Undifferentiated sediments		

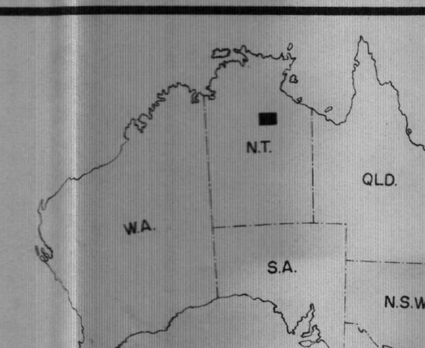
- Lithological boundary
- Probable lithological boundary
- Anticlinal axis
- Synclinal axis
- Fault
- Probable fault or lineament
- Edge of bed
- Probable edge of bed
- Edge of bed expressed as scarp

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

- Trend line
- Joint pattern
- Topographic scarp
- Laterite (L), Terrace (T), Scree (S)
- Dyke
- Sink holes

- Principal road
- Minor roads and tracks
- Railway line (Siding, Station)
- Telephone line
- Fence
- State boundary
- Mine
- Homestead
- Yard
- Windpump
- Airport or Airfield, Landing ground
- B Bore
- T Tank
- W Well
- S Spring
- WH Waterhole
- D 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 1:46,000 scale
Transverse Mercator Projection.



SCALE 1:250,000

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5 0 5 10 15 20 25 KILOMETRES

INDEX TO ADJOINING SHEETS

WATERLOO	VICTORIA RIVER DOWNS	DALY WATERS
LIMBUNYA	WAVE HILL	NEWCASTLE WATERS
BIRRINDUDU	WINNECKE CREEK	SOUTH LAKE WOODS

Photo-interpretation by the Photogeological Section,
Bureau of Mineral Resources, Geology and Geophysics 1966
Interpreted by: W.J. Perry

