1961/59

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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1961/59

GEOLOGICAL RECONNAISSANCE OF THE RAWLINSON-MACDONALD AREA, WESTERN AUSTRALIA.

by

A.T.Wells, D.J.Forman and L.C.Ranford

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CONTENTS

(/Contents ii).

ILLUSTRATIONS

Figures

TABLES

PLATES

SUMMARY.

Geological reconnaisance on the Macdonald and Rawlinson sheet areas has shown an aggregate thickness of 27,000 feet of Precambrian sedimentary rocks. These rocks have been divided into Lower and Upper Proterozoic but only on the north-east corner of the Macdonald sheet is the unconformity between the two sequences visible. Possible Archaean gneiss and quartzite have also been differentiated in the north-east Macdonald area. These rocks are similar to those in the Arunta Complex of the Alice Springs area. No relationship is visible between these rocks and those mapped as Lower Proterozoic

Large thicknesses of Lower Proterozoic quartz sandstone, quartzite and low-grade metamorphics are exposed on the southern half of the Rawlinson area and have been tentatively divided into the Barlee Beds, Dixon Range Beds and Dean Metamorphics. The relationships between these units cannot be determined with certainty, but the Dean Metamorphics are probably the oldest and the Barlee Beds the youngest.

The Dean Metamorphics and possibly the Dixon Range Beds and Barlee Beds are intruded by large sheets of quartz-albite porphyry (the Rawlinson Porphyry). Granite crops out south-east of the Kathleen and Dean Ranges where it has intruded the Dean Metamorphics and the Rawlinson Porphyry.

The Lower Proterozoic rocks are faulted against Upper Proterozoic rocks north of the Robert Range. The Upper Proterozoic sediments are contained in the Amadeus Geosyncline which extends from the Robert Range to the Dover Range and for an unknown distance farther north onto unmapped areas. The basal arenites of the Upper Proterozoic sequence extend onto the Webb sheet area to the north. The Upper Proterozoic rocks include a thick conformable sequence of conglomerate, sandstone, quartz greywacke, siltstone, dolomite and limestone about 14,000 feet thick. Included near the base of the Upper Proterozoic is a thin bed of tillitic sandstone which is similar lithologically to a tillitic bed (Areyonga Formation) near the base of the Upper Proterozoic sequence in the MacDonnell Range area.

Conspicuous lateral variations in the Upper Proterozoic sediments may delineate shoreline areas and shallow water environment on shelf areas. Three major faults have been deduced in the Upper Proterozoic sediments: a fault north of the Robert Range which was active during the period of Upper Proterozoic sedimentation, and two large faults which have downthrown a large block of sediments in the Sir Frederick Range of Mu Hills. Thin remnants of Ordovician limestone rest with an angular unconformity on Upper Proterozoic dolomite 7 miles north-west of the Sir Frederick Range.

Horizontal glacial sediments form a thin cover on the north-western part of the Macdonald area and occur as remnants unconformably overlying Precambrian rocks as far east as Buck Hills These sediments are thought to be Precambrian in age and represent part of the transgressive fluvio-glacial deposits which have their thickest development in the Canning Basin to the West.

A major orogeny occurred probably in the Lower Proterozoic with the intrusion of granite and quartz-feldspar porphyry.

The Upper Proterozoic rocks have been folded and with the exception of the north-south fold axes in a central zone west of the Sir Frederick Range, their predominant trend is east-west. At least two periods of folding affected the Upper Proterozoic rocks. The first produced the east-west trending folds. The second produced north-south trending folds and was probably associated with the block faulting in the Sir Frederick Range area. After folding the sediments were eroded before the transgression of the Ordovician sea. Subsequent movements were minor and produced tilting in the Ordovician sediments. Minor renewed movements along faults in the Mu Hills have affected some of the Permian glacial sediments.

Small secondary copper deposits occur in quartz-sericite schist in the south-eastern part of the Rawlinson area and structurally similar areas of possible Lower Proterozoic rocks may warrant prospecting.

The area has little petroleum potential. The Bonython Dolomite is the only possible source for petroleum. The possibility of marine Permian rocks on the western sector of the Rawlinson-Macdonald area is slight and in any case they would probably be comparatively thin.

INTRODUCTION.

GENERAL

In 1960 a field party from the Bureau of Mineral Resources, Geology and Geophysics, mapped the rocks of the Rawlinson (F/52,14) and Macdonald (G/52,2) areas to find any extension of the Palaeozoic rocks of the Amadeus Geosyncline and to determine the eastern limit of the Canning Basin sediments.

The party consisted of geologists A.T.Wells, D.J.Forman and L.C. Ranford. Field work was carried out during the months June to October.

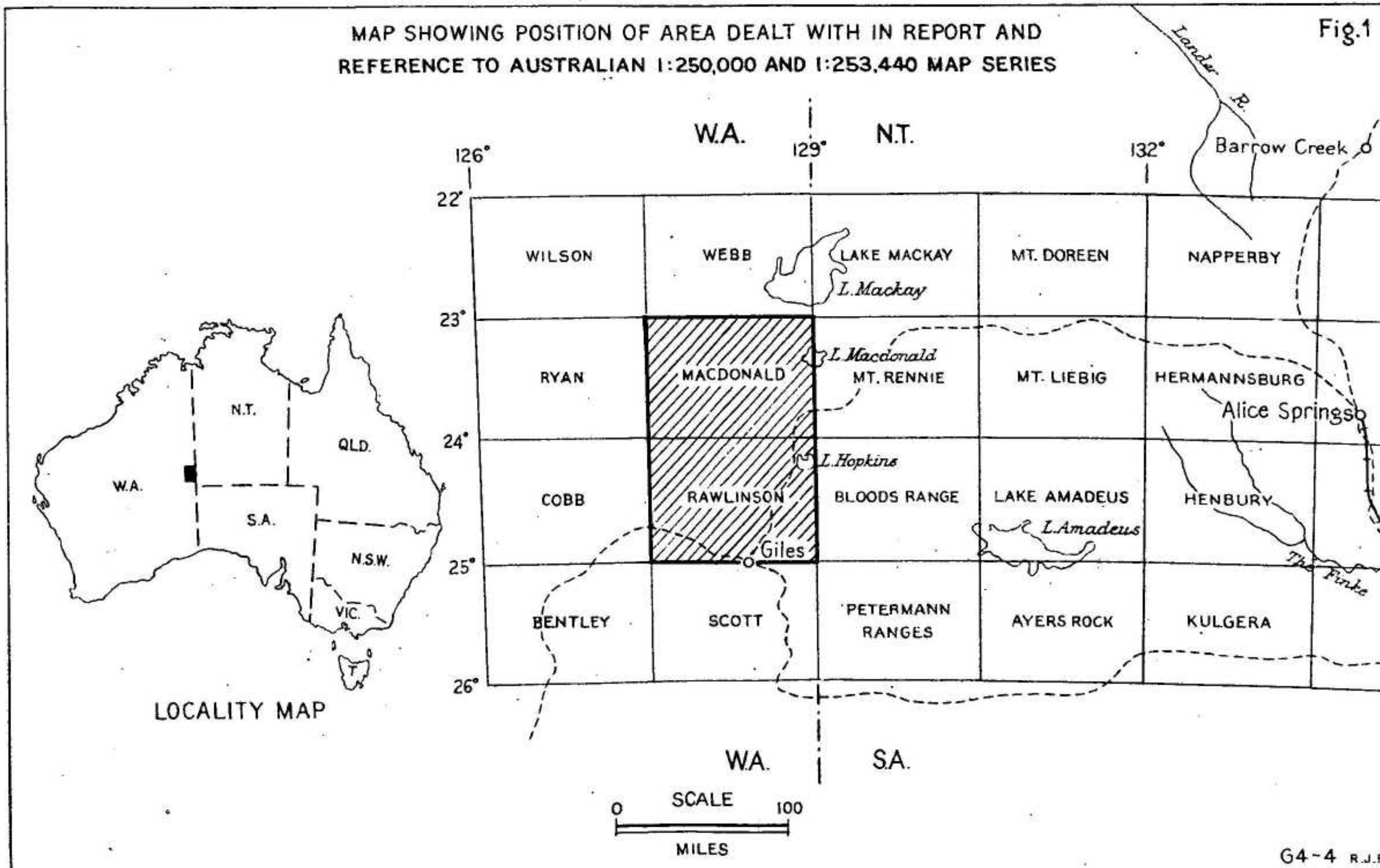
LOCATION AND ACCESS

The area investigated lies in Western Australia between latitude 23° and 25° South and between longitude 127°30' and 129° East. (Figure 1)

The Giles Weather Station, which is run jointly by the Bureau of Meteorology and the Weapons Research Establishment, lies a few miles south of the Rawlinson area and is the closest permanent settlement.

A dirt road branches west from the Adelaide-Alice Springs highway 10 miles south of Kulgera and leads for 400 miles to Giles via Mulga Park station and Mount Davies. The total distance by road from Adelaide to Giles is 1300 miles and from Alice Springs to Giles 570 miles.

Both Rawlinson and Macdonald lie within a native reserve and permission was given by the Native Welfare Department to enter the area. The natives are nomadic and although many smokes were seen very few natives were encountered away from the area around Giles.


MAP SHOWING POSITION OF AREA DEALT WITH IN REPORT AND
REFERENCE TO AUSTRALIAN 1:250,000 AND 1:253,440 MAP SERIES
Fig.1
W.A.
N.T.
126°
129°
132°
22°
23°
24°
25°
26°
Lander R.
Barrow Creek
WILSON
WEBB
LAKE MACKAY
L. Mackay
MT. DOREEN
NAPPERBY
RYAN
MACDONALD
L. Macdonald
MT. RENNIE
MT. LIEBIG
HERMANNSBURG
Alice Springs
L. Hopkins
COBB
RAWLINSON
BLOODS RANGE
LAKE AMADEUS
L. Amadeus
HENBURY
Giles
The Finke
BENTLEY
SCOTT
PETERMANN RANGES
AYERS ROCK
KULGERA
W.A.
S.A.
N.T.
QLD.
S.A.
N.S.W.
VIC.
T.
LOCALITY MAP
SCALE
0
100
MILES
G4-4 R.J.P

Supplies are brought to Giles by a monthly Bristol Freighter from Adelaide and a weekly mail plane from Alice Springs. The mail plane is chartered from Connellan Airways. Some equipment comes by train to Finke and then by truck to Giles, a distance of 487 miles.

Access to the northern part of the area is by a dirt road which branches north from the Mount Davies-Giles road 19 miles east of Giles. This road runs north to a point about 5 miles south of the Bonython Range and then east to Mt. Liebig in the Northern Territory. At Mt. Liebig this new road joins an older road which leads into Alice Springs. The road through the area studied was constructed in 1960 and it was intended to make a branch road west from Mount Leisler to the Canning stock route.

A Traeger transceiver type 59M10 was used for telegraphic communication with the Royal Flying Doctor base at Alice Springs.

CLIMATE.

The average annual rainfall is between 8 and 10 inches, falling mostly during the summer months, although both distribution and amount are very unreliable. The maximum temperature is above 100°F during much of the summer but the winters are pleasant with an average maximum of approximately 70°F. and an average minimum of between 45° and 50° F. Frosts were experienced during the survey in June but they were not common. The meteorological data for Giles provided by the Bureau of Meteorology is shown in Table 1.

FLORA AND FAUNA

The area lies within the Eremean Province and Desert Formation of Gardner (1942) and is characterized by extreme aridity, absence of permanent surface water, high annual mean and extreme diurnal range of temperature, and paucity of vegetation. North of the Rawlinson Range and Schwerin Mural Crescent sand dunes cover the major part of the area and the dominant vegetation is spinifex (*Triodia*) and desert oak (*Casaurina decaisneana*). The gibber plain between the high ranges in the south carries dense mulga (*Acacia*).

TABLE 1. - METEOROLOGICAL DATA - GILES WEATHER STATION.

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	
				Mean Maximum °F									Average
1957	101.9	94.5	94.4	90.6	76.9	71.6	61.5	73.4	83.2	92.6	96.0	93.3	86.0
1958	98.2	99.7	92.6	88.1	79.1	69.1	66.6	69.0	75.4	88.0	93.6	95.9	84.6
1959	101.1	96.4	95.1	87.0	71.9	69.9	67.5	74.0	81.4	91.9	97.8	93.2	85.6
1960	99.2	96.2	95.1	83.6	67.6	67.4	69.7	70.8	78.5	88.2	94.3	94.1	83.7
				Mean Minimum °F									Average
1957	76.4	71.3	68.3	65.6	52.2	52.3	39.6	47.7	56.1	65.1	69.3	70.6	61.2
1958	72.7	72.9	68.2	63.2	57.0	47.2	47.0	47.2	50.7	60.2	68.1	69.5	60.3
1959	76.9	71.6	69.0	62.2	52.0	47.2	46.0	49.1	57.4	64.3	72.0	68.2	61.3
1960	75.0	74.7	70.6	62.2	46.9	45.6	46.0	44.7	53.2	63.3	66.1	70.3	59.9
				Total Rainfall in points (100 pts = 1 inch)									Total
1957	139	90	13	37	33	63	77	2	10	12	0	460	936
1958	5	8	138	0	168	69	159	245	8	5	85	70	961
1959	98	59	19	2	93	4	104	0	0	22	10	83	494
1960	149	463	7	147	112	9	3	0	4	117	0	199	1210

The most important forms of animal life are lizards and small birds. A few kangaroos, emus, eagles, dingoes and rabbits were seen and all of these were more numerous around the margins of dry salt lakes and south of the Schwerin Mural Crescent.

DEVELOPMENT

The land is undeveloped except for a few bores put down immediately south of the Pass of the Abencerrages to provide water for the Giles Weather Station. The bores provide good water and this water was used by the field party throughout the season. A graded dirt road runs from Giles up to the Bonython Range and then across the border into the Northern Territory. and joins station tracks near Mount Liebig.

SURVEY METHOD

As access was limited and travelling very slow, the work was done by a series of reconnaisance traverses lasting usually between 6 and 11 days. Three base camps were established during the field season; the first at Giles, the second about 5 miles south of the Bonython Range and the third a few miles north-east of the Robert Range.

The geology was plotted onto aerial photographs (scale 1 1:40,000) and then transferred to uncontrolled 1 mile photo mosaics in the case of Macdonald, and to controlled transparent overlays at photo scale in the case of Rawlinson; both these bases were prepared by the Western Australian Department of Lands and Surveys. This material was then reduced to produce a map at a scale of 1:250,000 of each area. These two map sheets are referred to in the text as the Rawlinson area and the Macdonald area.

Barometric heights were recorded at intervals during traverses and later corrected with graphs drawn up from hourly readings taken in base camp. The datum point for these readings was Giles Weather Station which has an elevation of 1990 feet above sea level.

Sections were measured, where outcrop permitted, using either tape or abney level, depending on the dip of the strata. Location of large scale maps and columnar sections is shown in Figure 2.

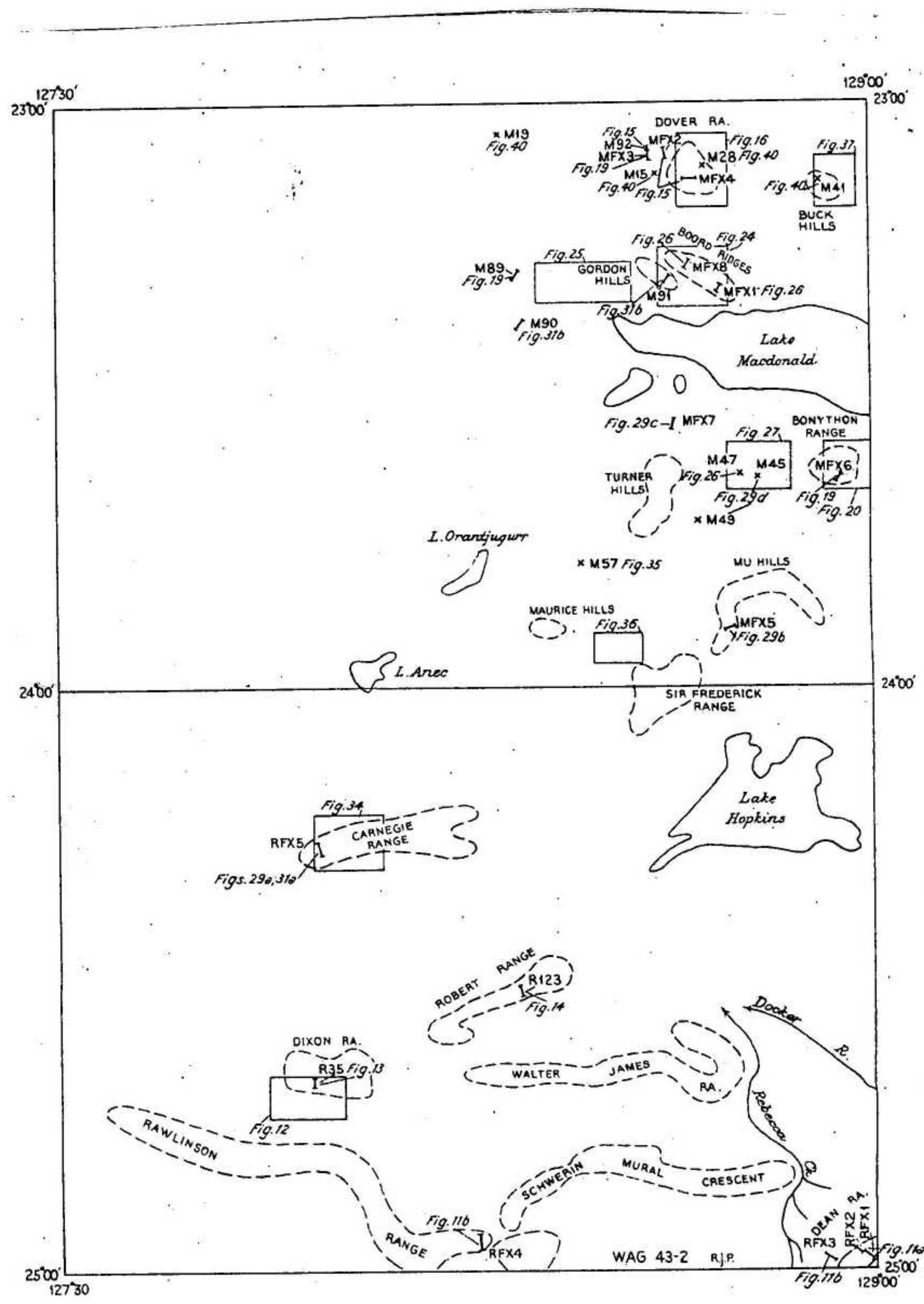


Fig.2 Location of large scale maps and columnar sections.

PREVIOUS INVESTIGATIONS.

Although many exploration and prospecting expeditions have described outcrops within the Rawlinson and Macdonald areas, no previous attempt has been made to map the units and determine their succession.

The explorer, Ernest Giles(1889) travelled through the southern part of the area just north of the Rawlinson Range in 1873. In 1889, W.H. Tietkins (1891) travelled from Alice Springs to the Western Australian border and then around Lake Macdonald. In 1897 Carnegie (1898) travelled south along the Western Australian-Northern Territory border and then moved west immediatdy north of the Rawlinson Range. Some prospecting was done within the area by Maurice in 1900 on an exploratory trip (Murray 1904) and in 1901 W.R. Murray (1904) on a similar expedition, prospected along the Western Australian-Northern Territory border. Only minor signs of mineralisation were found by both expeditions. In 1905 F.R. George (1907) led a Government Prospecting Expedition into the south-west corner of the Northern Territory and described rocks exposed along the eastern margin of the Rawlinson sheet. In 1926 Basedow (1929) visited the Petermann Ranges and described the rocks and their relationships in that area. An aerial expedition, led by D.Mackay (1934) and temporarily based on the Docker Creek, surveyed the area in 1930. A prospecting expedition to the Petermann and Tomkinson Ranges was led by M. Terry (1931) in 1930. Chewings (1935) made the first attempt to correlate 'rocks from the Rawlinson area with the better known succession to the east and north-east in 1935 and also proposed the concept of an Amadeus Sunkland. In 1936 H.A.Ellis (1937) accompanied an expedition searching for 'Lasseter's reef' and penetrated as far as the Wallace Hills on the Rawlinson sheet. In 1951 G.F. Joklik (1952) accompanied a similar expedition which crossed the Western Australian border north of the Kathleen Range and then traversed around 'Mount Ant' and part of the Walter James Range. Frome Broken Hill Coy.Pty. Ltd. (Gillespie,1959) made the first real attempt to study the geology of the area in 1958.

They measured about 12 sections and traversed throughout the eastern half of the Rawlinson area and the south-eastern corner of the Macdonald area.

PHYSIOGRAPHY.

The Rawlinson and Macdonald areas are characterised by their "old" landscape and internal drainage. Four main physiographic divisions have been recognized within the area (see Figure 3).

1. Sandplain with longitudinal (seif) dunes.
2. Areas of low ranges and hills.
3. Areas of high mountain ranges and hills.
4. Salt lakes.

The sandplain with its long sinuous east-west trending sand dunes is most extensive on the western and north-western parts of the area. The dunes stand up to 60 feet above the level of the sandplain and are fixed by a sparse to fairly dense cover of spinifex and other small shrubs. Drainage channels are virtually non-existent within this division. Much of this area may be underlain by Permian sediments similar to the low mounds and isolated hills which protrude through the sand cover in some localities.

The area of low ranges and hills is characteristic of the areas of outcrop of the Upper proterozoic and Permian sediments. The Upper Proterozoic sediments form strike ridges of hogback or cuesta form as well as more rounded hills, and the Permian sediments form mesa and butte topography. Drainage is not conspicuous and limited to small creeks in the immediate vicinity of the ranges and hills.

High ranges and mountains of possible Lower Proterozoic sediments occur on the southern half of the Rawlinson sheet (see Figure 4). These ranges stand between 500 and 1200 feet above the sand plain and approximately 3,000 feet above sea level at their highest point.