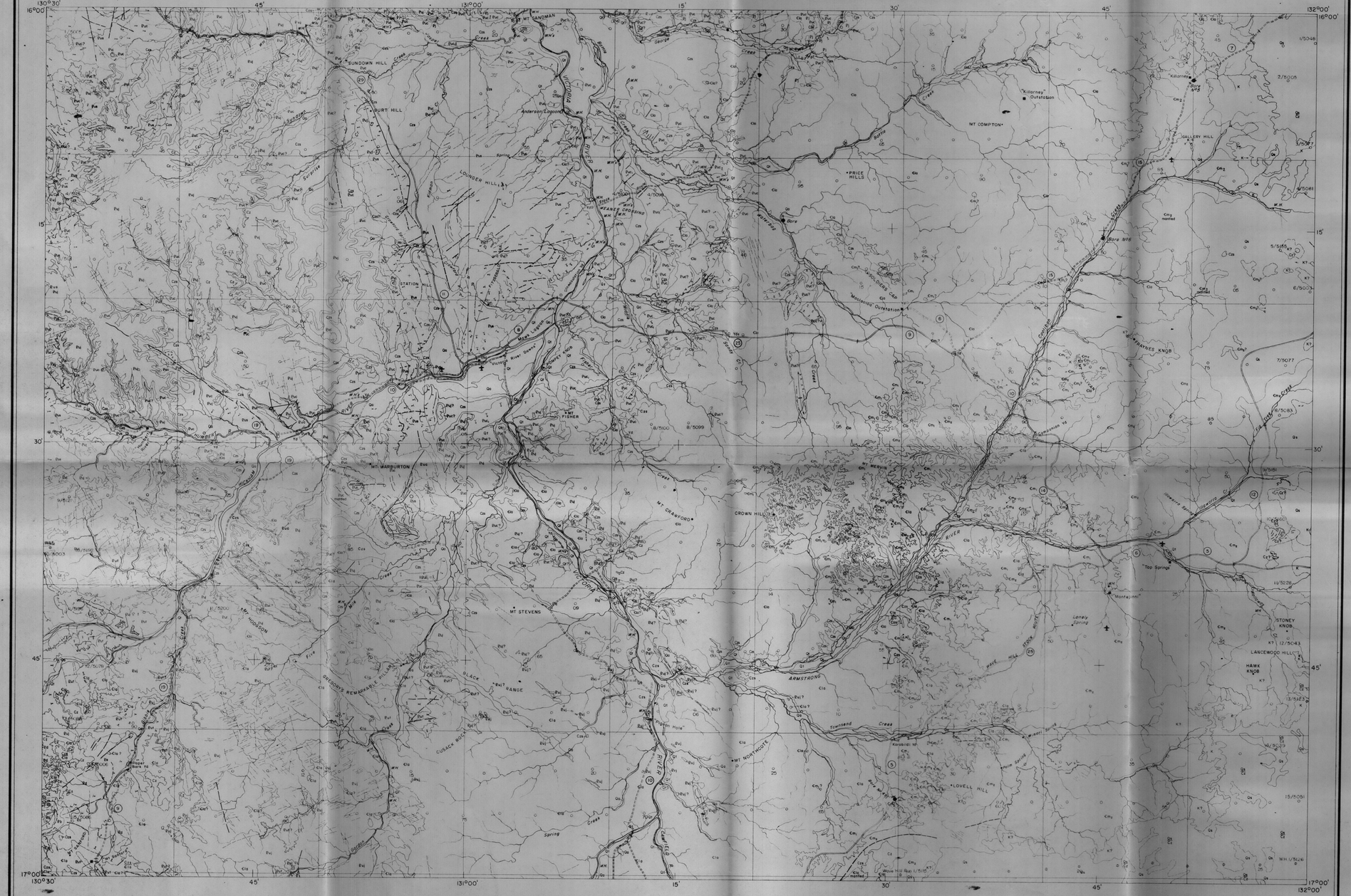
E52/A8/2

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

VICTORIA RIVER DOWNS

NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SE52-4



REFERENCE

Photogeological Character		Possible Geological Equivalent			
	Qa	Alluvium	QUATERNARY		CAINOZOIC
	Qs	Sand			
Light grey toned, soft appearance	Qt	Terrace deposits			
Medium grey toned	Czs	Soil, sand	UNDIFFERENTIATED		
Dark toned, mesa-form	Cz	Laterite			
Soft, light toned, with white patches	K	Mullaman Beds	CRETACEOUS	MESOZOIC	
Light and dark toned, forms low scarp	€m₂	Montejinni Limestone	CAMBRIAN	PALAEOZOIC	
Light and dark toned, forms scarp at lower level than €m₂	€m₁	Sediments			
Medium toned, smooth surface	€a	Antrim Plateau Volcanics			
Light to medium toned, bedded, very well jointed in places	Puj	"Jasper Gorge Sandstone"	PROTEROZOIC	PRECAMBRIAN	
Medium toned, bedded, soft, with prominent hard bed near base	Pj				
Soft, dark toned on steep slopes	Puc	"Coolibah Formation"			
Dark toned, forms low scarp	Puc₁	Marker bed			
Soft light toned in gently sloping areas					
Light toned, thin bedded	Pus	"Skull Creek Limestone" (Laing & Allen, 1956)			
Medium to light toned, thin bedded	Put	"Timber Creek Formation" (Laing & Allen, 1956)			
Dark toned, with smooth surface	Pe				
Dark toned, with dendritic drainage pattern	Pd				
Soft, light toned, well bedded	Pc				
Medium toned, well bedded	Pb				
Medium toned, hard appearance	Pa				

Formation names in inverted commas are unpublished names from Laing & Allen, 1956

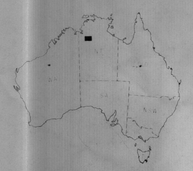
- Lithological boundary
- Probable lithological boundary
- Anticlinal axis
- Synclinal axis
- Fault
- Probable fault
- Edge of bed
- Probable edge of bed
- Edge of bed expressed as scarp

Estimated dips

- Horizontal
- Very low
- Low
- Medium
- Steep
- Vertical
- Trend line
- Joint pattern

- Principal road
- Minor roads and tracks
- Railway line
- Telephone line
- Fence
- State boundary
- Mine
- Homestead
- Yard
- Windpump
- Airport or Airfield, Landing ground
- Bore
- WH Waterhole
- Dam
- Photo-centre points
- Photo-centre points-adjoining sheet
- (5) Road mileage

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.