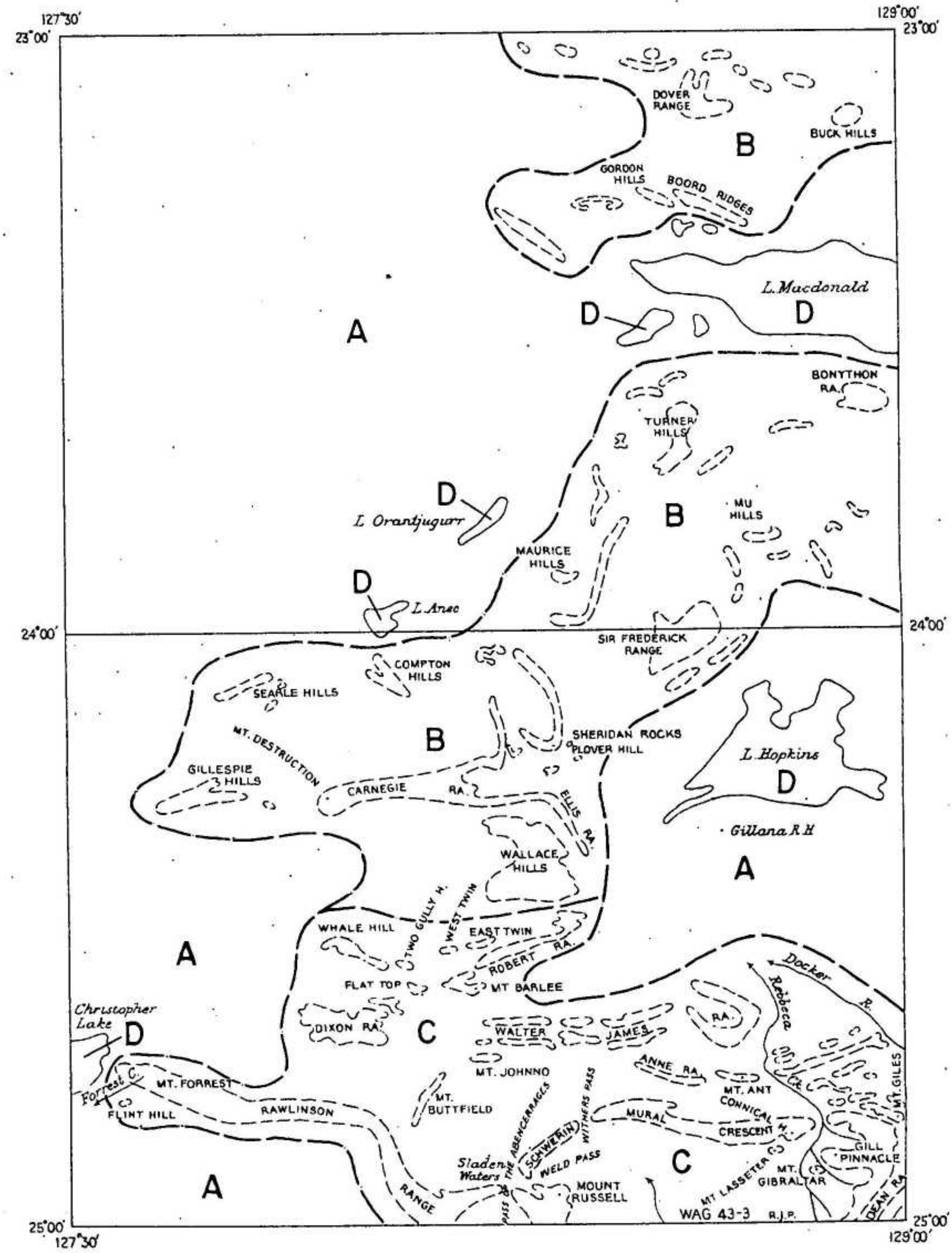


Fig. 3 Physiographic Divisions. A - seif dunes and sand plain, B - low ranges and isolated hills, C - high ranges and mountains, D - salt lakes.

Figure 4. Mt. Ant in the Anne Range. High mountains and ranges of physiographic Division C.

The drainage system is antecedent and the only channels of any consequence are the Docker Creek and Rebecca Creek; both lying in the south-east corner of the area and flowing in a northerly direction towards Lake Hopkins. Rebecca Creek has a gradient of approximately 4 feet per mile between the Schwerin Mural Crescent and the Ane Range. The ranges are strike ridges and are skirted by recent fans of alluvium and boulder scree.

Lake Macdonald and Lake Hopkins are large salt lakes which lie on the eastern side of the area. These lakes are areas of internal drainage and are approximately 1,450 feet above sea level. The drainage to these lakes is mostly subsurface, with only very few small surface channels visible. At the time of this investigation the water level in Lake Macdonald was approximately 4 inches below the surface and the water level on the western edge of Lake Hopkins was more than 3 feet below the surface. Other samller salt lakes are Christopher Lake, Lake? Grantjugurr and Lake Anec.

Specimens of limestone found near the edge of Lake Hopkins and the distribution and structure of rocks about Lake Macdonald suggests that these two lakes may partly overlie the Bonython Dolomite.

STRATIGRAPHY.

GENERAL

In the Rawlinson and Macdonald areas units of Archaean, Lower Proterozoic, Upper Proterozoic, Ordovician, Permian and Cainozoic age have been mapped. The only diagnostic fossils are those of Ordovician age. In this report the area underlain by the Upper Proterozoic rocks is regarded as forming part of the Amadeus Geosyncline. Only the known western end of the Geosyncline is covered by the Rawlinson and Macdonald areas. The Lower Proterozoic and Archaean rocks acted as basement and probably also as source areas for the younger sediments. The thin Permian glacial rocks are marginal to the marine sediments of the Canning Basin to the west. The relationship of formations in the Rawlinson-Macdonald area is shown in Figure 5 and details of the formations in Table 2.

All formation names used are new and have been approved by the West Australian Stratigraphic Nomenclature Committee.

LOWER PROTEROZOIC AND ARCHAEAN ROCKS.

Basement rocks of possible Lower Proterozoic and Archaean age crop out to the north and south of the western Amadeus Geosyncline. These have been mapped in two widely separated areas: One in the north-eastern corner of the Macdonald area; and the other in the southern half of the Rawlinson area. These two areas of rock are described separately.

Archaean and Lower Proterozoic on North-East Macdonald Area.

Foliated and massive porphyry, low grade metasedimentary rock, quartzite, foliated gneiss and granite crop out on the north-eastern corner of the Macdonald area where they form the core of a large faulted anticline trending at approximately 280°. These rocks are overlain unconformably by the Dover Sandstone of probable Upper Proterozoic age.

The relationships between the rocks older than the Dover Sandstone are not visible. Consequently the time-rock subdivisions given here are the result of tentative regional correlations and are not based on field evidence.

?Archaean

In the north-eastern corner of the Macdonald area and about ten miles further south in the core of a faulted anticline there are outcrops of foliated granitic gneiss, quartzite, granite and aplite. The granitic gneiss and quartzite are thought to be Archaean because of similarities with the Arunta Complex.

At M42 the foliation in the gneiss strikes between 270° and 285° and dips 70° south. These foliation trends can be seen on the air photographs even where outcrop is lacking.

?Lower Proterozoic.

The rocks of possible Lower Proterozoic age are dominantly porphyritic dacite and porphyritic rhyolite (Figure 6) but include porphyritic microgranodiorite, porphyritic microgranite, quartz-hornblende diorite, ? albitized dolerite, granite and steeply dipping, low grade, metasedimentary rock. The medium-grained and coarse-grained rocks are associated with the gneiss and quartzite and their relationship to the porphyritic dacite and rhyolite is not exposed. The fine-grained rocks with associated metasedimentary rocks appear to be overlying the gneiss and quartzite. Granite appears close to outcrops of porphyritic rhyolite and dacite but the only evidence to suggest an intrusive relationship between the two is the low grade metamorphism and shearing of the fine-grained porphyritic rocks.

TABLE 2 - STRATIGRAPHY OF THE RAWLINSON - MACDONALD AREA.

AGE	FORMATION	MAP SYMBOL	MEASURED THICKNESS AND LOCALITY	PHOTO-INTERPRETED THICKNESS	LITHOLOGY AND PALAEONTOLOGY	TOPOGRAPHY	CORRELATION AND REMARKS
QUATERNARY		Qs			Aeolian sand	Seif dunes and sand plain	
		Qa			Alluvium	Soil plain & scree slopes	
		Qt			Evaporites	Salt lakes	
		Ql			Travertine	Low rounded hills generally bordering salt lakes.	
		Qc			Conglomerate	Scree slopes.	
TERTIARY		not mapped			Duricrust-laterite, grey billy and pisolitic ironstone	Capping hills and low mounds	
PERMIAN	BUCK FORMATION	Pb	137' (M20)	-------	Poorly sorted coarse sandstone, tillitic sandstone, boulder beds, siltstone, striated and facetted, erratics. Possible glacial pavement.	Rarely mesas & buttes mostly rounded low hills.	Grant Formation, Braeside Tillite and Paterson Formation of Canning Basin. Finke River Beds ?
			ANGULAR UNCONFORMITY				
ORDOVICIAN (post-Tremadocian-lower-most Ordovician)		O	10' (M71)	-------	Red limestone with pelecypods gastropods, orthid & strophomenoid brachoipods. asaphid trilobites echinoderm ossicles, and conodonts.	Low mounds almost obscured by travertine and sand.	*Orthis leviensis* beds, MacDonnell Range (Stokes Formation)
			ANGULAR UNCONFORMITY				
UPPER PROTEROZOIC	MAURICE FORMATION	Bum	757' (M57)	6300' Maurice Hills	Cross-bedded sandstone, quartz-greywacke, micaceous siltstone. Abundant clay pellets; heavy mineral concentrations.	Thick-bedded sandstone forms strike ridges, otherwise poor outcrop.	
	ELLIS SANDSTONE	Bue	1995' Carnegie Range	1600' S.E. of Maurice Hills	Quartz-sandstone, & minor interbedded calcareous sandstone. Cross-bedded, clay pellets and few rounded quartzite pebbles. Heavy mineral concentrations.	Sandstone forms strike ridges or prominent ranges.	Lateral
	SIR FREDERICK CONGLOMERATE	Bus	1200' Carnegie Range	-------	Boulder conglomerate with phenoclasts mainly quartz sandstone with quartz mica schist and quartzite.	Forms prominent hills and ranges with characteristic rounded profiles and even slopes.	Equivalents
	CARNEGIE FORMATION	Buc	4123' Carnegie Range	3950' South of Maurice Hills	Quartz-greywacke, shale and siltstone. Heavy mineral concentrations.	Poor outcrops in low hills and in places forms bed of claypans.	Lateral
?	BOORD FORMATION	Buo	2794' Boord Ridges	-------	Calcarenite, calcilutite, dolomite, limestone with interbedded shale and siltstone. Abundant stromatolites. Tillite and calcareous sandstone near base.	Poor outcrops on alluvial flats. Limestone forms low strike ridges.........	Equivalents ......Correlated with Areyongs Formation of Hermannsburg Area.
			? DISCONFORMITY				

Figure 6. Hills of Lower Proterozoic porphyry, buttes of Buck Formation in middleground and scarp of Dover Sandstone on horizon, in the Dover Range.

Figure 7. Dean Metamorphics overlying Rawlinson Porphyry. Dean Range at Wooroorlana Rockhole, N.T.

Figure 8. Dean Metamorphics - Rawlinson Range near Giles Weather Station. (Australian News & Information Bureau photo.)

Figure 9. Dean Metamorphics at Mt.Lasseter and eastern end of Schwerin Mural Crescent.

The sediments are grey and greenish-grey shale, siltstone sandstone, light grey, laminated chert and a light grey chert breccia.

The porphyritic rhyolite is foliated, brown or pinkish-brown, fine-grained and aphanitic or else porphyritic in quartz and feldspar. At M30 it contains fresh pyrite.

The porphyritic dacite is dard grey and fine-grained with phenocrysts of bluish quartz, white plagioclase and grey microcline and contains black clumps of hornblende and biotite. At many localities the rock is foliated and altered to a grey and greenish-grey, medium-grained quartz-feldspar-mica schist.

A conformable sequence of foliated porphyry and laminated chert is exposed at M32 and interbedded porphyries are exposed at M31. This suggests that some of the fine-grained igneous rock may have been extrusive.

A light pinkish-brown, coarse, even-grained, muscovite granite crops out as residual tors at M33 and half a mile south of M21 a coarse, even-grained, biotite granite is associated with a black and white feldspar-quartz-biotite schist and is overlain by the Dover Sandstone. Granite crops out at M39 together with vein quartz and pegmatite but the relationships are not certain.

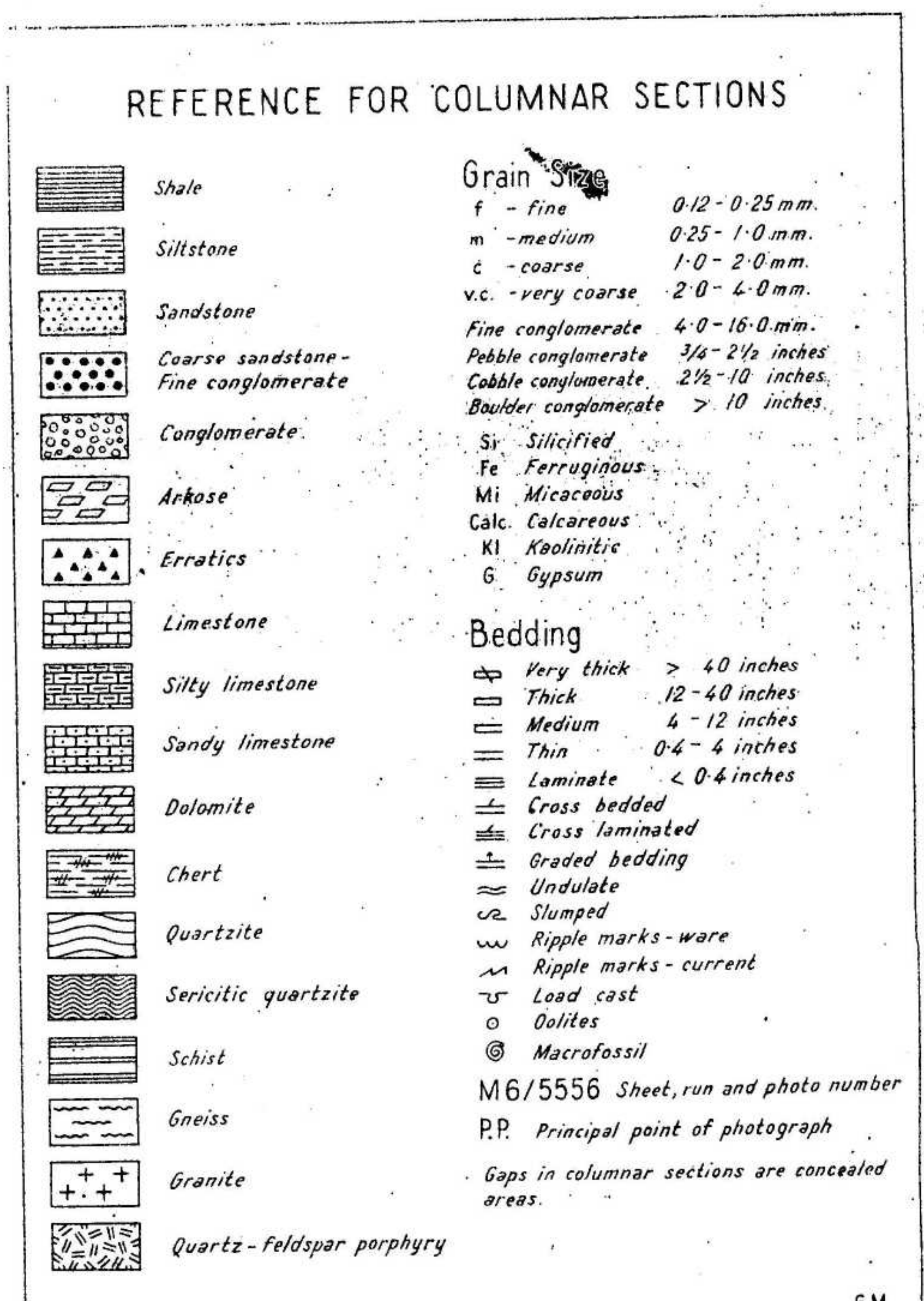
Lower Proterozoic on the Rawlinson Area.

Rocks thought to be Lower Proterozoic crop out on the Rawlinson area between $24^{\circ}30'S$ and 25° of south latitude. They extend south of 25° for an unknown distance on the Scott sheet. These rocks crop out as long prominent ranges: the Rawlinson Range (Figure 8), Schwerin Mural Crescent (Figure 9), Dean Range, Kathleen Range, Dixon Range, Robert Range, and Walter James Range.

The ranges, hills and ridges are composed dominantly of quartzite, conglomerate, siltstone, arkose, sandstone, slate and schist. Three units have been recognized: the Barlee Beds, the Dixon Range Beds and the Dean Metamorphics. The rocks occurring between the ranges are obscured by sand and therefore it is impossible to determine the relationship between these three units with certainty. However, the Dean Metamorphics are probably the oldest and the Barlee Beds the youngest.

The base of the sequence is intruded by granite and acid porphyry. Thermal metamorphism and metasomatism due to these intrusions is very slight; the dominant metamorphic effects having been caused by directed stress.

Figure 10.


REFERENCE FOR COLUMNAR SECTIONS
Shale
Siltstone
Sandstone
Coarse sandstone - Fine conglomerate
Conglomerate
Arkose
Erratics
Limestone
Silty limestone
Sandy limestone
Dolomite
Chert
Quartzite
Sericitic quartzite
Schist
Gneiss
Granite
Quartz - feldspar porphyry
Grain Size
f - fine 0·12 - 0·25 mm.
m - medium 0·25 - 1·0 mm.
c - coarse 1·0 - 2·0 mm.
v.c. - very coarse 2·0 - 4·0 mm.
Fine conglomerate 4·0 - 16·0 mm.
Pebble conglomerate 3/4 - 2½ inches
Cobble conglomerate 2½ - 10 inches
Boulder conglomerate > 10 inches
Si Silicified
Fe Ferruginous
Mi Micaceous
Calc. Calcareous
Kl Kaolinitic
G Gypsum
Bedding
Very thick > 40 inches
Thick 12 - 40 inches
Medium 4 - 12 inches
Thin 0·4 - 4 inches
Laminate < 0·4 inches
Cross bedded
Cross laminated
Graded bedding
Undulate
Slumped
Ripple marks - ware
Ripple marks - current
Load cast
Oolites
Macrofossil
M6/5556 Sheet, run and photo number
P.P. Principal point of photograph
Gaps in columnar sections are concealed areas.
G M.

Dean Metamorphics.

The name Dean Metamorphics is used for a thick sequence of fine to coarse quartzite, pebbly quartzite, schistose sericitic quartzite, slate, conglomerate, sericite-quartz schist and quartz-sericite schist.

There is no type section, but incomplete sections have have been measured in the Dean Range (RFX1&2), 2 miles west of the Dean Range (RFX3), and at the pass of the Abencerrages (Rawlinson Range, RFX4). These sections are shown in Figure 11 (a) and (b). A thickness of three thousand four hundred feet was measured in the Dean Range.

The complete range of lithologies and their order is unknown and recognition of the Dean Metamorphics sometimes depends on criteria such as igneous intrusions, degree of metamorphism, and structure.

The degree of metamorphism is variable, the arenaceous rocks ranging from dense foliated and lineated quartzite to friable sandstone.

Some typical lithologies are not included in the sections and are described here. At "Mount Sargood" there is approximately four hundred feet of black and white banded, laminated, medium to coarse-grained quartzite and several hundred feet of pinkish-brown, conglomeratic quartzite with interbeds of grey slate. Two miles south-east of the Kathleen Range there is a thin bed of conglomerate, in which boulders of granite, aplite, epidotised fine-grained igneous rock and quartz-albite porphyry are set in a matrix of green quartz-sericite schist.

Igneous intrusions: The Dean Metamorphics are intruded by very coarse, foliated, porphyritic, sericite granite, pink granite aplite, coarse even-grained, granophyric muscovite granite, coarse foliated sericite-feldspar rock, quartz-feldspar porphyry, (see Figure 7), quartz veins and thin pegmatite veins.

The intrusion of the Dean Metamorphics by the Rawlinson porphyry is most clearly demonstrated near the Kathleen Range (Figure 47). The granite intrudes the Dean Metamorphics three miles south-east of the Kathleen Range (Figure 47) and intrudes the porphyry east of the Dean Range.

Porphyries of flow origin and associated tuff and agglomerate may be a part of the Dean Metamorphics sequence but there is no direct proof.

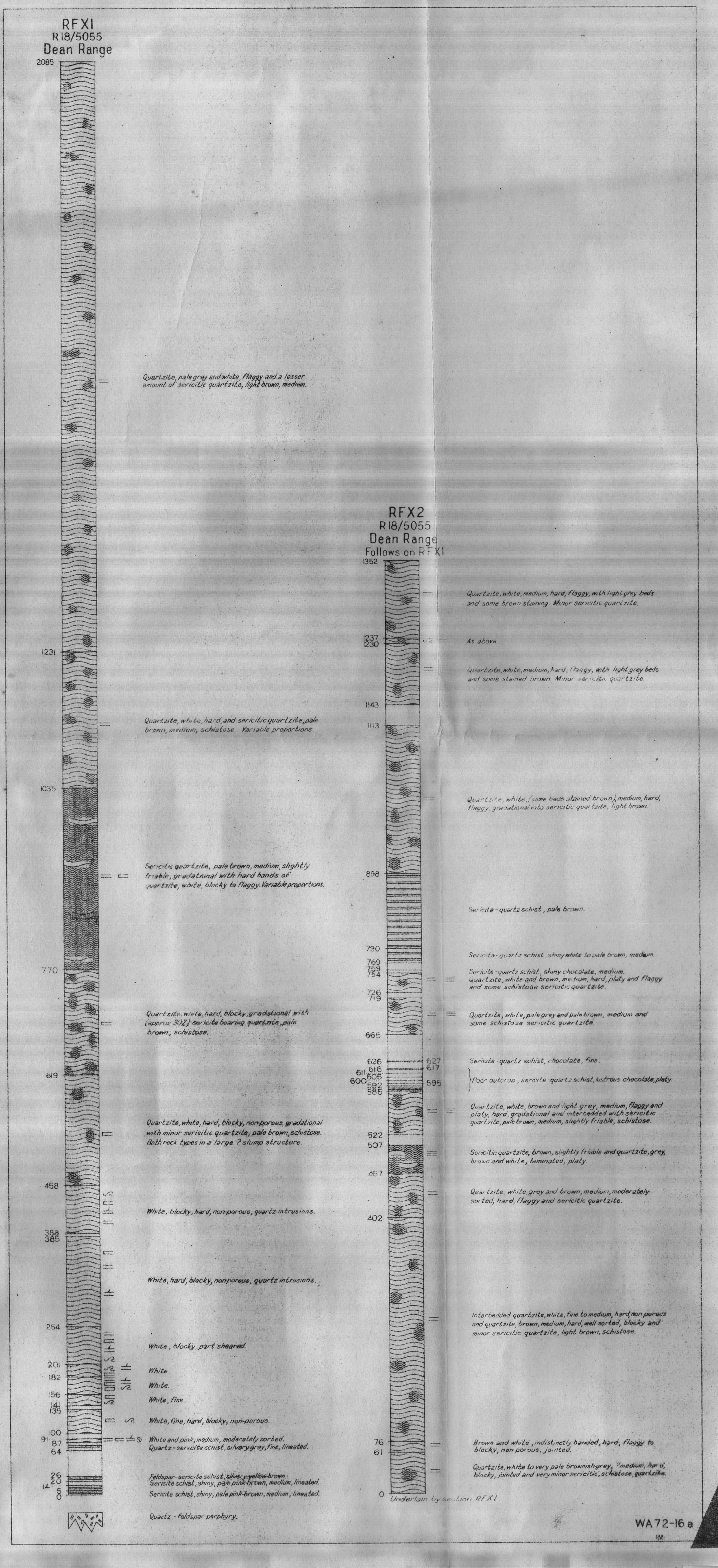
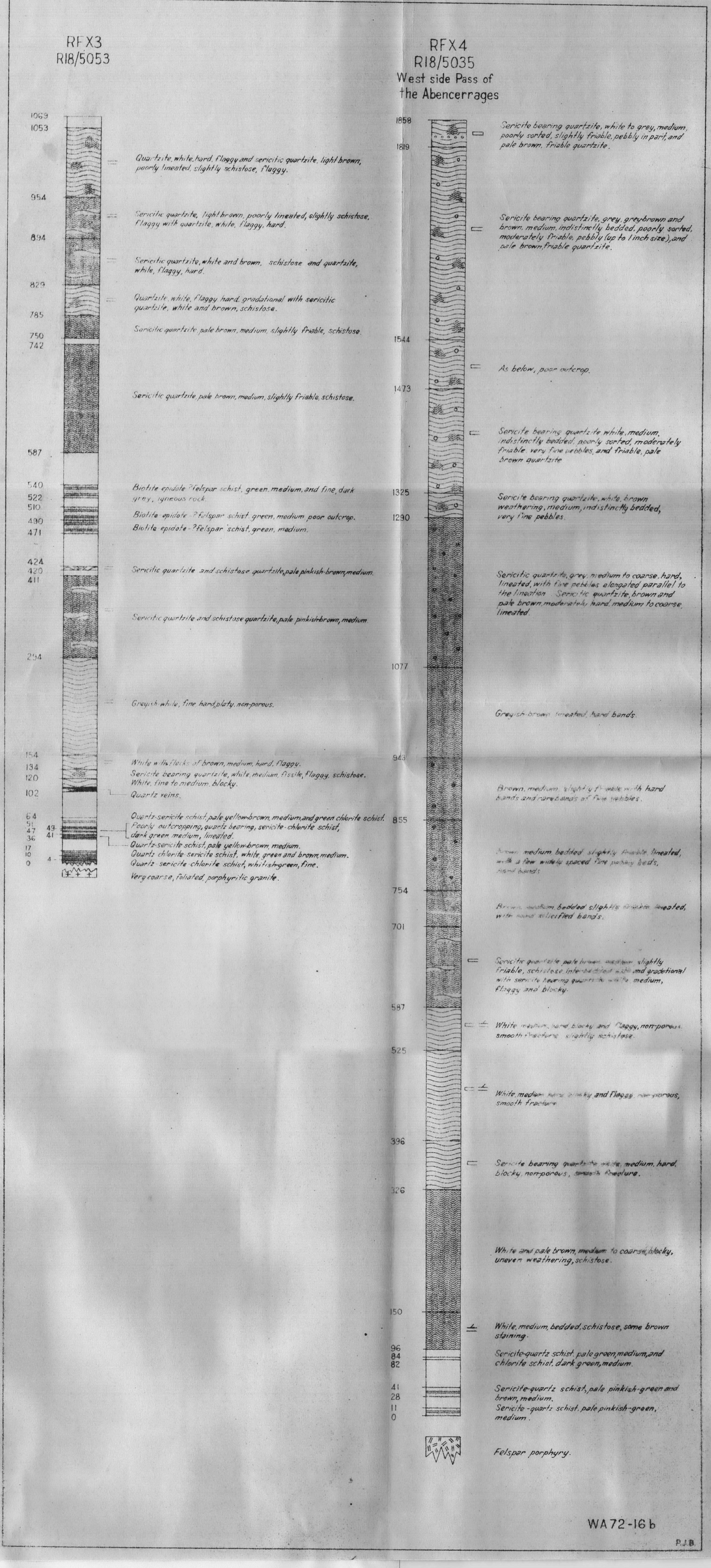


Figure 11 (a). Sections of the Dean Metamorphics, Dean Range.



11 (b). Sections of the Dean Metamorphics, two miles west of the Dean Range and at the Pass of the Abencerrages.

Dixon Range Beds.

Dixon Range Beds is the name used for the sequence of sandstone, siltstone shale, arkose and fine conglomerate which crops out in the Dixon Range and south of the Walter James Range. The base of the beds is not exposed but it is presumed that these rocks are younger than the Dean Metamorphics, and are probably older than the Barlee Beds for the following reasons.

(i) Sediments of the Dixon Range Beds crop out a short distance south of the Walter James Range (Barlee Beds) and dip north beneath it.

(ii) In the Robert Range and at some of the hills to the north (localities R125, R126) the Dixon Range Beds appear to be conformable beneath the Barlee Beds.

About 4500 feet of sediment crop out in the west-plunging syncline in the Dixon Range (Figure 12 and 13), where the sediments are dominantly sandstone with interbedded micaceous siltstone and varying amounts of shale, arkose, arkosic grit, pebble conglomerate and possibly greywacke. Cross-stratification and both current and wave ripple markings are common. The Dixon Range has many large strike valleys and the rock in these intervals is concealed.

The sandstone is pale yellow, pale yellow-brown, pale grey, pale purple and purple. The clastic material is poorly sorted and sub-rounded or sub-angular. The coarse sandstone and fine conglomerate contains quartz, feldspar and rock fragments.

The arkose is pale purple, yellow-brown or pink. It ranges from medium-grained arkose to a fine conglomeratic arkose containing sub-rounded to angular grains of microcline up to three quarters of an inch in length.

Immediately to the south of the Walter James Range the Dixon Range Beds crop out as a sequence of fine sandstone, siltstone shale and arkose. These rocks are better sorted and finer grained than those in the Dixon Range. The sandstone contains a considerable amount of pyrite. Current and wave ripple marking is very common.

The effects of low grade metamorphics are obvious in several places. A recrystallization lineation was measured trending 27° and a vertical fracture lineation was measured trending 335°. These lineations agree with those measured in the Dean Metamorphics near the Kathleen Range.

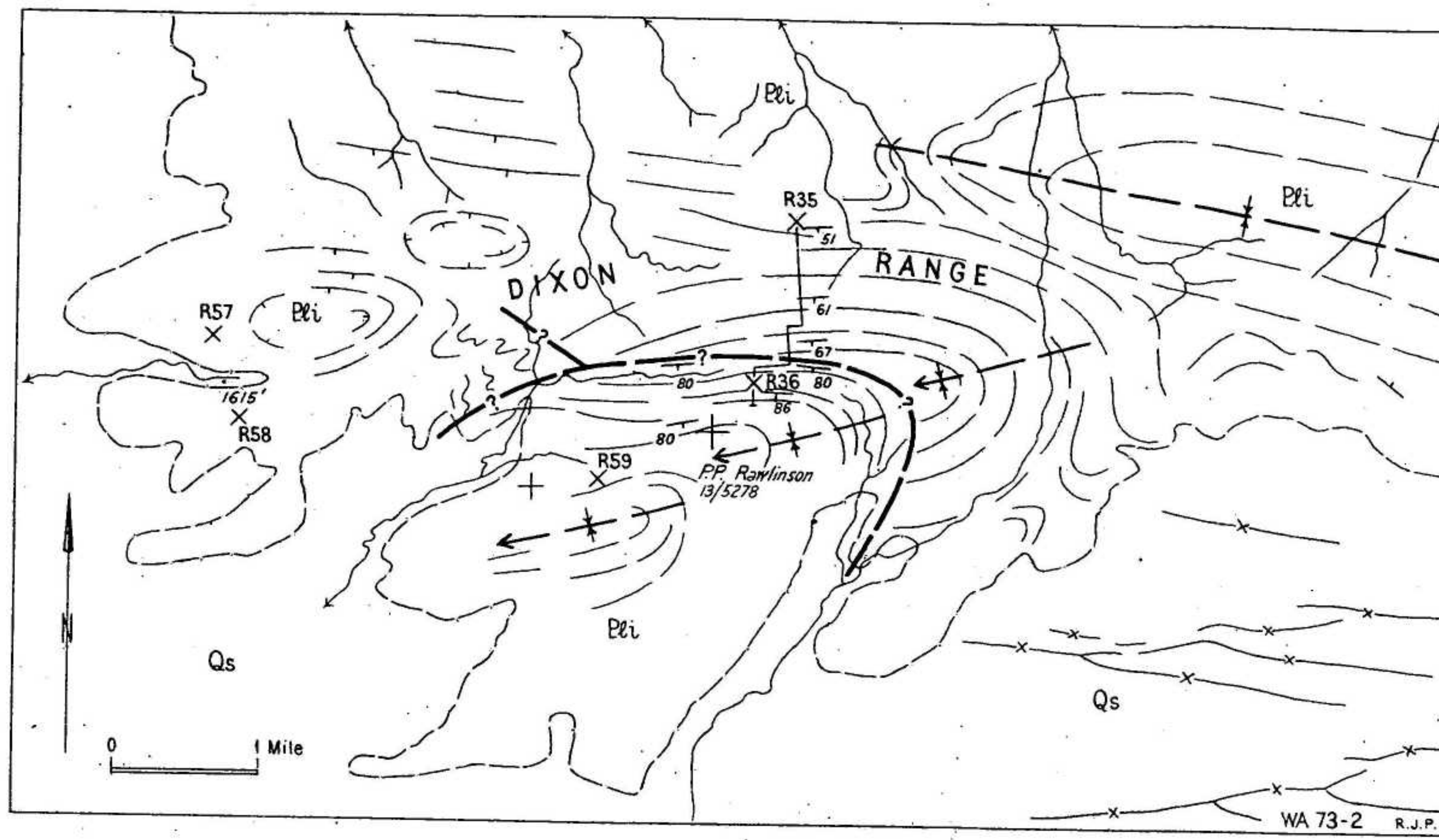


Figure 12. Dixon Range Beds, (Pℓi) Dixon Range.

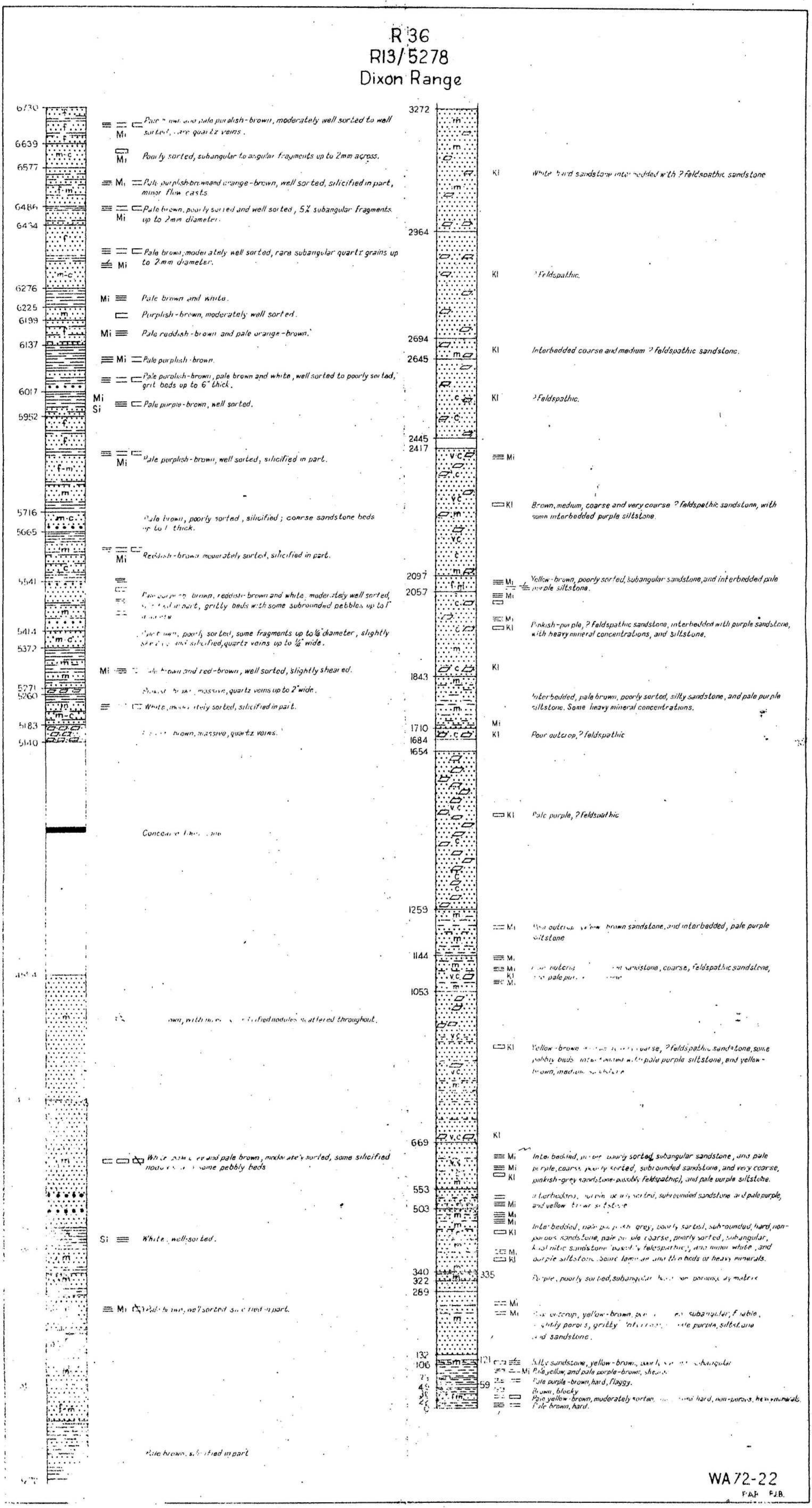


Figure 13. Section of the Dixon Range Beds, Dixon Range.

The sequence is intruded by quartz veins. A dark grey quartz-rich rock of igneous appearance was collected from R35 (Figure 12). The specimen submitted for petrographic examination was insufficient to ascribe an igneous or metamorphic origin to the rock.

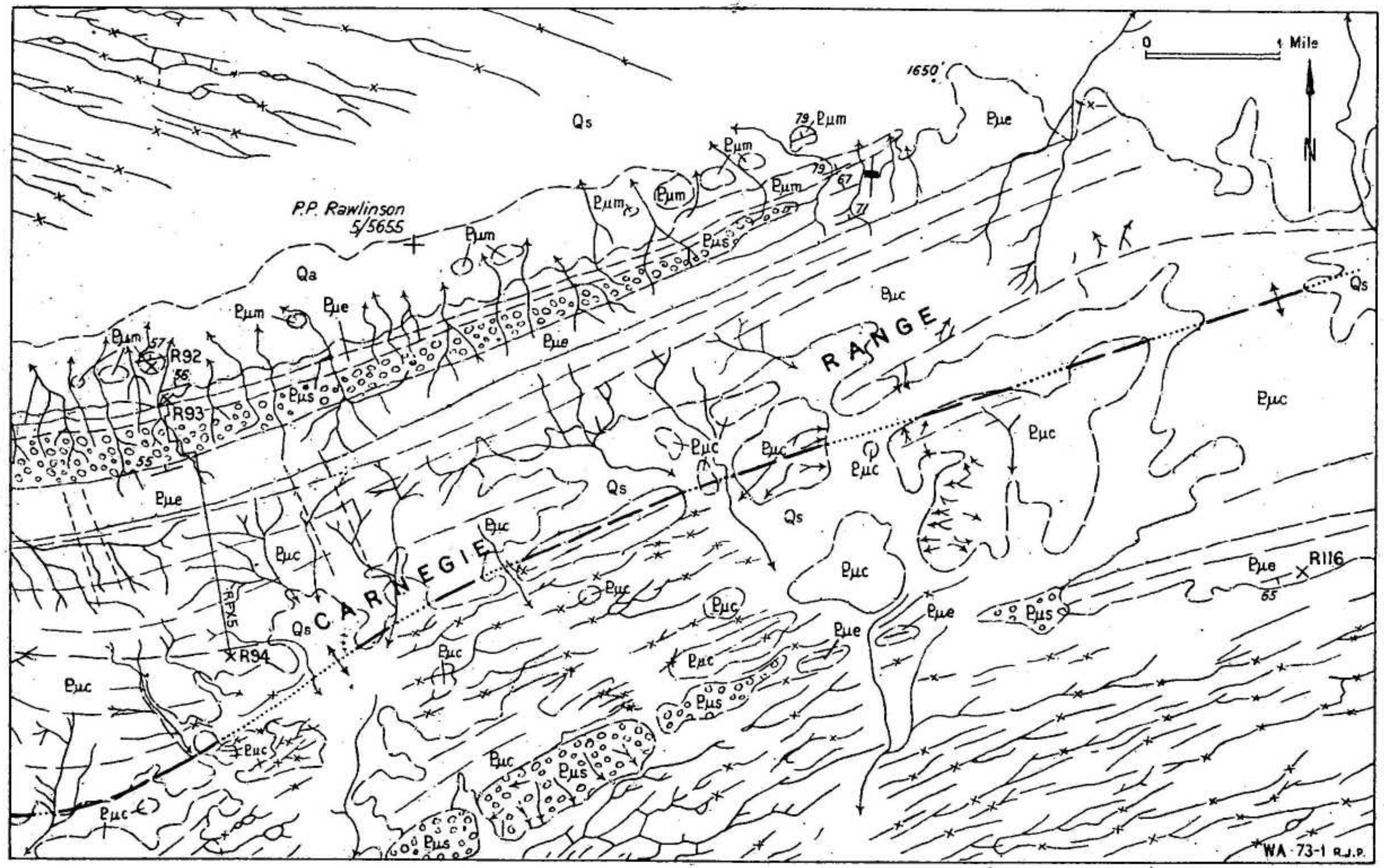
Barlee Beds.

Barlee Beds is the name used for the sequence of quartz sandstone, kaolinitic sandstone, micaceous siltstone, shale and conglomerate which probably overlie the Dixon Range Beds. The Barlee Beds are the uppermost unit of the possible Lower Proterozoic sequence and no contact with younger sediments is exposed. The unit is probably faulted against the Upper Proterozoic sediments along the Robert Fault.

About 3900 feet of section was measured in the Robert Range (Figure 14). The dominant lithology is a monotonous sequence of medium, coarse and very coarse-grained, moderately to poorly sorted, pebbly, cross-bedded, partly silicified and partly kaolinitic sandstone. The colour varies from white to fawn, pinkish-brown, red-brown and purplish-black depending largely on the nature of the matrix or cement (e.g.kaolinitic, siliceous, ferruginous). Current bedding sets average about 18" inches in thickness. Ripple marks on the finer grained and better sorted material are dominantly the current type but wave ripple marking is also present. Clay pellets are found in large numbers in some beds but are not a general feature of the sequence.

Thick shaly sediments are known from only one locality (R86), where 100 feet of red-brown, grey-green and white shale and slate underlies about 300 feet of sandstone with a 50 foot transition zone of interbedded sandstone and shale. These rocks are thought to be the uppermost part of the Barlee Beds exposed on the Rawlinson area.

Conglomerate is known from the Anne Range at R78 and R79. The conglomerate is interbedded with sandstone and forms lenses about ten feet thick. The fragments are up to 8 inches in diameter and average about half inch diameter. The smaller fragments are angular whereas the larger cobbles are rounded. The cobbles are dominantly quartzite, vein quartz, siltstone and chert. There is some cross-stratification in the matrix of the conglomerate and the interbedded sandstone. This conglomerate is not known in the Barlee Beds from other localities and consequently the Anne Range sequence is only tentatively correlated with the Barlee Beds.



<u>Figure 34.</u> Interfingering of Sir Frederick Conglomerate (Pµs) and Ellis Sandstone (Pµe), in the Carnegie Range. Carnegie Formation (Pµc), Maurice Formation (Pµm).

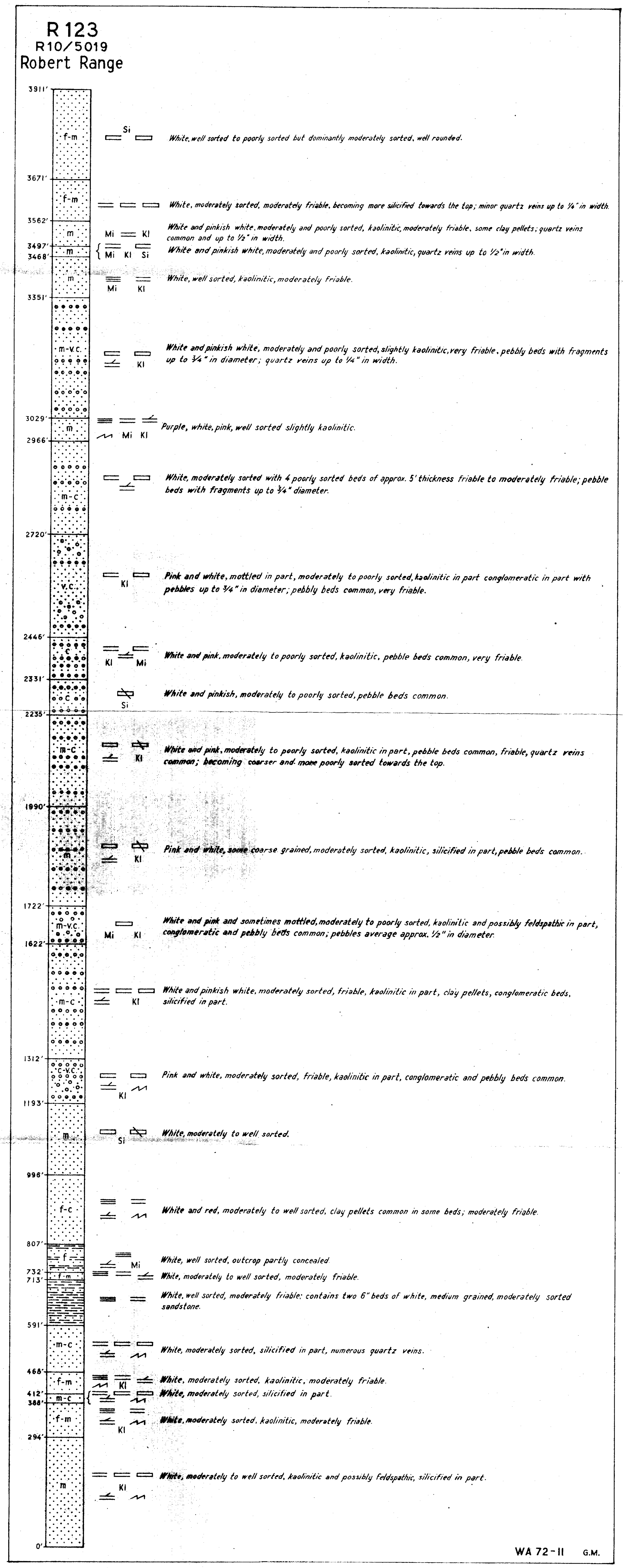


Figure 14. Section of the Earlee Beds, Robert Range.