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5 0 5 10 15 20 25 KILOMETRES

INDEX TO ADJOINING SHEETS

AUVERGNE	DELAMERE	LARRIMAH
WATERLOO	VICTORIA RIVER DOWNS	DALY WATERS
LIMBUNYA	WAVE HILL	NEWCASTLE WATERS

Photo-interpretation by the Photogeological Group,
Bureau of Mineral Resources, Geology and Geophysics 1966
Interpreted by: W.J. Perry

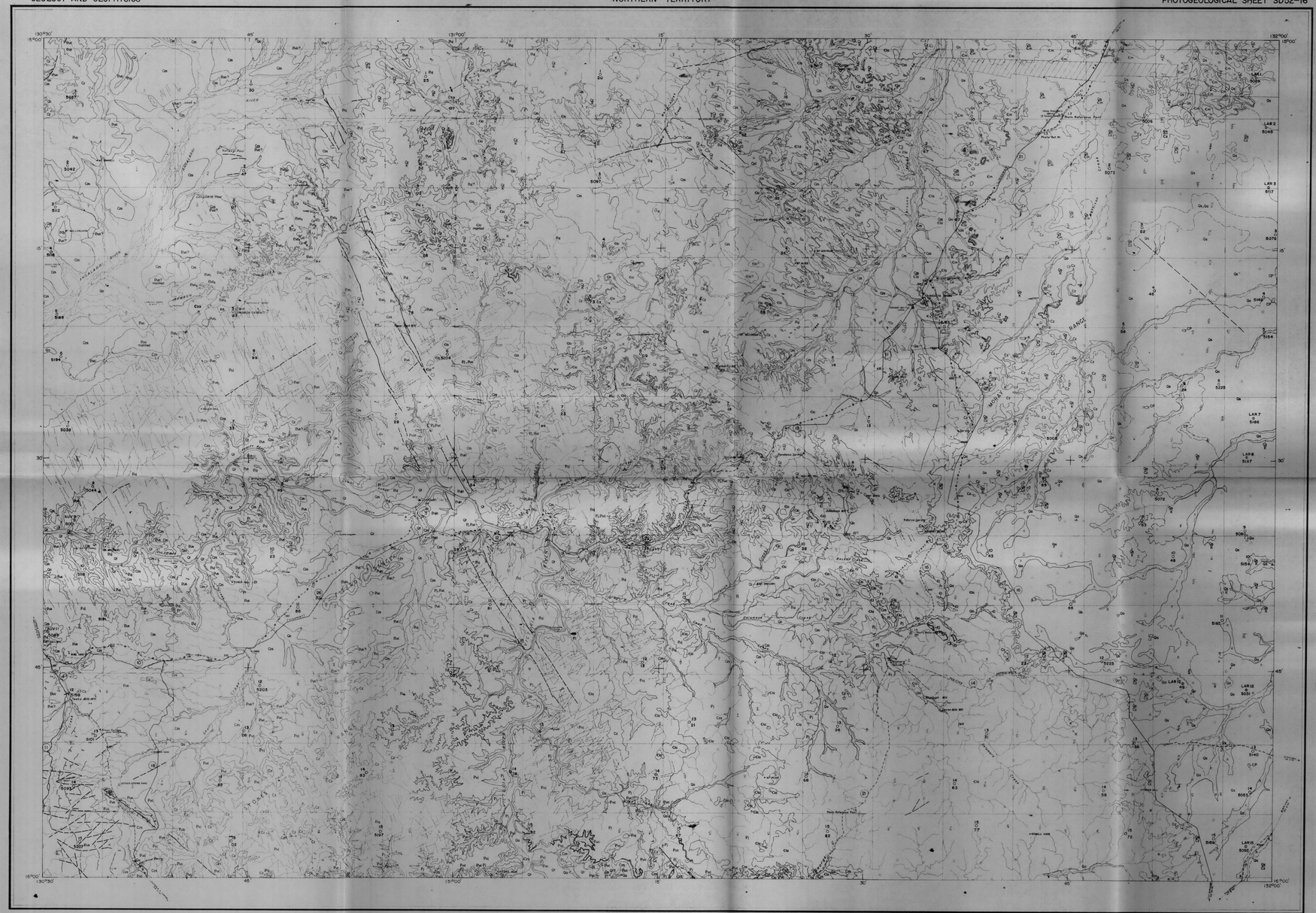
E52/A4/3

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

DELAMERE

NORTHERN TERRITORY

AUSTRALIA 1:250,000
PHOTOGEOLOGICAL SHEET SD52-16



REFERENCE

Photogeological Character		Possible Geological Equivalent		
	Qa	Alluvium	QUATERNARY	CAINOZOIC
	Qs	Sand		
Light grey toned, soft appearance	Qt	Terrace deposits		
	CP	Clay pan		
Medium grey toned	Czs	Sand, soil	UNDIFFERENTIATED	
Medium toned, poorly bedded	Czd	Consolidated detritus		
Dark toned, forms low scarp	Cz	Laterite		
Light toned, soft	K	Mullaman Beds	CRETACEOUS	MESOZOIC
Mottled pattern, flat lying	€m	Daly River Group	MIDDLE CAMBRIAN	PALAEOZOIC
Mottled pattern	€m$_2$	Montejinni Limestone		
Light to medium toned, smooth surface	€la	Antrim Plateau Volcanics	LOWER CAMBRIAN	
Medium toned, rough surface	€l	Sediments associated with €la?	LOWER CAMBRIAN ?	
Medium toned, bedded, scarp forming	Puy	Yambarra Beds ("Pinkerton Beds")	PROTEROZOIC	PRECAMBRIAN
Light to medium toned, soft, bedded	Puo	Anglarri Siltstone ("Auvergne Shale")		
Light toned, soft	Puo$_3$			
Dark toned, forms low scarp	Puo$_2$			
Medium toned, low relief	Puo$_1$			
Light to medium toned, bedded, well jointed in places, forms prominent scarp	Puj	"Jasper Gorge Sandstone"		