The Anne Range sequence is underlain by a very fine-grained, chocolate-brown, foliated quartz-feldspar porphyry which may intrude the sequence. The Barlee Beds are intruded by quartz veins.

Igneous Intrusives.

The Rawlinson Porphyry: The Rawlinson Porphyry is a foliated, grey or brown, fine-grained, quartz-albite porphyry which intrudes the Dean Metamorphics (and possibly the Dixon Range Beds and the Barlee Beds). It has been traced in outcrop from the Kathleen Range to the Rawlinson Range. Where it abuts against granite, the granite is intrusive into the porphyry. Quartz veins and narrow pegmatite veins also intrude the porphyry.

The rock contains phenocrysts of quartz, albite and in some places microcline. The feldspars are pink or white and are up to 1.2 centimetres in length. The quartz is a pale blue colour and is up to 0.3 centimetre in diameter.

The groundmass is made up typically of a fine-grained schistose aggregate of quartz, biotite, sericite, iron ore, and epidote in variable proportions.

The relationship of the Rawlinson Porphyry to the Dean Metamorphics is not always clear. It does intrude the Dean Metamorphics near the Kathleen Range (Figure 47). The porphyry appears conformable with the Dean Metamorphics and hence it was probably intruded as flat lying sheets.

South of the Kathleen Range a green, massive or foliated rock is associated with the Rawlinson Porphyry. The rock contains epidote, quartz, actinolite and minor chlorite. There are no phenocrysts in the rock but it has a pseudo-amygdaloidal texture with the pseudo-amygdales composed of epidote rimming quartz or calcite. The original nature of the rock is not known. In places this rock contains malachite.

A brown, foliated, fine-grained, igneous rock containing magnetite crops out at R16 near the road about one mile north of the southern boundary of the Rawlinson area.

Granite: There are no outcrops of granite on the Rawlinson area, however there are two outcrops near its south-east corner. One is on the Scott sheet to the south, the other is on both the Bloods Range and Petermann Range sheet areas to the east (Figure 47).

The outcrop on the Scott Sheet area has an area of about five square miles. It is a composite granite, the rock types include, very-coarse, foliated, porphyritic, muscovite granite, coarse, even-grained, muscovite granite, coarse, even-grained, muscovite granite with sparsely distributed one inch microcline crystals, and pink, medium-grained, aplitic granite. Thin section examination shows that in some specimens albite has replaced the rims of the microcline phenocrysts and has almost entirely replaced the groundmass microcline. On its north-western edge the granite intrudes the Dean Metamorphics and on its eastern edge the granite is possibly separated from the Dean Metamorphics by a concealed fault.

The intrusive contact of the granite with the Dean Metamorphics is demonstrated by : (i) an embayment of the granite along the strike of the Dean Metamorphics, (ii) by rare xenoliths of the Dean Metamorphics in the granite and, (iii) by the local stratigraphy of the Dean Metamorphics.

The second body of granite crops out on the Bloods Range and Petermann Range sheets. The outcrop has not been traced to the south-east but it has an area of at least 100 square miles.

On its western edge it is a light greenish-pink, coarse, even-grained, granophyric, muscovite granite with a two foot to eight foot thick border zone of medium to coarse-grained, porphyritic, granophyric granite where it abuts against the Rawlinson Porphyry.

The granite has no strong foliation or platy flow but the adjacent Rawlinson Porphyry is strongly foliated. Discontinuous one inch to two inch thick pink, medium-grained, porphyritic, granite aplite dykes and quartz veins intrude the Rawlinson Porphyry near the contact.

The coarse,even-grained, granophyric granite aplite contain microperthite and quartz with accessory iron ore, biotite, and plagioclase and secondary sericite and chlorite.

Age

On the Rawlinson sheet area the rocks of possible Lower Proterozoic age are faulted against the sediments of the Amadeus Geosyncline. Further north on the Macdonald area the suspected Lower Proterozoic rocks are overlain by the Dover Sandstone of probable Upper Proterozoic Age; the boundary between these two units is a structural and metamorphic unconformity. It is therefore logical to conclude that the Dean Metamorphics, Dixon Range Beds and Barlee Beds are also older than Upper Proterozoic.

these two units is a structural and metamorphic unconformity. It is therefore logical to conclude that the Dean Metamorphics, Dixon Range Beds and Barlee Beds are also older than Upper Proterozoic.

Moderate to high grade gneiss and granitized quartzite forms the bulk of the Musgrave, Mann and Everard Ranges and is very common in the Arunta Complex. The possible Lower Proterozoic rocks of the north-east Macdonald area are underlain by gneiss similar to that in the Arunta Complex. The Dean Metamorphics, Dixon Range Beds and Barlee Beds are intruded by granite only at the base, there is little or no granitization and the metamorphic grade is low. Therefore it is deduced that they are younger than Archaean. Their age is possibly Lower Proterozoic. No granite samples were taken for age determination.

UPPER PROTEROZOIC

A sequence of approximately 14,000 feet of sandstone, conglomerate, quartz greywacke, calcareous sandstone, siltstone, limestone and dolomite crops out in the western Amadeus Geosyncline.

No fossils other than stromatolites have been discovered within the sequence but the basal units are similar to the basal units of the Upper Proterozoic at Ellery Creek in the MacDonnell Range, (west of Alice Springs).

The sediments have been subdivided into seven new formations. These are from bottom to top: the Dover Sandstone, Bonython Dolomite, Boord Formation and laterally equivalent Carnegie Formation, Ellis Sandstone and laterally equivalent Sir Frederick Conglomerate and the Maurice Formation.

The Dover Sandstone, Bonython Dolomite and the base of the Boord Formation are probably Upper Proterozoic in age by correlation with units in the MacDonnell Range area. There is no evidence for the age of the overlying formations except they are unconformably overlain by Ordovician sediments and as no fossils have been found in them they are tentatively included in the Upper Proterozoic.

Dover Sandstone

The name Dover Sandstone is used for a sequence of very coarse to medium-grained sandstone, finely conglomeratic sandstone, fine conglomerate and siltstone which unconformably overlies possible Lower Proterozoic rocks and is overlain by the Bonython Dolomite.

The unit is restricted to the north-eastern quadrant of the Macdonald area where it crops out prominently as cuestas, mesas and hogbacks (Figure 6).

The name is taken from the Dover Range where the formation overlies weathered quartz-feldspar porphyry (Figure 16). Between the Dover Range and Mount Webb (on the Webb sheet area), the unmetamorphosed Dover Sandstone overlies foliated quartz-feldspar porphyry, granite and biotite schist. The foliation in the schist and quartz-feldspar porphyry is not parallel to the bedding in the Dover Sandstone.

The sandstone and conglomeratic sandstone is typically white, grey or pale brown. Near the base of the section it is very coarse-grained to medium-grained, cross-bedded in part, poorly sorted, sub-angular and silicified. Higher in the section the sandstone is ripple marked in part and is typically medium-grained, moderately sorted, sub-rounded and silicified. About 270 feet above the base there is a distinctive outcrop, about ten feet thick, of grey, medium-grained, moderately sorted, sub-rounded, laminated and platy, silicified sandstone. There is siltstone interbedded with the sandstone near this interval.

Three sections have been measured (Figure 15). The top of the Dover Sandstone was concealed in these. Sandstone and siltstone about 390 feet thick crops out in the Dover Range and the ridges to the north-west. The interval between this outcrop and outcrop of the Bonython Dolomite is concealed except for some rubble probably derived from ferruginous siltstone. Assuming this interval is included in the Dover Sandstone, the maximum possible thickness of the unit is 730 feet.

When struck with a hammer much of the Dover Sandstone gives off a foetid smell.

The age of the Dover Sandstone is probably Upper Proterozoic.

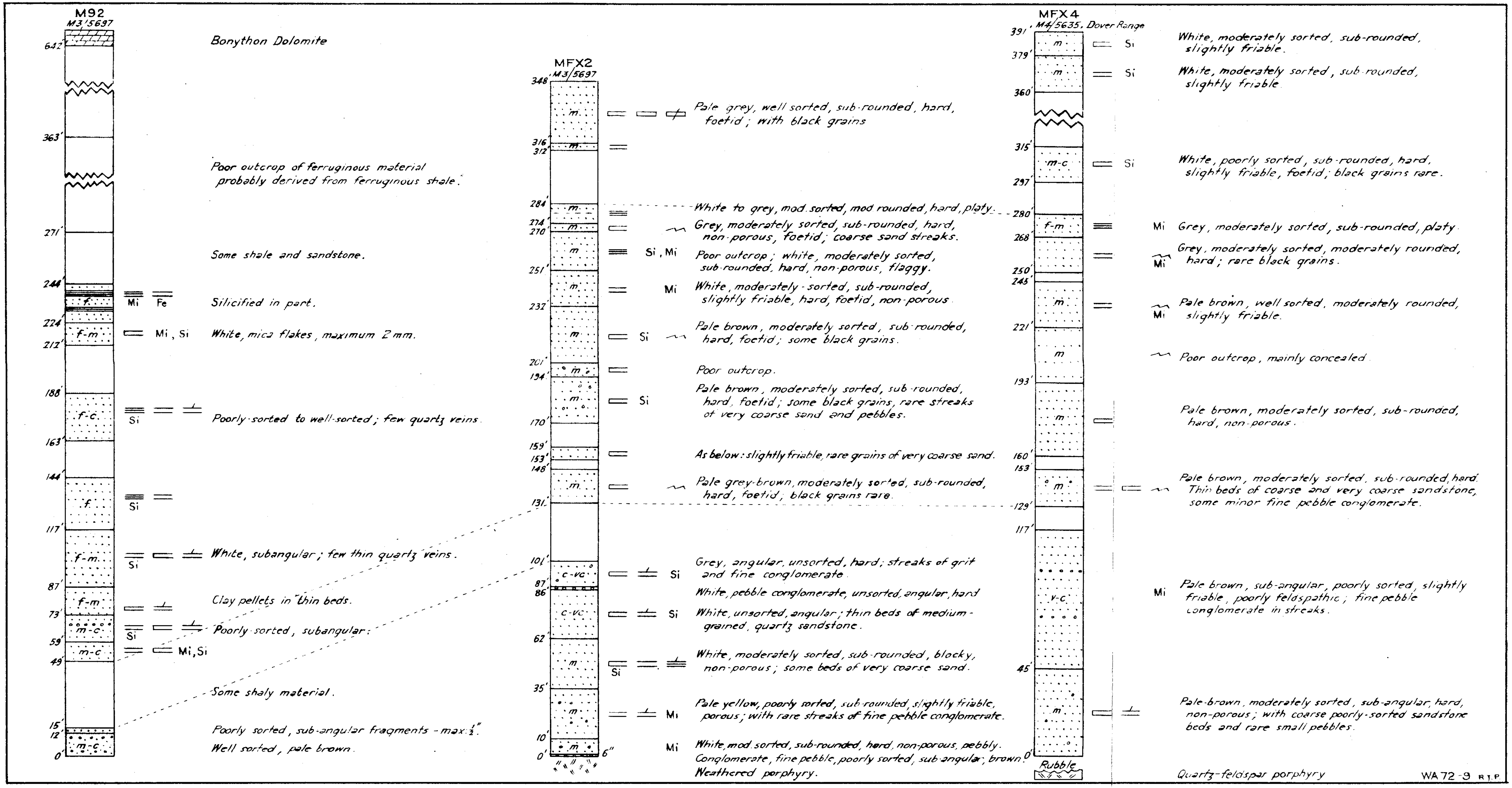


Figure 15. Sections of the Dover Sandstone.

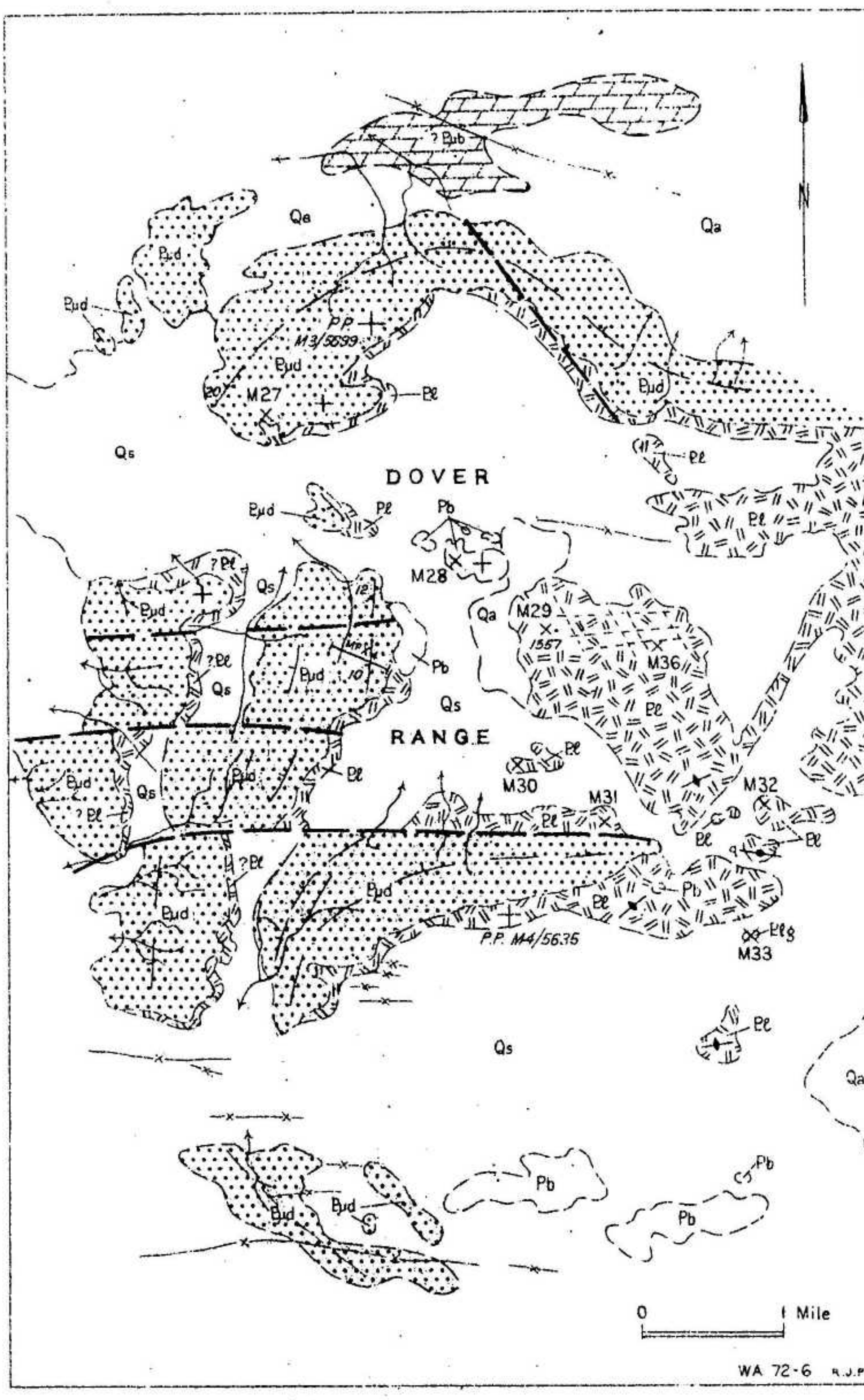


Figure 16. Unconformity between Upper and Lower Proterozoic rocks in the Dover Range. Sediments and porphyry Bl. granite Blg, Dover Sandstone Bud, Bonython Dolomite Bub, Buck Formation Pb.

Bonython Dolomite

The name Bonython Dolomite is used for a tightly folded sequence of interbedded dolomite, limestone, silty dolomite, silty limestone and siltstone which overlies the Dover Sandstone and is overlain by the Carnegie Formation and the Boord Formation. The contact between the Bonython Dolomite and the Boord Formation has not been seen. The contact between the Bonython Dolomite and the Carnegie Formation appears to be conformable where examined locally.

The unit crops out in low mounds and hills over the eastern halves of the Macdonald and Rawlinson areas as far south as the Carnegie Range. Lakes Macdonald and Hopkins are thought to have formed, at least in part, over the Bonython Dolomite.

The dolomite and limestone is dark grey, grey, white, grey-brown, brown, pink, red, yellow or black. The rock is most typically grey or brown or with alternate grey and brown laminae. It is generally laminated, fine, rarely medium-grained (0.25mm.-1mm.), hard, foetid, flaggy, non-porous, crystalline dolomite, crystalline limestone, calcilutite, dololutite, and dolarenite. Oolites are a common feature in the dolarenite and calcarenite. Stromatolites with a cylindrical form and with convex upwards laminae are very common in some beds where they form biostromes (Figure 17).

Secondary silicification of the limestone and dolomite is widespread and has produced lenses, beds and laminae of chert, silicified dolomite and silicified limestone. The dolomite and limestone, particularly the dark grey or black varieties, give off a foetid odour when cracked open with a hammer. Several specimens were submitted for estimation of non-gaseous hydrocarbons.

The interbedded siltstone is rarely exposed. It is typically white or yellow and contains sodium and calcium sulphate. Gypsum is the most abundant mineral.

The total thickness of the Bonython Dolomite is unknown due to incompetent folding (Figure 18) and poor exposure. Figure 20 shows the structure of the Bonython Range where 800 feet of section was measured (MFX6).

Figure 17. Stromatolites in the Bonython Dolomite.

Figure 18. Bonython Dolomite, Bonython Range.

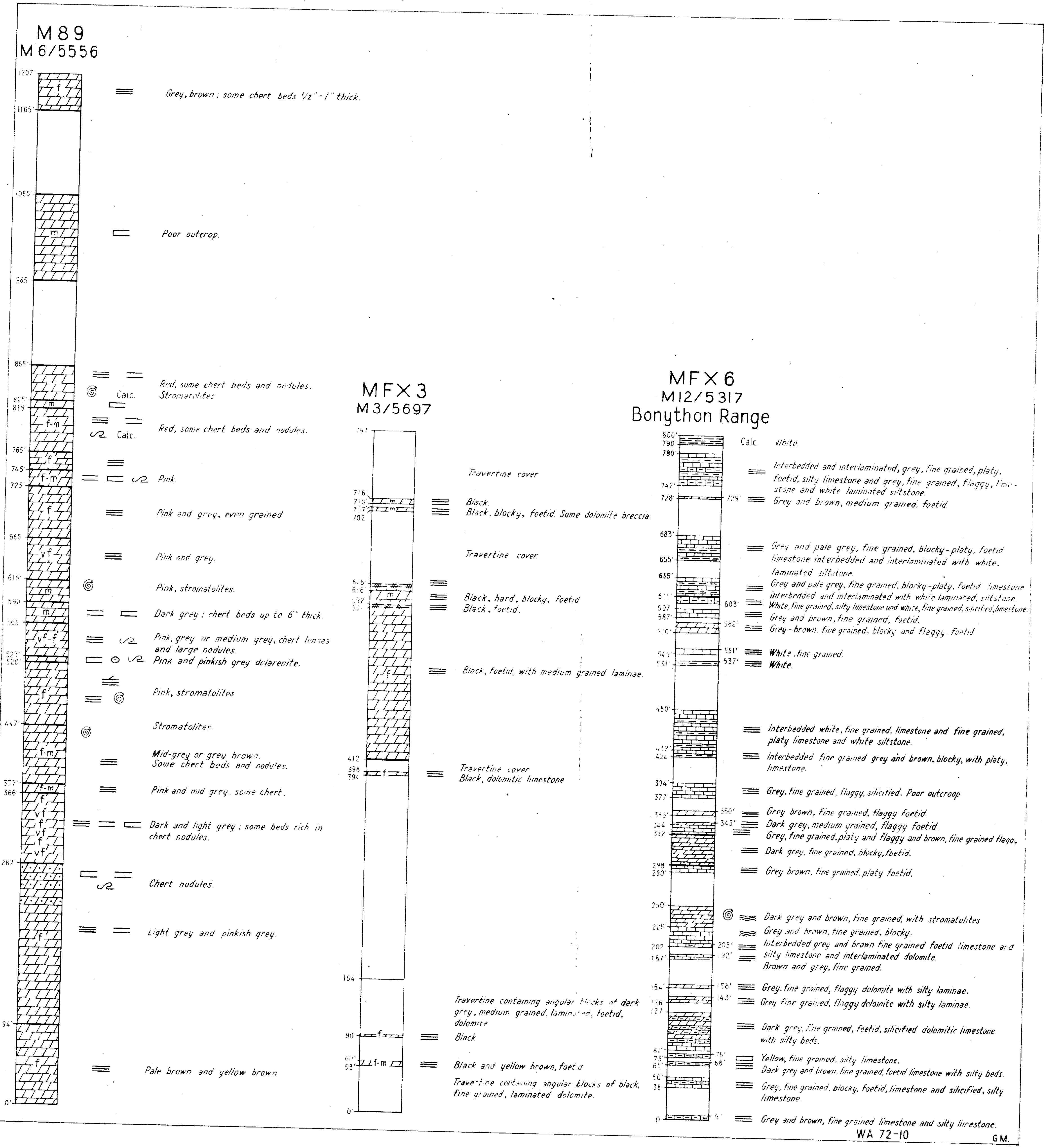


Figure 19. Sections of the Bonython Dolomite.

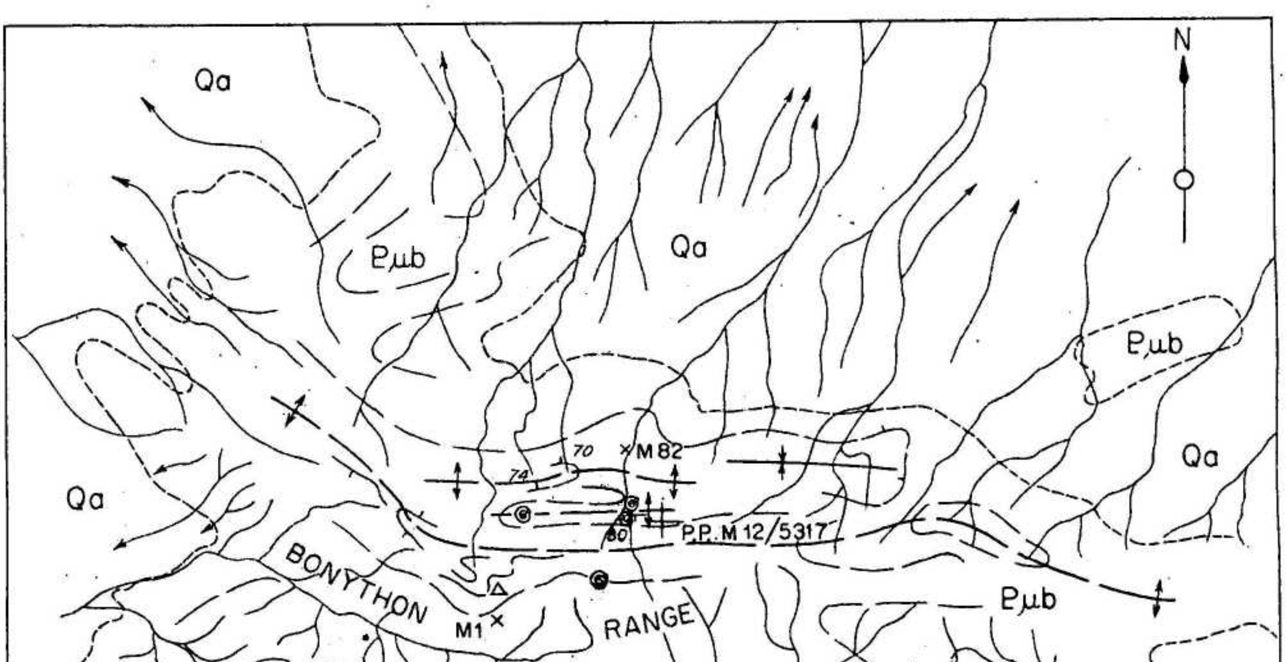


Figure 20. Structure of Bonython Dolomite (Ꞓub), Bonython Range.

This section contains a higher proportion of silty dolomite and siltstone beds than MFX3 (800 ft.) which was measured in dolomite overlying the Dover Sandstone. Neither MFX6 nor MFX3 can be compared closely with the section at M89 where 1200 feet of section was measured (Figure 19).

Boord Formation

The Boord Formation is defined as a sequence of calcilutite, calcarenite, dolomitic limestone, sandstone and siltstone with boulder beds of possible glacial origin near the base of the formation. No contacts with underlying or overlying units were seen. Because the boulder beds contain boulders of Bonython Dolomite and Dover Sandstone in addition to basement rocks a disconformity is deduced between the Boord Formation and the underlying Bonython Dolomite. The overlying Ellis Sandstone is believed to be conformable. 12 miles west of the Bonython Range at M47 the Boord Formation interfingers with the Carnegie Formation (Figure 27) and these two units are thought to be laterally equivalent.

The name of the formation is taken from the Boord Ridges. Exposures of the formation are poor. It crops out at Boord Ridges and Gordon Hills, 8 miles west of Gordon Hills and 12 miles west of the Bonython Range.

Sections were measured at MFX1 (2800 feet) and MFX8 (475 feet) in the Boord Ridges and at M47 (1400 feet), 12 miles west of the Bonython Range. Columnar sections are shown in Figure 26. None of these sections is accurate due to scanty and unreliable dip information.

At Boord Ridges the limestone and dolomite are exposed in widely spaced low ridges separated by areas of alluvium. Small fragments of siltstone and shale occur on the alluvium which may indicate thick sections of these sediments interbedded with the carbonate rocks.

The base of outcrop of the Boord Formation at Boord Ridges and north of the Gordon Hills is a persistent horizon of angular debris of limestone, chert and ferruginous material. (See Figures 24, 25). No solid outcrop is present where this debris occurs but it can be followed for several miles on the air-photos.

Figure 21. Pisolitic limestone of Boord Formation, Boord Ridges.

Figure 22. Glacial debris near base of Boord Formation, Boord Ridges. Note sharp contact with underlying calcareous sandstone.

Figure 23. Oolitic chert and limestone, Loord Formation, Loord Ridges.

TABLE 2. Sheet 2.

AGE	FORMATION	MAP SYMBOL	MEASURED THICKNESS AND LOCALITY	PHOTO-INTERPRETED THICKNESS	LITHOLOGY AND PALAEONTOLOGY	TOPOGRAPHY	CORRELATION AND REMARKS
? UPPER PROTEROZOIC	BONYTHON DOLOMITE	Bub	1200' W. of Gordon Hills. (M89)		Dolomite with chert bands and nodules. Minor limestone calcilutite and siltstone. Stromatolites.	Low mounds and rarely ranges	Correlated with Bitter Springs. Limestone of Hermannsburg area.
	DOVER SANDSTONE	Bud	391' Dover Range	880' east of Dover Range	Quartz sandstone, shale, siltstone and some fine conglomerate. Basal pebble conglomerate.	Strike ridges and ranges.	Correlated with Heavitree Quartzite of Hermannsburg area.
			ANGULAR	UNCONFORMITY			
? LOWER PROTEROZOIC		Blg			Granite		
		Bl			Quartz-feldspar porphyry, siltstone, chert and conglomerate.		
				? UNCONFORMITY			
? ARCHAEAN		Ag			Gneiss, and quartzite.		Arunta Complex.

LOWER PROTEROZOIC SEQUENCE OF RAWLINSON AREA.

AGE	FORMATION	MAP SYMBOL	MEASURED THICKNESS AND LOCALITY	PHOTO-INTERPRETED THICKNESS	LITHOLOGY AND PALAEONTOLOGY	TOPOGRAPHY	CORRELATION AND REMARKS
? LOWER PROTEROZOIC		Blg			Granite.	Low rough hills. Rugged country.	Crops out on adjoining [illegible] Range sheet area near Dean Range.
	RAWLINSON PORPHYRY	Blr			Quartz-feldspar porphyry. Probably as discordant sills.	Poor outcrops on alluvial flats.	
	BARLEE BEDS	Blb	3911'		Quartz sandstone, fine conglomerate. Some fine pebble beds.	High ranges and strike ridges.	
	DIXON RANGE BEDS	Bli	? 6730'		Quartz sandstone, siltstone, arkose and some quartz-mica schist. Ripple marked and cross bedded.	Low ranges and strike ridges.	
	DEAN METAMORPHICS	Bld	3436'		Quartzite, quartz sandstone, quartz-mica schist and minor slate and chlorite schist.	High ranges and prominent mountains.	

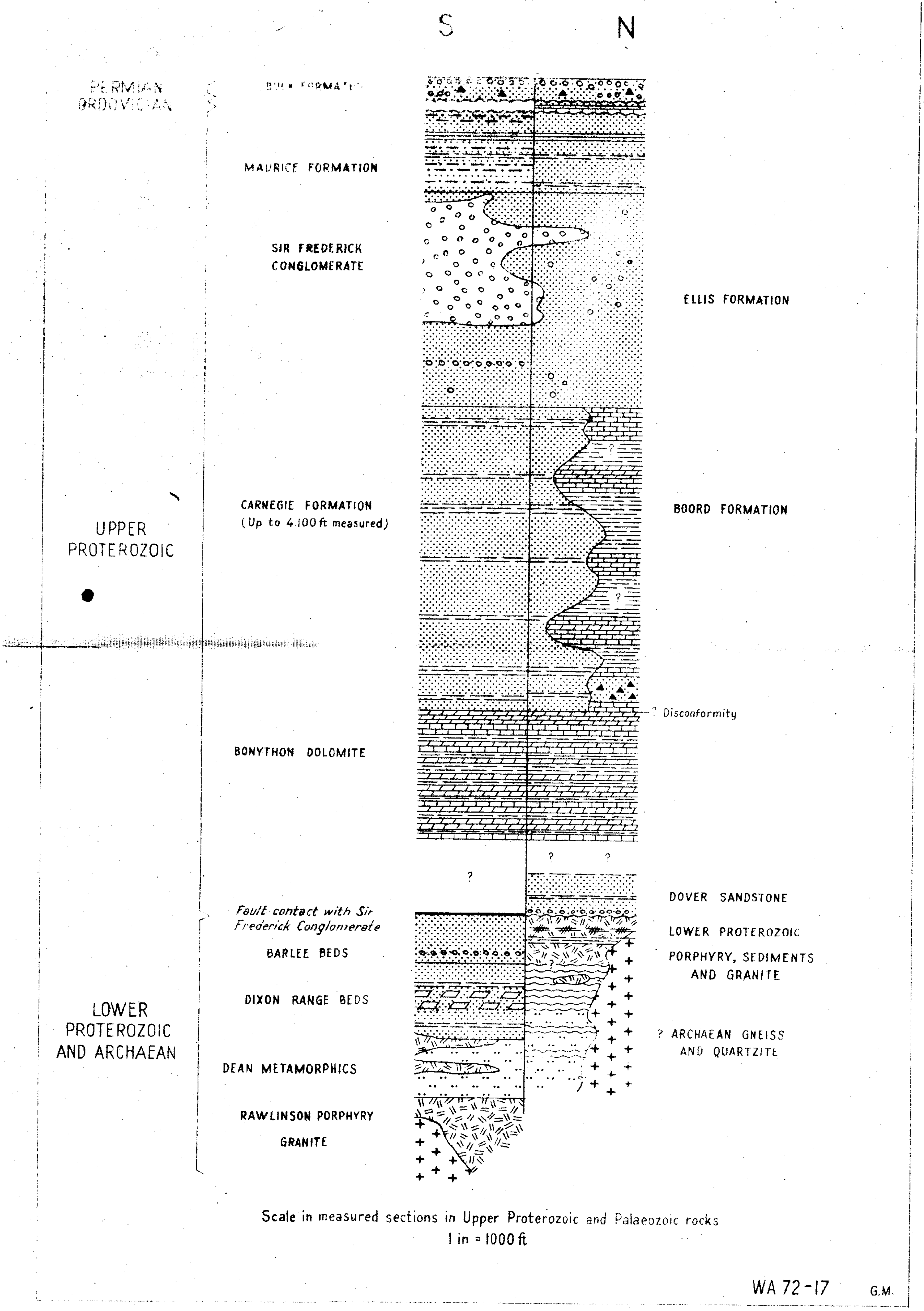


Figure 5. Relationship of Formations.

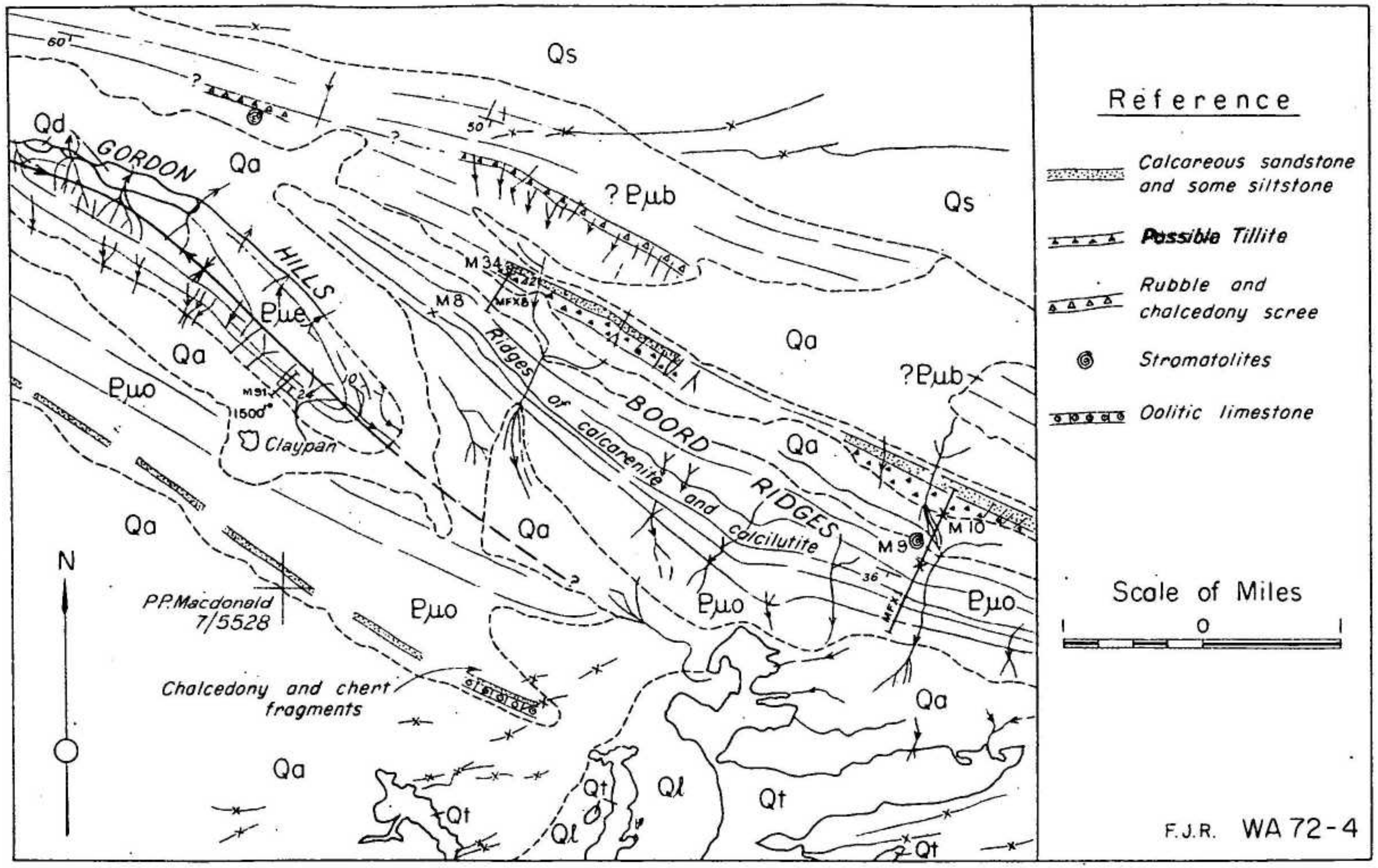


Figure 24. Tillite locality at Boord Ridges. Bonython Dolomite (Bub), Boord Formation (Buo), Ellis Sandstone (Bue).

To the west of the Gordon Hills some sandstone crops out above the breccia horizon. Better exposures of this sandstone are present further west near M69. This bed of pale brown, well sorted, medium-grained, thin and medium-bedded sandstone grades upwards into coarse, poorly sorted and bedded sandstone which contains subangular pebbles and grains. Near the top of this exposed section chocolate siltstone is interbedded with the sandstone. The breccia and possibly some non outcropping sandstone occur below the sections MFX1 and MFX8. (Figure 24).

MFX8 (Figure 26) is a section across the best exposure of the possible tillite beds which are approximately 250 feet thick. The conglomerate contains rounded to angular pebbles, cobbles and boulders up to eight feet across of algal limestone, sandy limestone, dolomite, fine conglomerate, chert, quartz sandstone, quartzite, jasper, vein quartz, schist and quartz-feldspar porphyry (Figure 22). Many of the phenoclasts are facetted and a few striated but there are none of an indubitable glacial origin. The matrix is a yellow-green, medium-grained, friable, moderately sorted and subangular sandstone. This section of possible glacial material is underlain and interbedded with medium-grained, kaolinitic and calcareous sandstone, and underlain by red, fine-grained, laminated limestone.

MFX1 (Figure 26) is a section through the conglomerate horizon and a considerable thickness of concealed rock, into the limestone sequence which occurs near the top of the Boord Formation. The calcilutite which crops out near the top of the Boord Formation ranges in colour from blue, grey and dark grey to yellow and pink and is commonly foetid and laminated or thin-bedded and in some places undulate bedded. These horizons are known to contain stromatolites of algal origin. Silicification has produced nodules, laminae and irregular bodies of chert (Figure 23). Where the limestone is oolitic the oolites have retained their shape as rounded bodies of chert with interstitial spaces filled with radiating spherulitic silica. The top limestone ridge at the Boord Ridges is a pisolitic, blue-grey calcarenite (Figure 21).

At M47 the Boord Formation is underlain by at least 360 feet of the Carnegie Formation and the basal breccia, sandstone and tillite sequence appears to be missing.

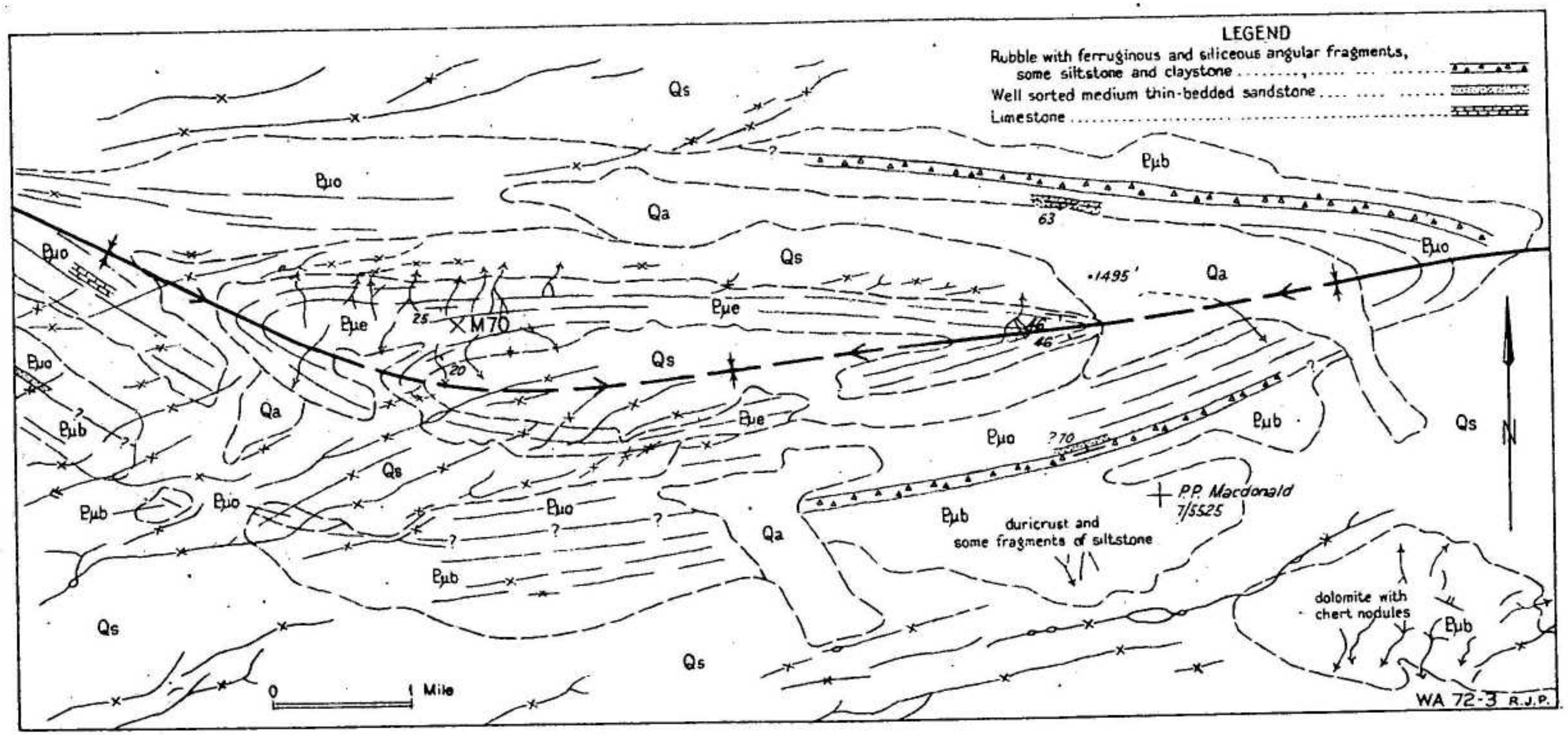


Figure 25. Upper Proterozoic formations west of Gordon Hills. Bonython Dolomite (Pub); Boord Formation (Puo); Ellis Sandstone (Pue).