Dark toned, soft, bedding visible in places	Pj	Soft sediments		
	Pj, Puc	where undifferentiated		
Soft, dark toned on steep slopes	Puc	"Coolibah Formation"		
Light to medium toned, bedded, scarp forming	Pua	Sandstone		
Medium toned, soft	Pr	Sediments		
Light toned, thin bedded	Pus	"Skull Creek Limestone"		

Formation names in inverted commas are unpublished names from Laing & Allen, 1956

- Lithological boundary
- Probable lithological boundary
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- Probable fault or lineament
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- Probable edge of bed
- Edge of bed expressed as scarp

Estimated dips –

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- Low
- Medium
- Steep
- Vertical
- Trend line
- Joint pattern
- Topographic scarp
- Sink holes

- Principal road
- Minor roads and tracks — position doubtful
- Railway line
- Telephone line
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- Bore
- Tank
- Well
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- Dam
- Photo-centre points
- Photo-centre points-adjoining sheet
- (22) Road mileage

Areas not covered by aerial photographs

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

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PORT KEATS	FERGUSSON RIVER	KATHERINE
AUVERGNE	DELAMERE	LARRIMAH
WATERLOO	VICTORIA RIVER DOWNS	DALY WATERS

Photo-interpretation by the Photogeological Group, Bureau of Mineral Resources, Geology and Geophysics 1966
Interpreted by: W.J. Perry, B.M.R.; and J.C. Rivereau, Institut Français du Pétrole.

DSD / 8.16 / 1