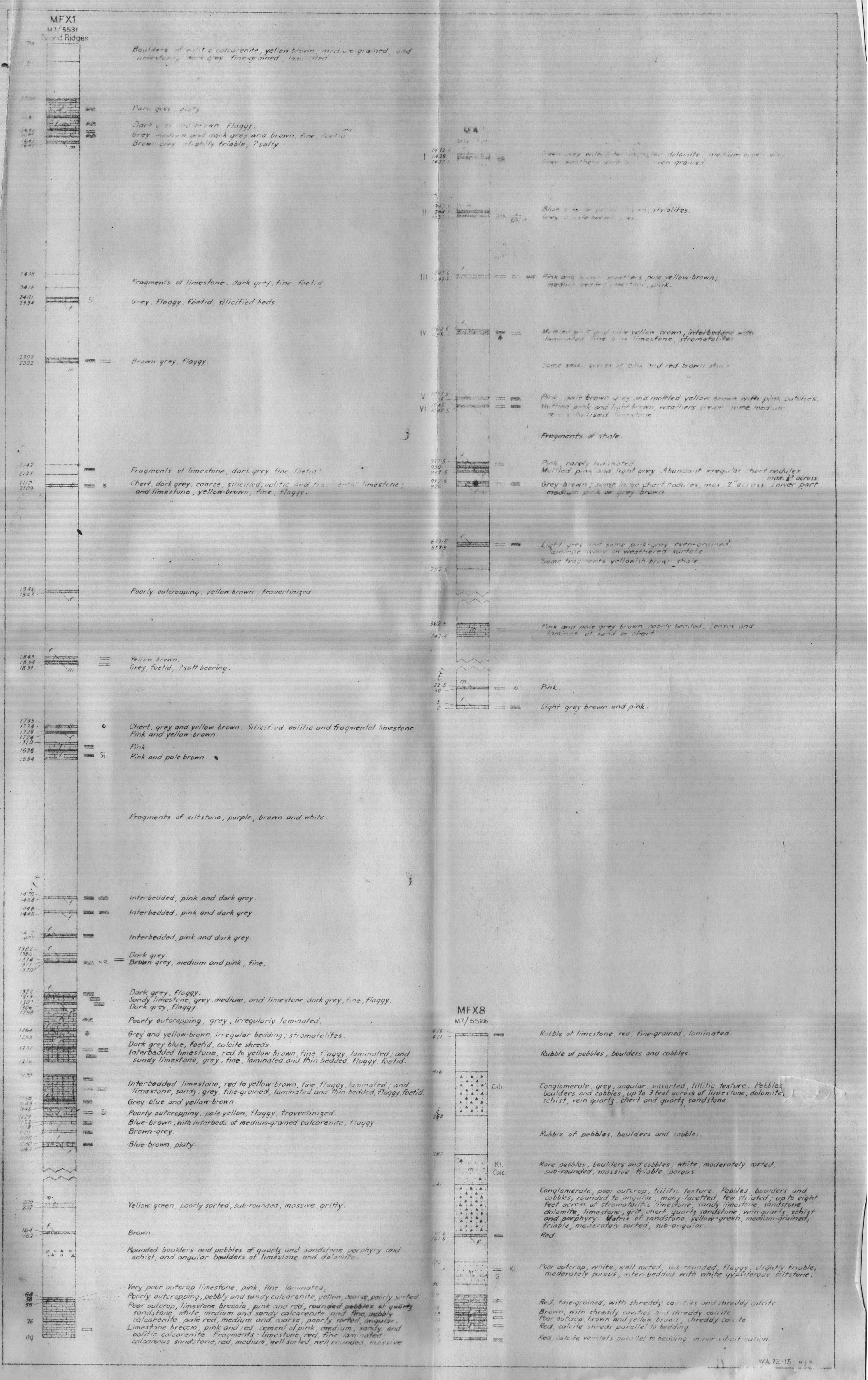


Figure 26. Sections of the Boord Formation.

Stylolytes were found in one medium-grained limestone in the section. In some places where calcarenite has been deposited on calcilutite there has been contemporaneous erosion with small angular pieces of calcilutite in the overlying beds.

The breccia at the base of the Boord Formation may represent an intraformational breccia and a horizon where some erosion of the Bonython Dolomite took place. There is no evidence to suggest an angular discordance between the two formations.

The evidence of interfingering of the Boord Formation and the Carnegie Formation is present south-west of Lake Macdonald at M47 (Figure 27). Outcrops are poor but the beds of stromatolitic limestone can be traced laterally into beds of friable sandstone and siltstone of the Carnegie Formation.

The Boord Formation is tentatively placed in the Upper Proterozoic.

Carnegie Formation

The name Carnegie Formation is used for the sequence of sandstone, quartz greywacke and siltstone which rests conformably on the Bonython Dolomite, conformably underlies the Ellis Sandstone and interfingers with the Boord Formation. The name is taken from the Carnegie Range where an incomplete section of 4100 feet was measured. Incomplete sections were measured at RFX5 (4123 feet), MFX5 (2052 feet), MFX7 (656 feet), M45 (366 feet) and M49 feet) (Figure 29 a, b, c and d).

Most of the outcrop is poor and it forms low strike ridges and low rubble covered hills. In several places the Carnegie Formation underlies claypans on which lines of quartz greywacke and sandstone rubble indicate the strike of the beds (Figure 28). Outcrops occur between the Turner Hills and Bonython Range, Mu Hills, and from the Maurice Hills south to the Carnegie Range. The southernmost outcrop is a low ridge east of the Ellis Range.

The quartz greywacke and sandstone is typically purple-brown, thin and medium-bedded, moderately sorted, subrounded. Clay pellets, ripple marking and cross-bedding are common throughout the section. Average grain size ranges from 0.1mm. to 0.5mm. (very fine to medium). The arenites contain

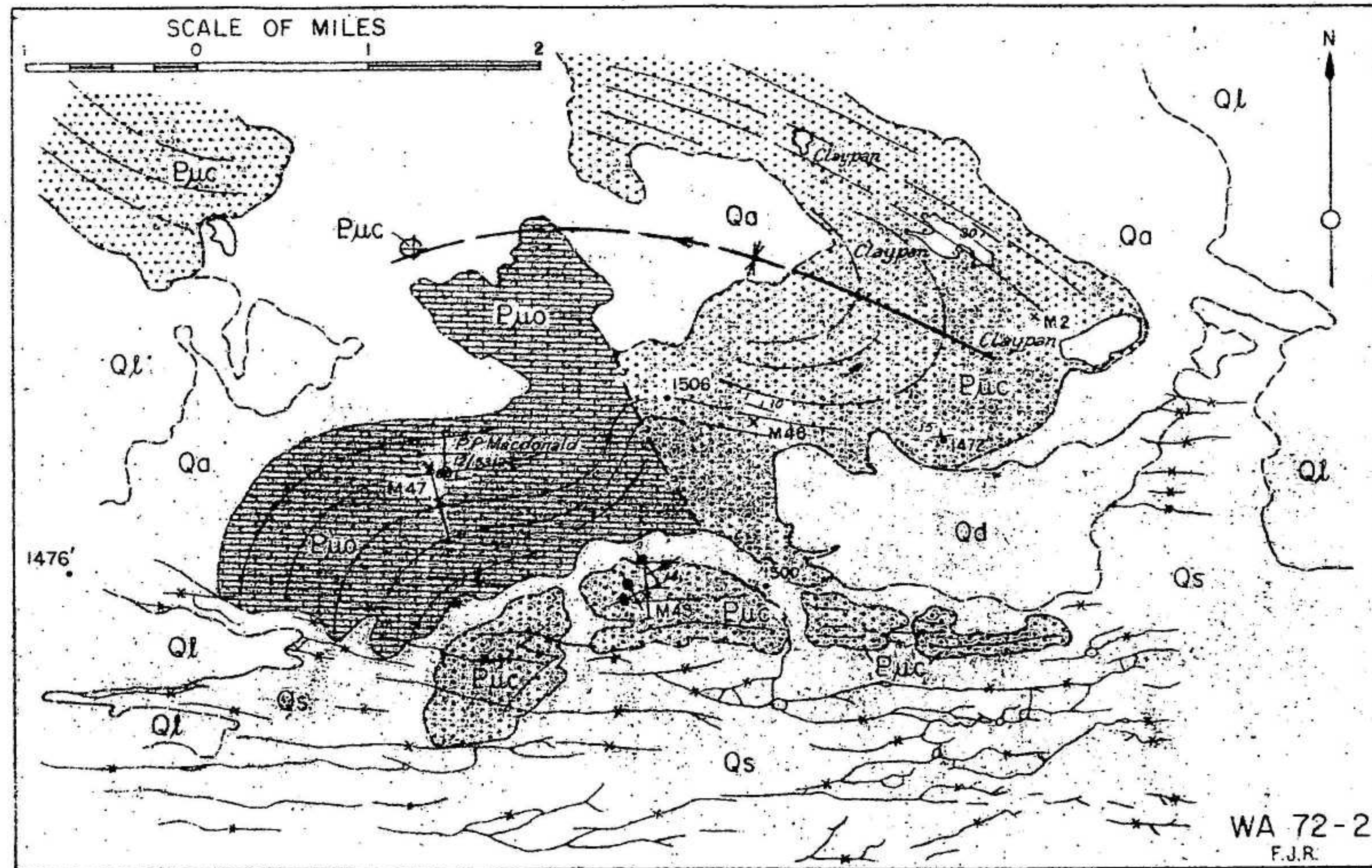


Figure 27. Transition of Boord Formation (Puo) and Carnegie Formation (Puc) 9 miles west of the Bonython Range.

Figure 28. Carnegie Formation in claypan, B91, 10 miles north-north-west of Plover Hill.

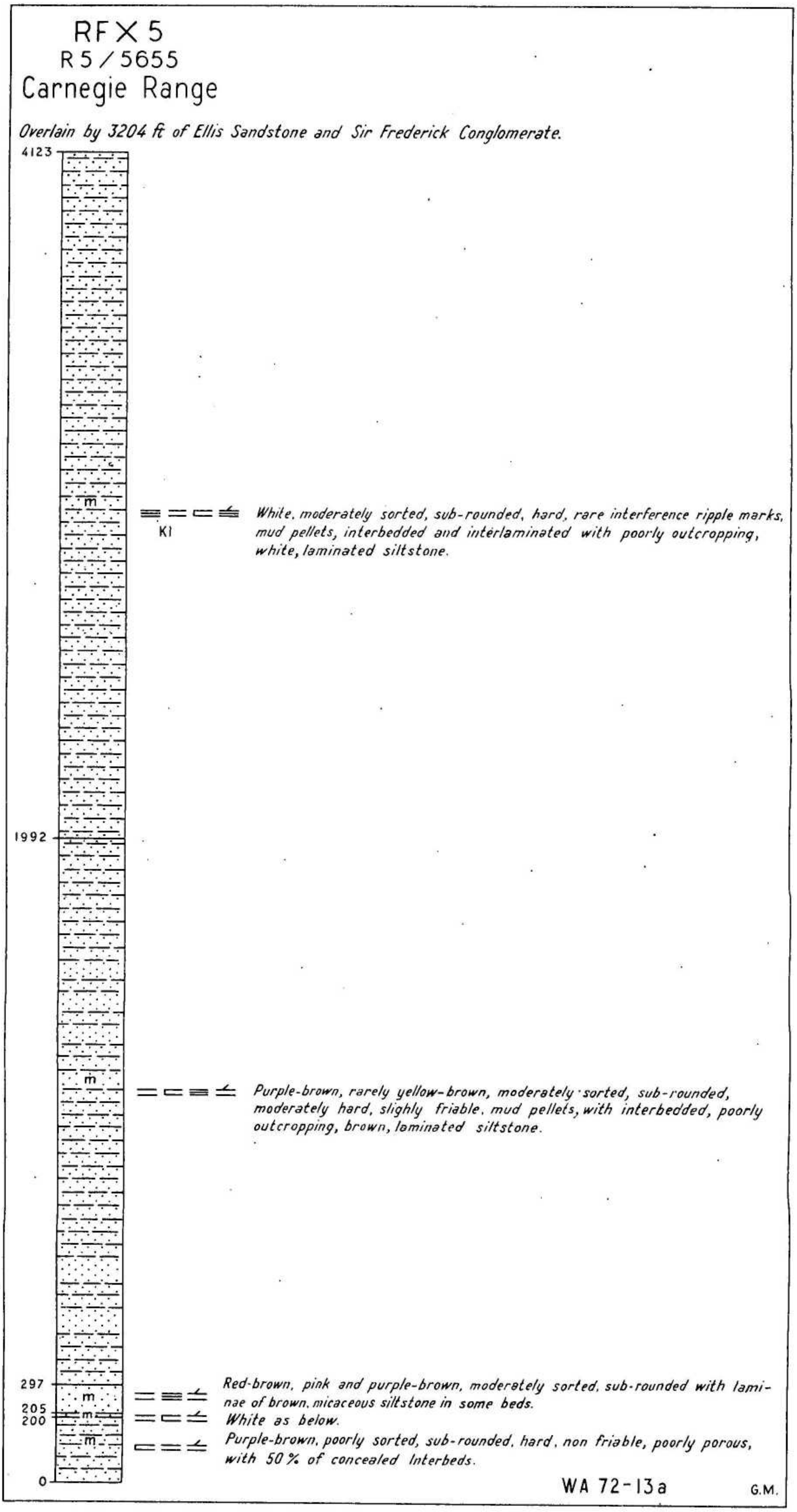


Figure 29. (a) Section of the Carnegie Formation; Carnegie Range.

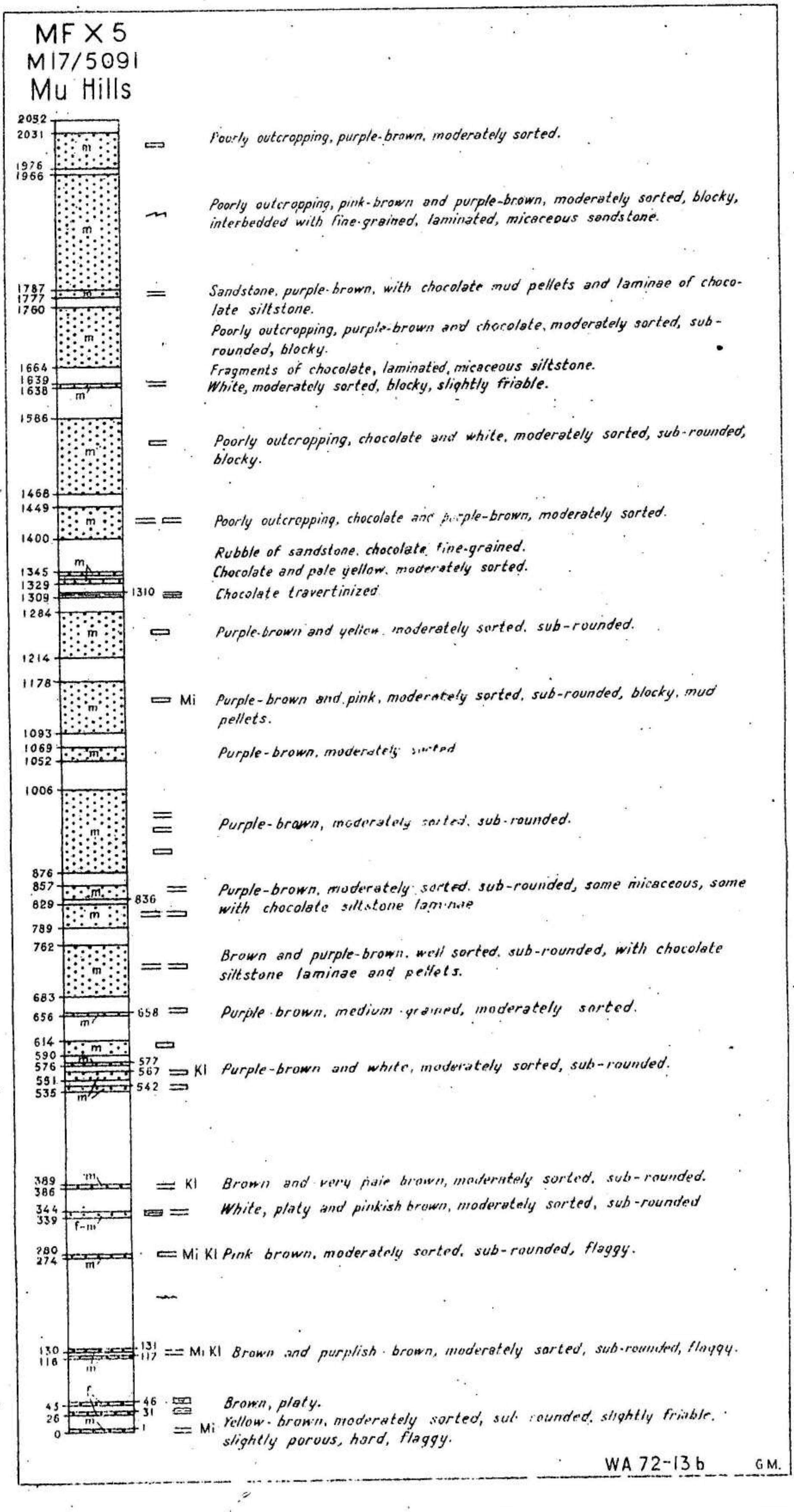


Figure 29. (b) Section of the Carnegie Formation, Mu Hills.

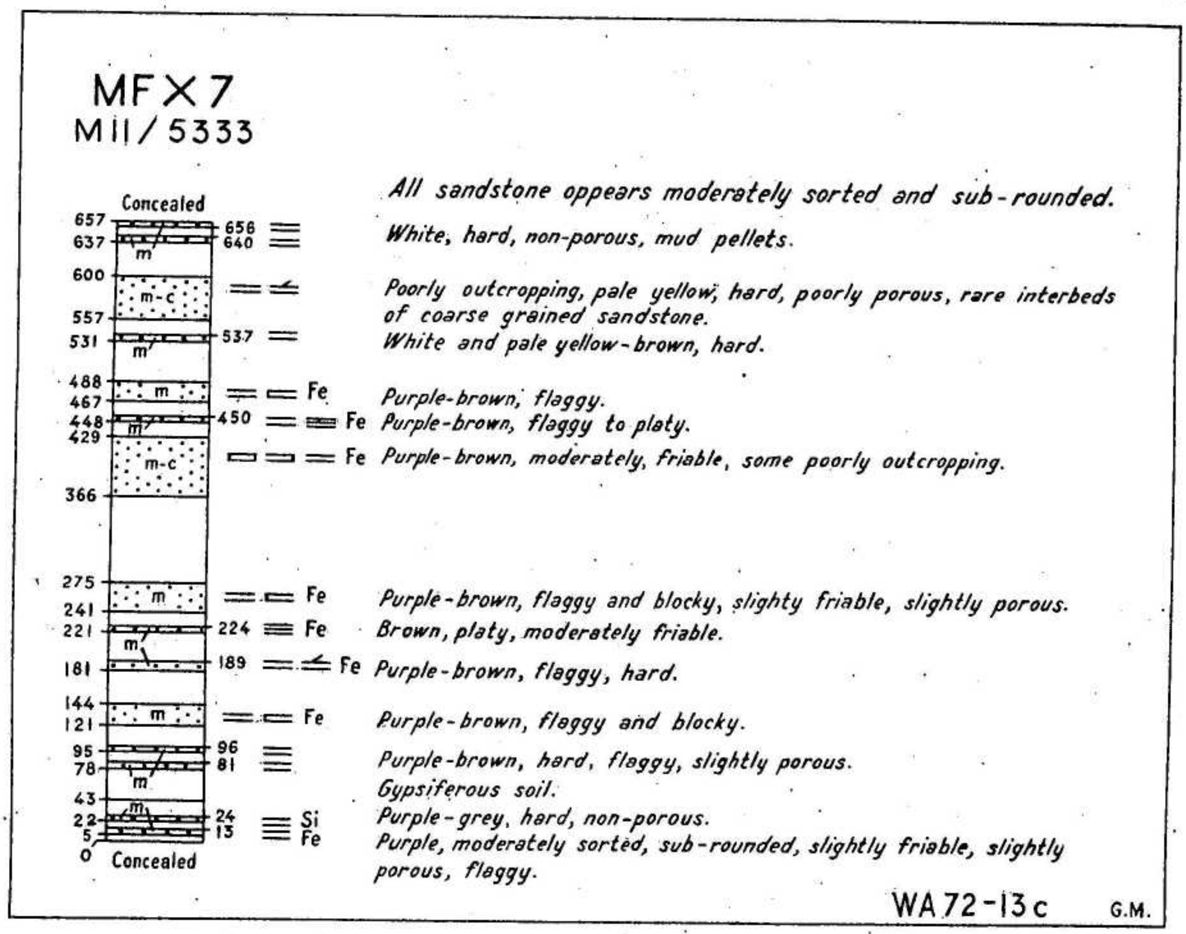


Figure 29. (c) Section of the Carnegie Formation, M11/5333.

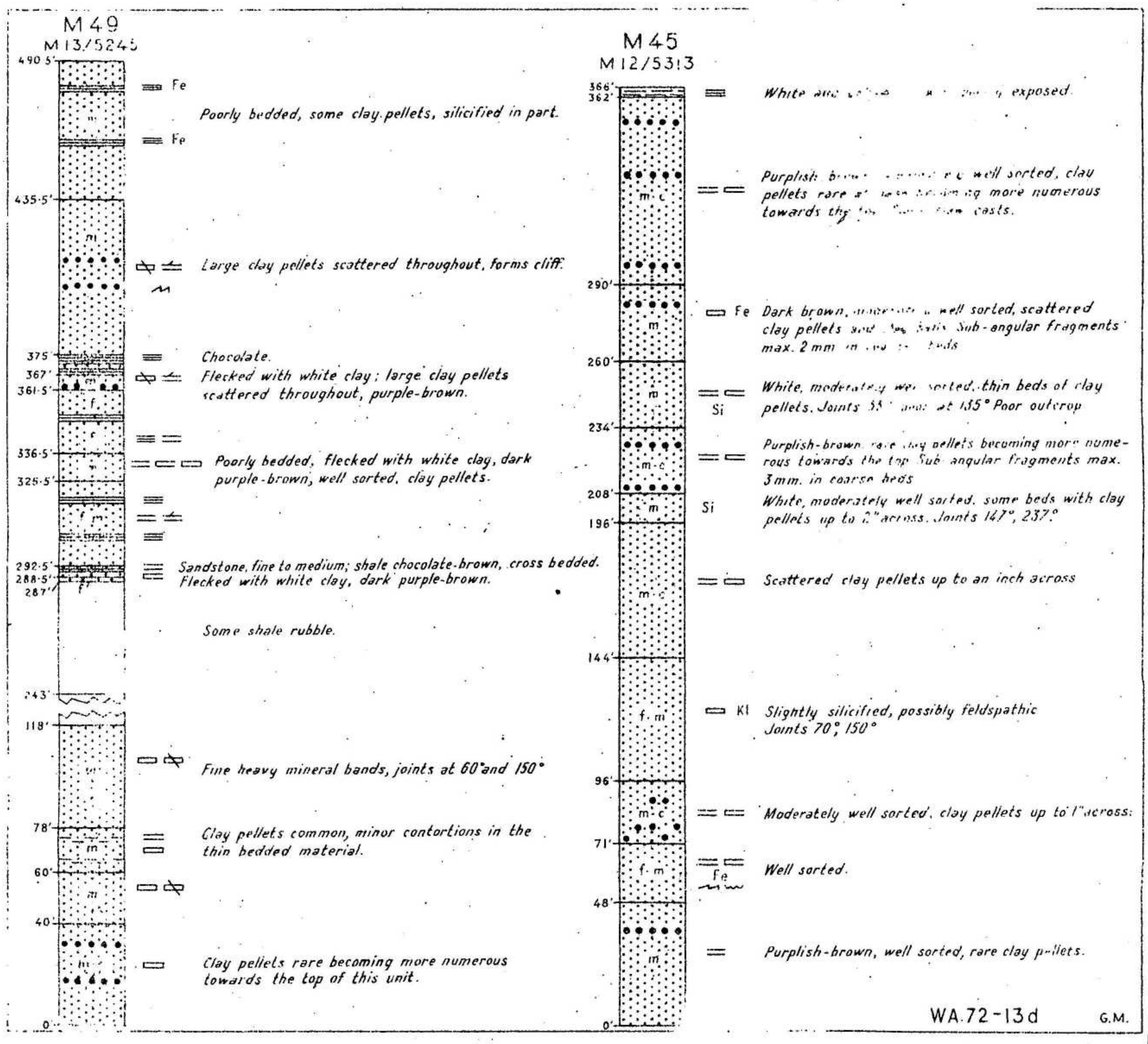


Figure 29. (d) – Sections of the Carnegie Formation.

from less than 2% up to 20% rock fragments of quartzite, chert and fine sericitic quartzite. A very fine arenite from M73 has about 50% subrounded quartz and 50% granular calcite together with rare quartzite and muscovite grains. A medium-grained arenite from M63 is also calcareous and contains 10% rock fragments (chert, quartzite), and about 70% quartz grains in a matrix of calcite. Most of the sediments contain very little matrix. Rare rock fragments (less than 5mm. across) and some muscovite flakes are present in some of the coarser, current-bedded, quartz greywacke.

The siltstone is typically purple-brown or chocolate-brown, laminated and finely micaceous. Gypsum occurs in the siltstone in many places.

North of the Turner Hills, near M63 the sediments are slightly different to the normal types and consist of poorly bedded sandstone, laminated siltstone, fine-grained laminated siliceous sandstone and a few thin beds of fine conglomerate.

Near Plover Hill and in the Carnegie Range the top of the Carnegie Formation is composed of interbedded white sandstone and siltstone. This lithology is not typical of the formation further north. Section RFX5 (Figure 29a) illustrates the lithologies in the Carnegie Range.

Cross-bedding sets in the Carnegie Range show current direction was from the west or west-south-west.

No organic remains have been found in the Carnegie Formation and its age is regarded as probably Upper Proterozoic.

Ellis Sandstone

The name Ellis Sandstone is used for a sequence of kaolinitic sandstone and pebbly sandstone with subordinate calcareous sandstone and siltstone which lies conformably above the Carnegie Formation or Boord Formation, is interfingered with the Sir Frederick Conglomerate and is conformably overlain by the Maurice Formation. The relationship between the Ellis Sandstone and the Boord Formation is shown in Figures 24 and 25 and the relationship between the Ellis Sandstone and Sir Frederick Conglomerate is shown in Figure 34.

Sections were measured at RFX5 in the Carnegie Range, at M91 in the Gordon Hills and at M90 approximately 12 miles west-south-west of the Gordon Hills, and are shown diagrammatically in Figure 31 a and b. The maximum thickness measured was 1995 feet in the Carnegie Range (Figure 34).

Figure 30. Heavy mineral laminae in Ellis Sandstone, Ellis Range.

No fossils were found and the unit is tentatively placed in the Upper Proterozoic.

The sandstone crops out on the northern half of the Rawlinson area and over most of the Macdonald area as low hills and long sinuous strike ridges. The most northerly outcrop is in the Gordon Hills. The main outcrops are the Turner Hills, the Carnegie Range, the Ellis Range, the Gordon Hills, the Compton Hills and Plover Hill.

The dominant lithology is a uniform white, laminated, and thin bedded, cross-laminated and cross-bedded, medium-grained, moderately to well sorted sandstone with clay pellets scattered irregularly throughout.

In thin section the Ellis Sandstone is a fine to medium-grained, clean, moderately to well sorted, well rounded quartz sandstone. The average grain size varies between 0.14 mm. and 0.28 mm. Chert and quartzite make up between 6% and 15% of the rock. Tourmaline occurs as rare rounded grains. Authigenic growth of the quartz grains has resulted in sutured contacts and tends to disguise the rounded nature of the quartz grains.

Cross-bedding is a constant feature of this formation; the sets have an average thickness of about 18 inches. Interpretation of the cross beds in the Carnegie Range suggests currents from the west and south-west. Current lineation is a prominent feature on bedding planes in many exposures of the Ellis Sandstone.

Current and wave ripple marks, current crescents, slump structures and scour and fill structures were seen in various outcrops of the Ellis Sandstone but none of these features is characteristic of the formation. Heavy mineral concentrations (mostly hematite) in thin laminae were seen in several places (Figure 30).

Although white sandstone is most common, minor pale brown, purple-brown and red-brown sandstone was found at some localities. Approximately 30 feet of light grey, massive, calcareous sandstone occurs in the sequence at Plover Hill and in the Turner Hills, but does not appear in any of the measures sections.

Pebbles scattered irregularly through the Ellis Sandstone are a common feature of the outcrops on the southern half of the Macdonald area and of those on the Rawlinson area. North of the Sir Frederick Range and at the western end of the

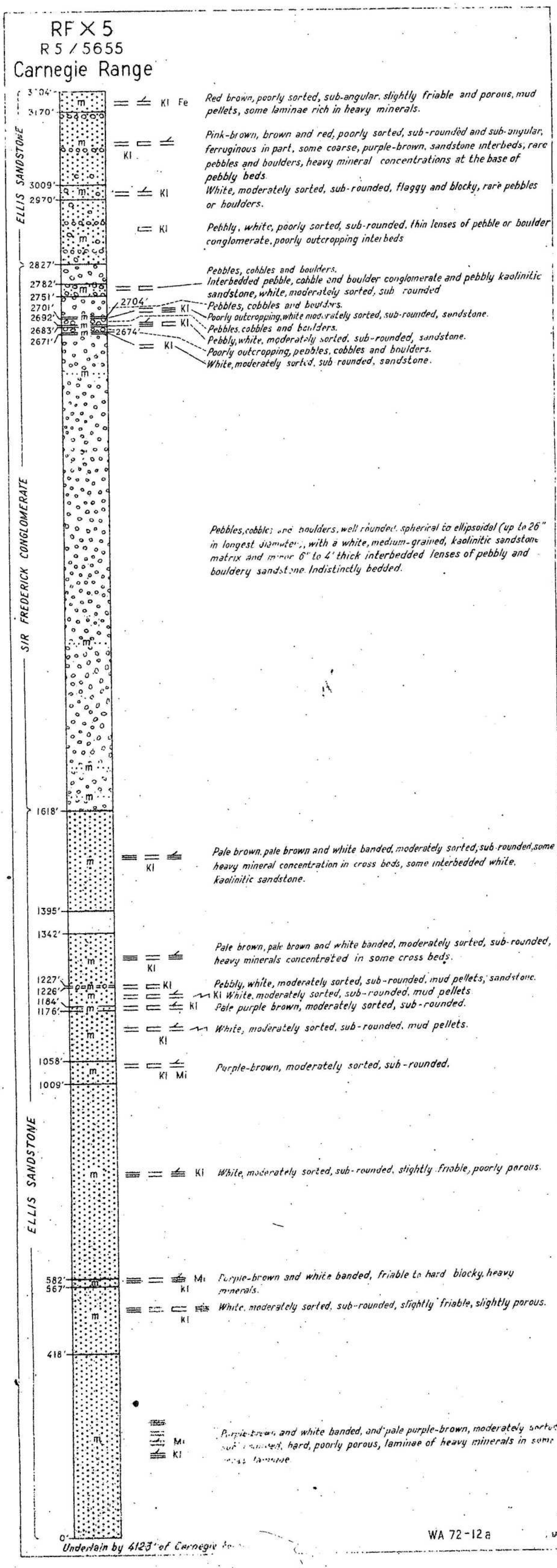


Figure 31 (c). Section of the Ellis Sandstone and Sir Frederick Conglomerate.

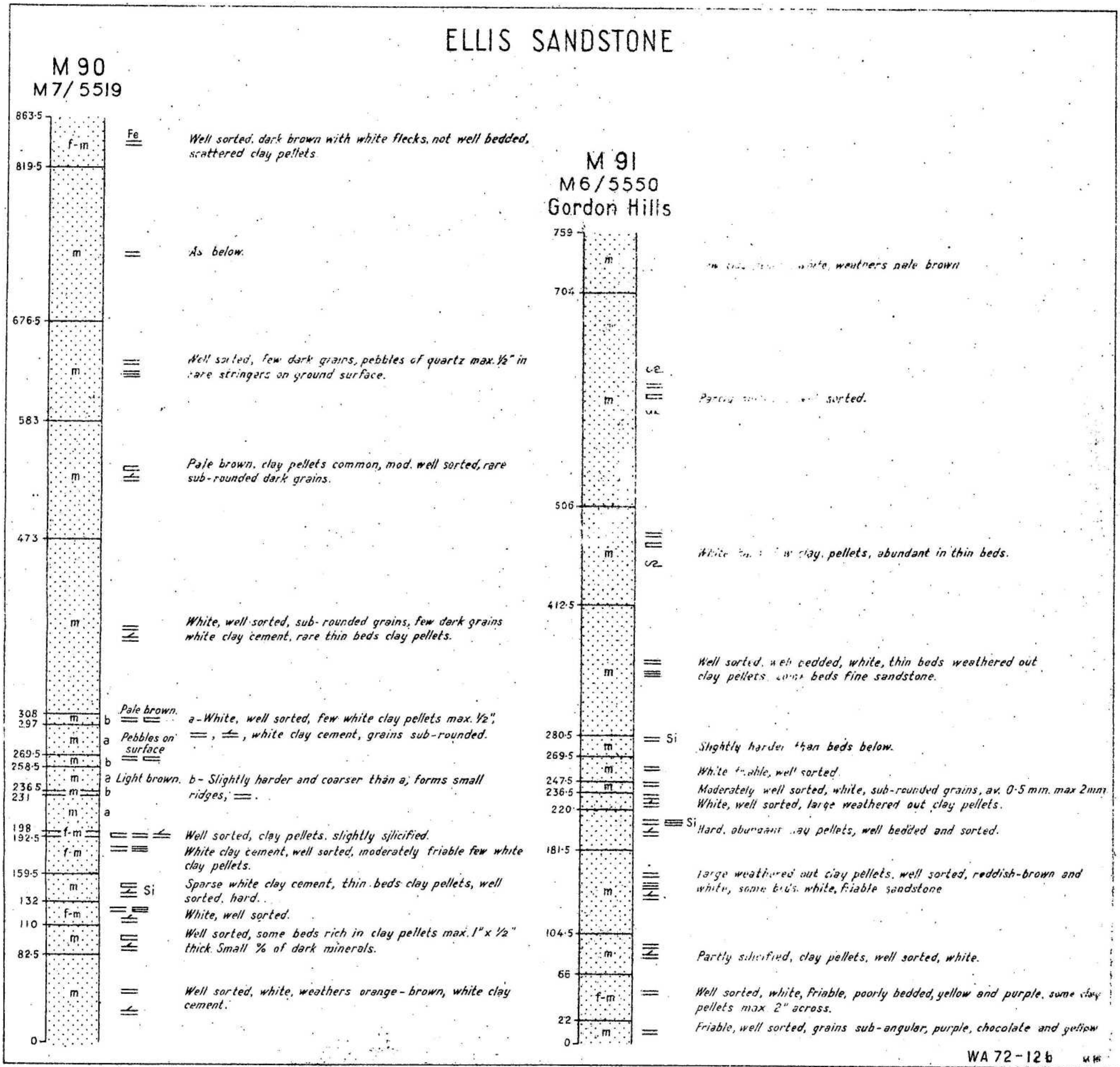


Figure 31 (b). Sections of the Ellis Sandstone.

Carnegie Range the pebbly sandstone gives way to conglomerate which has been mapped as the Sir Frederick Conglomerate.

Siltstone is not common in the Ellis Sandstone and where it does occur, it is invariably as thin beds of laminated, micaceous siltstone.

Sir Frederick Conglomerate

The name Sir Frederick Conglomerate is used for a sequence of pebble, cobble and boulder conglomerate with a kaolinitic sandstone matrix and thin beds and lenses of sandstone and pebbly sandstone.

The formation is conformably overlain by the Maurice Formation and conformably underlain by the Carnegie Formation; it lenses laterally into the Ellis Sandstone (Figure 34).

The Sir Frederick Conglomerate crops out in the south-eastern corner of the Macdonald area in the Sir Frederick Range (Figure 32) and Mu Hills and in the northern part of the Rawlinson area in the Carnegie Range, Gillespie Hills, Searle Hills and as low mounds to the north of the Robert Range.

The only section through this formation was measured in the Carnegie Range at RFX5 (Figure 31). Possibly the greatest exposed thickness of conglomerate is in the Sir Frederick Range but lack of dip information prevented a section being measured. North of the Sir Frederick Range the massive conglomerate interfingers with, and grades into the sandstone and pebbly sandstone of the laterally equivalent Ellis Sandstone, and here the combined thickness of these two units is estimated (by photo interpretation) to be at least 7,000 feet. Along the strike in the Mu Hills, the Sir Frederick Conglomerate lies immediately above the Carnegie Formation and no Ellis Sandstone is exposed.

The dominant lithology is a moderately to poorly sorted conglomerate with subrounded to well rounded, ellipsoidal pebbles, cobbles and boulders set in a white sandstone matrix (Figure 33). Overall the rock is very friable and dips are difficult to obtain owing to the rubble lying at the surface.

The boulders measure up to 42 inches in maximum diameter and are composed dominantly of silicified sandstone and quartzite with smaller quanities of vein quartz and quartz-mica schist. All these rock types are represented in the Lower Proterozoic units to the south.

Figure 32. Sir Frederick Conglomerate, from summit of the Sir Frederick Range.

Figure 33. Sir Frederick Conglomerate, Sir Frederick Range.

The coarsest conglomerate crops out in the Gillespie Hills where the boulders average approximately 6 inches in diameter. Some faceted boulders were seen but they are not common.

Maurice Formation

The name Maurice Formation is used for the sequence of sandstone, quartz greywacke, fine micaceous sandstone and micaceous siltstone which conformably overlies the Ellis Sandstone and the Sir Frederick Conglomerate. It is the youngest of the possible Upper Proterozoic units in the Rawlinson-Macdonald area. The top of the formation is eroded.

The name is taken from the Maurice Hills.

The thickest measured section is 757 feet at M57 (Figure 35) but photo-interpreted thicknesses of the formation are of the order of 5,000 to 6,000 feet near the Maurice Hills.

The Maurice Formation crops out in mesas, ranges and hills on the northern half of the Rawlinson area; further north on the Macdonald area outcrops are poor with the exception of a few low ridges. The quartz greywacke and the sandstone is more resistent to erosion than the micaceous sandstone and siltstone.

A complete section is not eeposed but a gradation of rock types occurs in the outcrops from north to south. The northern outcrops are predominantly even-grained quartz sandstone and siltstone. The southern outcrops are predominantly cross-stratified quartz greywacke with minor greywacke and micaceous siltstone.

The Maurice Hills contain quartz sandstone interbedded with micaceous siltstone. The sandstone is brown, medium-grained, poorly bedded, thick bedded, moderately sorted, contains thin beds rich in clay pellets and in places is cross-bedded and has wave and current ripple marks. This sandstone together with some fine sandstone and minor siltstone beds occurs near the middle of the formation and is responsible for the more resistant topographic features. The arcuate ridges at Maurice Hills which form the nose of a north plunging syncline, continue intermittently to the north to a point about 10 miles west of the Turner Hills. A possible equivalent resistant sandstone ridge is present in the Maurice Formation at R99 north-west of Plover Hill. At this point the sandstone is siliceous, moderately

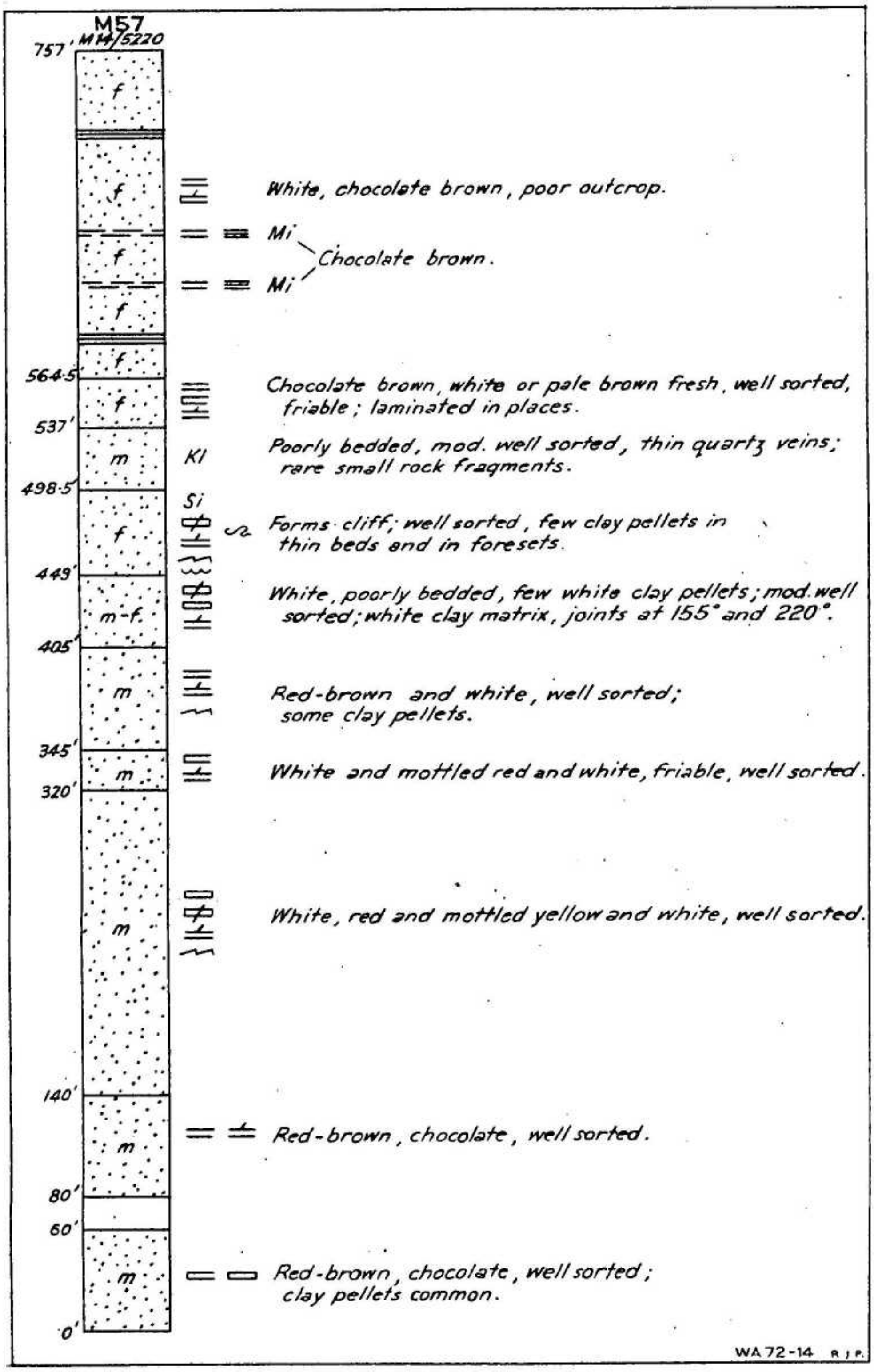


Figure 35. Section in the Maurice Formation.

well sorted, red-brown with some ripple marks. The sandstone is interbedded with chocolate siltstone and overlies blue-grey, micaceous, friable, calcareous sandstone. No other outcrops of calcareous sandstone were seen but a large area of travertine between M56 and M57 north of the Maurice Hills is possibly underlain by soft calcareous sandstone. Some heavy mineral concentrations in thin beds and laminae were seen in the sandstone at some localities.

The known youngest beds of the formation were seen at M56 and consist of thin bedded and laminated fine sandstone interbedded with chocolate siltstone and minor shale. The sandstone is finely micaceous in a few beds, well-bedded and sorted and has thin beds rich in clay pellets.

The lowermost beds of the Maurice Formation were seen 3 miles east of the Maurice Hills where they conformably overlie the Ellis Sandstone north of the Sheridan Hills. The sediments are well sorted, medium to fine, reddish-brown and white sandstone, well sorted, medium to thin bedded, poorly bedded, cross-bedded, finely micaceous with some clay pellets up to ½ inch across.

The basal beds of the Maurice Formation were also seen 8 miles north of Plover Hill. They are finely micaceous, yellow and red-brown, thin bedded and laminated sandstone and grade into the underlying even-grained Ellis Sandstone which at this point contains some thin beds of coarse sandstone.

In some places rare rounded pebbles occur in the quartz sandstone but they are not a feature of the Maurice Formation.

In the Carnegie Range and in outcrops further south, the sediments of the Maurice Formation become coarser grained, cross-bedding becomes so pronounced that bedding is almost impossible to distinguish, and rock fragments with clay pellets and a clay cement compose the bulk of the sediments.

In the southernmost outcrops at Wallace Hills the dominant rock types are quartz greywacke with minor greywacke and minor interbedded micaceous dark chocolate-brown, laminated siltstone. The quartz greywacke is usually medium to coarse, cross-bedded, poorly sorted and bedded, contains abundant purplish-brown and rarely white irregular clay and siltstone fragments up to 3 inches across, white kaolinitic flecks, heavy mineral concentrations in thin beds and laminae, and rare subangular and subrounded pebbles.

Cross-bedding in the Maurice Formation at Wallace Hills suggests derivation of the sediments mostly from the south-east and south but some are equivocal.

Specimens of the quartz greywacke from the Maurice Formation are made up of subangular quartz and rock fragments (fine quartz-sericite schist, quartzite and chert) which together compose up to 20% of the sediment. There are rare large mica flakes. The matrix is made up of fine sericite, limonite, and kaolin. A specimen from R100 contains up to 20% kaolinite as tabular cleaved plates. They may be a product of weathered feldspar grains.

The sediments were probably derived from source areas in the south and south-east with comparatively rapid deposition of coarser sediment in the near shore areas to the south near the Wallace Hills, with better sorted sandstone deposited further north.

ORDOVICIAN

A small outlier of fossiliferous calcarenite crops out about seven miles north-west of the summit of the Sir Frederick Range. The calcarenite contains fragmentary pelecypods, gastropods, orthid and strophomenoid brachiopods, asaphid trilobites and echinoderm ossicles. Conodonts extracted from the limestone are dated by R.A. Mactavish (pers. comm.) as undoubtedly Ordovician.

The calcarenite is speckled pink and white. The fragmentary nature of the organic remains indicates reworking of the sediment. It crops out in two small mounds that are almost obscured by sand and travertine (M71, M77, Figure 36). At M71 the calcarenite appears to be overlain by several feet of white, medium, well sorted sandstone, but no contacts are exposed. Some of this sandstone is red-brown due to iron staining. Fine, medium, well sorted, and well rounded sandstone crops out nearby.

The poorly exposed bedding planes in the calcarenite seem to dip at 5° to 10° to the east. The Bonython Dolomite and Carnegie Formation, which crop out within 50 feet of the Ordovician rocks, are steeply dipping and trend beneath them. Therefore, although no contacts were seen, it is probable that the Ordovician rocks unconformably overlie the Bonython Dolomite and the Carnegie Formation. Figure 36 is a map of

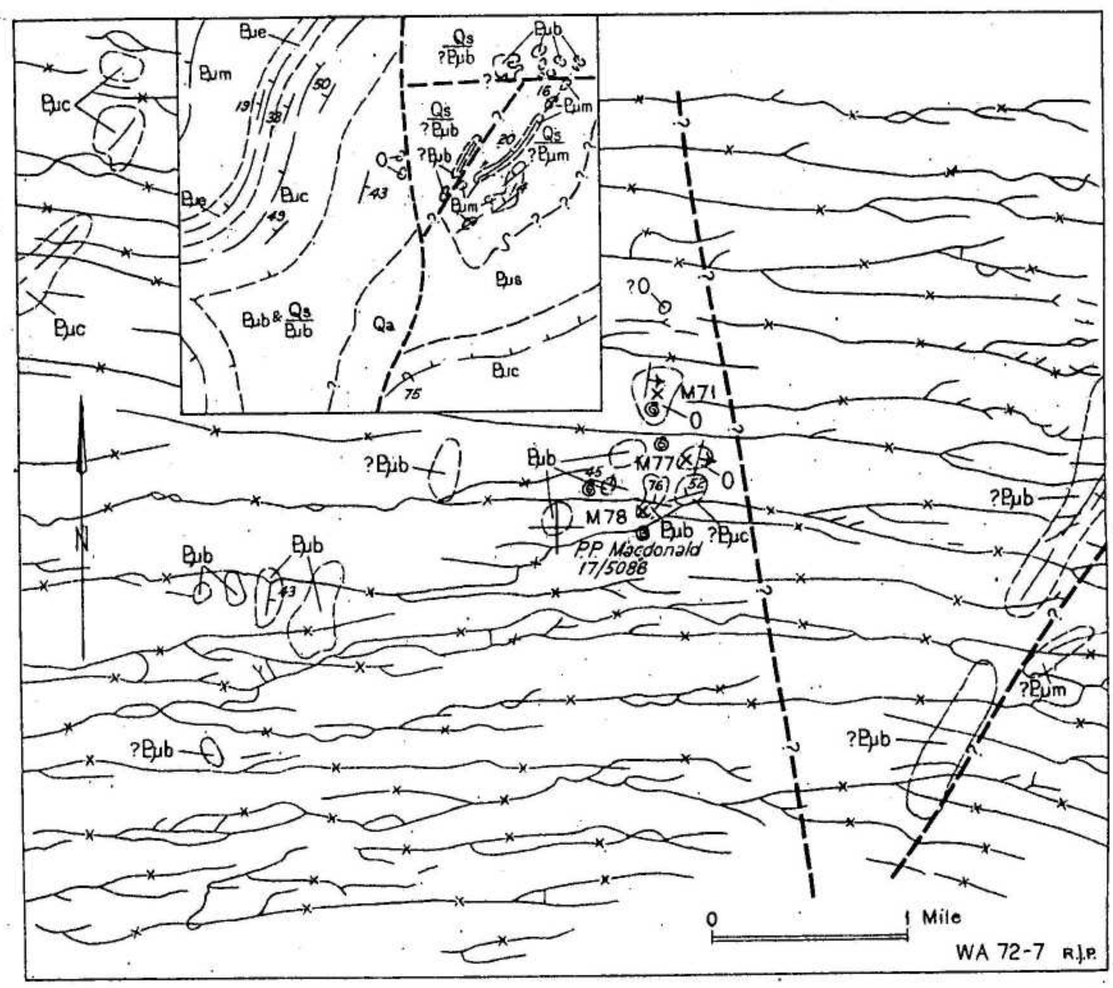


Figure 36. Outcrops of Ordovician rocks (O) 7 miles north-west of the Sir Frederick Range. Bonython Dolomite, Ᵽub; Carnegie Formation, Ᵽuc; Sir Frederick Conglomerate, Ᵽus; Ellis Sandstone, Ᵽue; and Maurice Formation, Ᵽum. Inset shows regional geology.

the area and shows the relationships of the Ordovician rocks to the older sediments. A major north-north-west trending fault is inferred near the Ordovician outcrops but its position is uncertain.

The closest known outcrops of fossiliferous Ordovician rock to this locality are about 150 miles to the east in the George Gill Range and near the Cleland Hills.

PERMIAN

Buck Formation

The Buck Formation is defined as a sequence of quartz sandstone, tillitic sandstone, conglomerate and siltstone. The unit is intended to include the terrestrial products of a continental glaciation which probably took place during the Permian period. The name is taken from the Buck Hills on the north-east corner of the Macdonald area.

The Buck Formation crops out in the Buck Hills (Figure 37) and near the Dover Range (Figure 16) as isolated buttes. One hundred and thirty seven feet of section was measured at M28 in the Dover Range. Sections of Buck Formation are shown in Figure 40. On the western half of the Macdonald and Rawlinson areas the unit crops out in low rounded hills and rarely in low mesas surrounded by sand plain. Exposure in these hills is often very poor due to a capping of duricrust. Many of the outcrops, particularly along the western edge of the area, have not been visited. Outcrops of conglomeratic and coarse sandstone, siltstone, and conglomerate near the Mu Hills are tentatively placed in the Buck Formation.

Each rock type occurs as a lens and the relative position of the sandstone, siltstone or conglomerate varies in each outcrop.

The sandstone is typically white or yellow, coarse-grained, current bedded and contains angular fragments and erratics up to 3 feet across.

The conglomerate contains rounded, flattened and striated boulders and cobbles mostly of quartzite and silicified quartz sandstone. In places granite, schist, vein quartz, acid porphyry and black and white banded chert make up a large percentage of the phenoclasts.

The siltstone is usually white, poorly sorted and contains erratics up to 2 feet across. Where the siltstone is overlain by sandstone, load casts are a common feature.

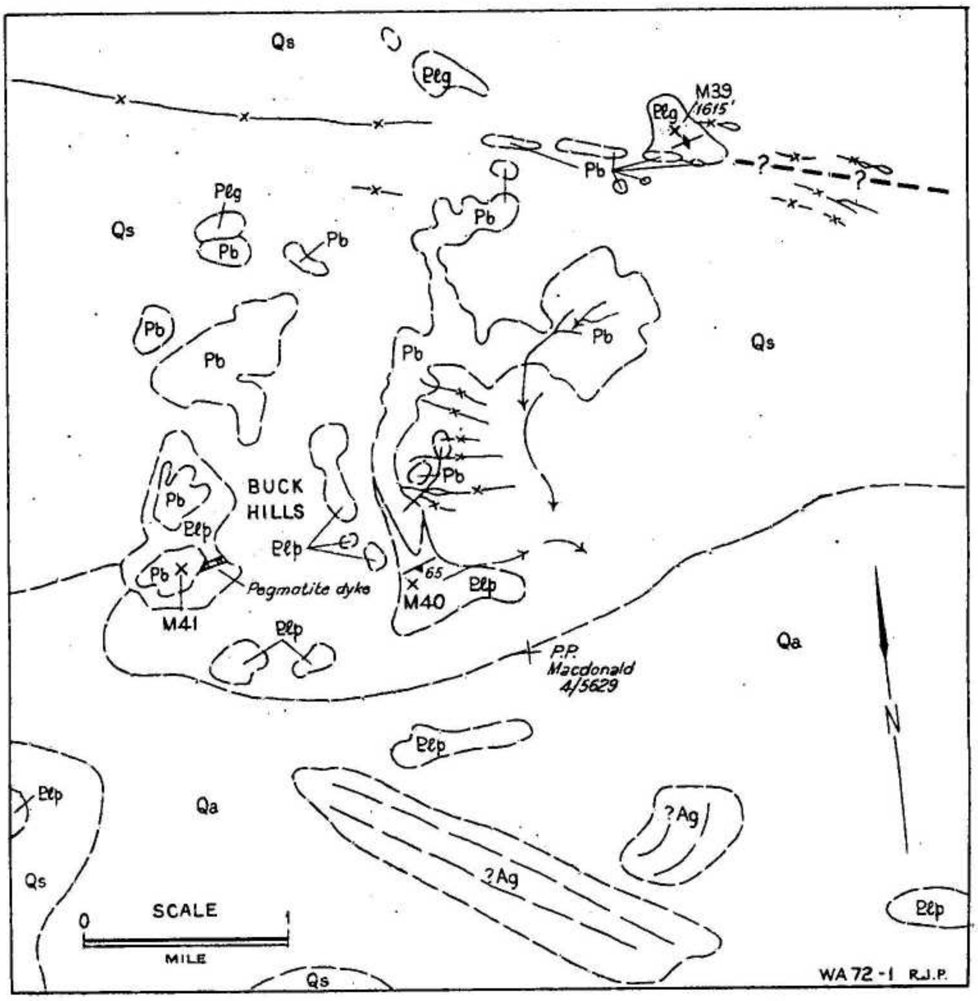


Figure 37. Permian Buck Formation (Pb) unconformably overlying Lower Proterozoic porphyry (Plp) at Buck Hills. ?Archaean gneiss and quartzite, (Ag.)

Figure 38. Permian Buck Formation unconformably on Lower Proterozoic porphyry, M41, Buck Hills.

Figure 39. Possible glacial pavement. Permian Buck Formation on Upper Proterozoic Dover Sandstone, 8 miles east of the Dover Range.

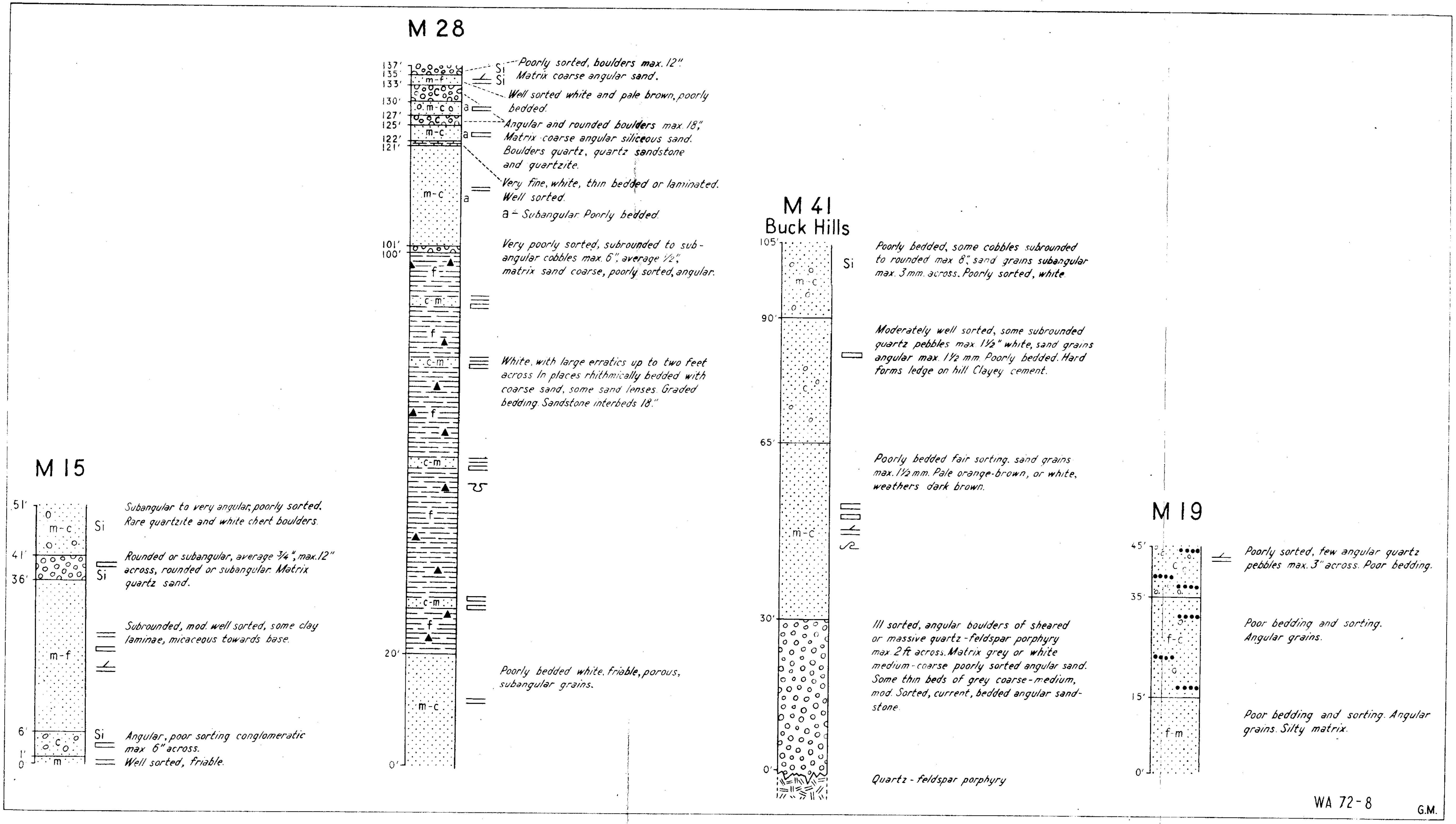


Figure 40. Sections in the Permian Buck Formation.

Five miles west of the Dover Range the sediments are contorted probably as a result of ice action.

The Buck Formation unconformably overlies: the Maurice Formation south-east of Compton Hills, and in the Maurice Hills; the Ellis Sandstone in the Searle Hills; the Bonython Dolomite west of the Dover Range; quartz-feldspar porphyry and granite at the Buck Hills and Dover Range; and stromatolitic dolomite at R111 (Boord Formation or Bonython Dolomite). The Buck Formation has been tentatively identified along a fault scarp in the Mu Hills where it abuts against the Ellis Sandstone, Sir Frederick Conglomerate and Carnegie Formation.

The top of the Buck Formation has been eroded.

The surface of the unconformity proves there was some relief before deposition of the unit. In the Dover Range the Buck Formation was deposited next to steep cliffs which now have a relief of about 150 feet above the base of the unit. In the Buck Hills the surface of the unconformity is irregular and there is 15 to 20 feet difference in elevation in the small mesa at M41 (Figure 38). In mesas about $\frac{1}{4}$ mile away the unconformity is about 100 feet lower in elevation. This relief was responsible for local contribution of debris.

A possible glacial pavement where pebble beds rest on Dover Sandstone is present west of the Buck Hills (Figure 39). The faint glacial striae trend nearly north-south but the direction in which the ice moved could not be ascertained.

The elongated outcrops of Buck Formation on the north side of Buck Hills lie on a fault zone (Figure 41). In these outcrops the unit contains numerous quartz stringers and veins which have made the unit more resistant to erosion.

The presence of facetted and striated pebbles, boulders and cobbles, large angular erratics both in the sandstone and siltstone, and a possible glacial pavement 7 miles west of Buck Hills suggest that the formation has a glacial origin. The closest outcrops of similar glacial sediments are those of the Canning Basin to the west. The marine fluvio-glacial Grant Formation of Sakmarian age occurs in the deeper parts of the Canning Basin and at its margin. The Buck Formation may have been part of a blanket of terrestrial and fluvio

Figure 41. Permian Luck Formation, Luck Hills. Formation is silicified on fault zone to produce ridge on right and foreground.

glacial deposits which rimmed the Sakmarian sea. No fossils have been found in the Buck Formation but on the foregoing evidence it is tentatively dated as Permian.

TERTIARY

Pisolitic Ironstone and Siliceous Billy.

Ironstone and billy are most abundant as a capping on the Buck Formation. Minor outcrops of ironstone occur as low mounds between sand dunes and "grey billy" crops out as isolated boulders throughout the area. Neither of these deposits was common and nowhere is a full laterite profile developed.

Siliceous chert breccia and rubble, with some rounded boulders, overlies the Bonython Dolomite on the south side of the Bonython Range. This deposit may be part of the basal beds of the Boord Formation, which is considered to represent a disconformity in the Upper Proterozoic sequence.

QUATERNARY

Quaternary deposits cover the major part of the Rawlinson and Macdonald areas. These deposits have been subdivided into the following units.

Conglomerate:

Dissected remnants of flat lying, poorly sorted, ferruginized and silicified conglomerate crop out along the southern margin of the Rawlinson Range. The maximum exposed thickness is approximately 100 feet at R51. The fragments in the conglomerate average approximately 4 inches in diameter and measure up to 2 feet across. They are dominantly quartzite with smaller amounts of quartz-mica schist, phyllite and vein quartz and were derived from the adjacent mountain range. The angularity of the fragments, the poor sorting and the position of the sediments indicate their piedmont origin.

Similar sediment is recorded from the southern part of the Hermannsberg sheet (Pritchard and Quinlan, 1960) but in that area they are unlithified. Both deposits are at present undergoing dissection and were probably formed during Pleistocene times.

Conglomerate of this type may be much more extensive than indicated as much of the area adjacent to the ranges is covered by more recent scree and alluvium.

Sand dunes

Seif dunes up to 60 feet high cover the major part of the Rawlinson and Macdonald areas. These dunes are fixed by spinifex, except at the top and therefore changes in form are very slight under the prevailing conditions. There is evidence of sand movement from the east, because sand is banked up on the eastern side of hills and there are no dunes on the western side. The main mass of sand was probably transported before the vegetation appeared, but this movement is continuing at present along the tops of the dunes.

The general trend of the dunes is east-west but they vary between west-south-west and north-west depending on the proximity of wind deflecting mountain ranges, as well as local differences in the wind regime. This is clearly demonstrated in the variations in dune direction between the Robert Range and Schwerin Mural Crescent on the Rawlinson area. Another effect of the deflecting barriers are the wind scoured channels around the western end of some hills.

The best developed dunes occur in the western part of the area away from the mountain ranges and the areas with the least dunes are south of the Schwerin Mural Crescent and the north-eastern part of the Macdonald area. The most effective winds for sand movement are bidirectional from calculations at Giles (Veevers and Wells, 1961). The main wind (at Giles) blows from the south-south-east and the less frequent wind from the north to north-north-east. According to the theory proposed by Bagnold (1941), the present wind system as measured at Giles could satisfactorily explain the form of the seif dunes encountered throughout most of the area. However, previous workers have deduced that these dunes were formed during an arid part of the Pleistocene (see discussion in Veevers and Wells, 1961).

Travertine and caliche:

Limestone deposits of these types are found marginal to all the salt lakes and also as isolated deposits and sheet deposits away from the salt lakes. The travertine marginal to the salt lakes is thought to have formed by precipitation from ground water at or near the surface and forms botryoidal masses of banded, grey and white, fine-grained limestone.

Isolated outcrops of travertine commonly occur over the Bonython Dolomite, Carnegie Formation and the Ellis Sandstone.

These deposits are massive and sometimes banded, grey, white and pink, fine-grained limestone often containing irregular masses of chert. They were probably formed in the soil or weathered rock as caliche and have been exposed by erosion.

The large sheet of travertinous limestone on the northern part of the Macdonald area is possibly an old lake deposit which has been subsequently indurated and dissected.

Alluvium

Gravel and sand is found along the creek beds and as alluvial fans marginal to the mountain ranges and hills. Small areas of alluvium also occur between the sand dunes in low areas. The largest alluvial patches are in the south-eastern portion of the area, where the ranges are higher and the creeks larger.

Evaporites.

Evaporite deposits occur in and around Lake Macdonald, Lake Hopkins, Lake Anec and Lake Orantjugurr. Salt forms a thin crust approximately ⅛ inch thick on these lakes and the underlying material is a mixture of gypsum, clay and silt. Banks of gypsum and travertine occur around Lake Macdonald and also as remnants standing within the lake. Such a remnant at M6 (Figure 42) stands about 25 feet high and contains large numbers of fragments of fresh water gastropods. An analysis of this material yielded the following results:-

SiO_2	CaO	SO_3	$H_2O(180^oC)$	$Fe_2O_3 + Al_2O_3$
10.36%	27.2%	39.35%	18.13%	1.5%

At M59 on Lake Macdonald, three samples were collected. M59A consisted of fine crystalline salt forming a layer approximately ⅛ inch thick. M59B was a grab sample of dark brown mud with small gypsum crystals and was taken from the layer between ⅛ inch and 6 inches below the surface. M59C was a grab sample taken from a layer between 12 and 15 inches below the surface and consisted of dark grey to black, fine-grained, clayey mud with large gypsum crystals. The water table was approximately 4 inches below the surface at the time of collection.

Figure 42. Quaternary gypsum and travertine, north-west part of Lake Macdonald, at M6.

The results of analysis by S. Baker for water soluble salts on these three samples are listed below.

	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	Total %
M59A	57.[illegible]	1.93	0.40	0.19	36.8	97.02
M59B	4.75	12.42	4.57	0.27	2.95	24.96
M59C	4.75	16.0	6.41	0.24	3.35	30.75

Other samples were collected at M65 on the western edge of Lake Macdonald and at R107 on the western edge of Lake Hopkins. Both these samples were of the surface salt approximately $\frac{1}{8}$ inch thick. Results of analysis by S. Baker for water soluble material for these two samples are as follows:-

	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	Total
M65	41.25	13.47	2.24	1,63	28.0	86.59
R107	42.1	6.44	0.24	0.53	30.0	79.31

CORRELATION WITH THE CENTRAL AMADEUS GEOSYNCLINE

Pritchard and Quinlan (1960) mapped the southern half of the Hermannsburg sheet area where a sequence of 35,000 feet of sedimentary rocks, from Upper Proterozoic to Upper Palaeozoic, rest unconformably on an Archaean basement (Arunta Complex). Residuals of a thin cover of Lower Cretaceous siltstone and sandstone and some Tertiary gravels rest unconformably on the basement or younger sediments.

The correlations between the Hermannsberg and Rawlinson-Macdonald areas given here are tentative because of the large distance (approx. 200 miles) between the two areas and lack of supporting fossil evidence. Figure 43 summarizes the correlations.

Basement rocks

The gneiss and quartzite of the north-eastern Macdonald area is tentatively correlated with the Arunta Complex. The possible Lower Proterozoic rocks have no known equivalents on the northern edge of the Central Amadeus Geosyncline.

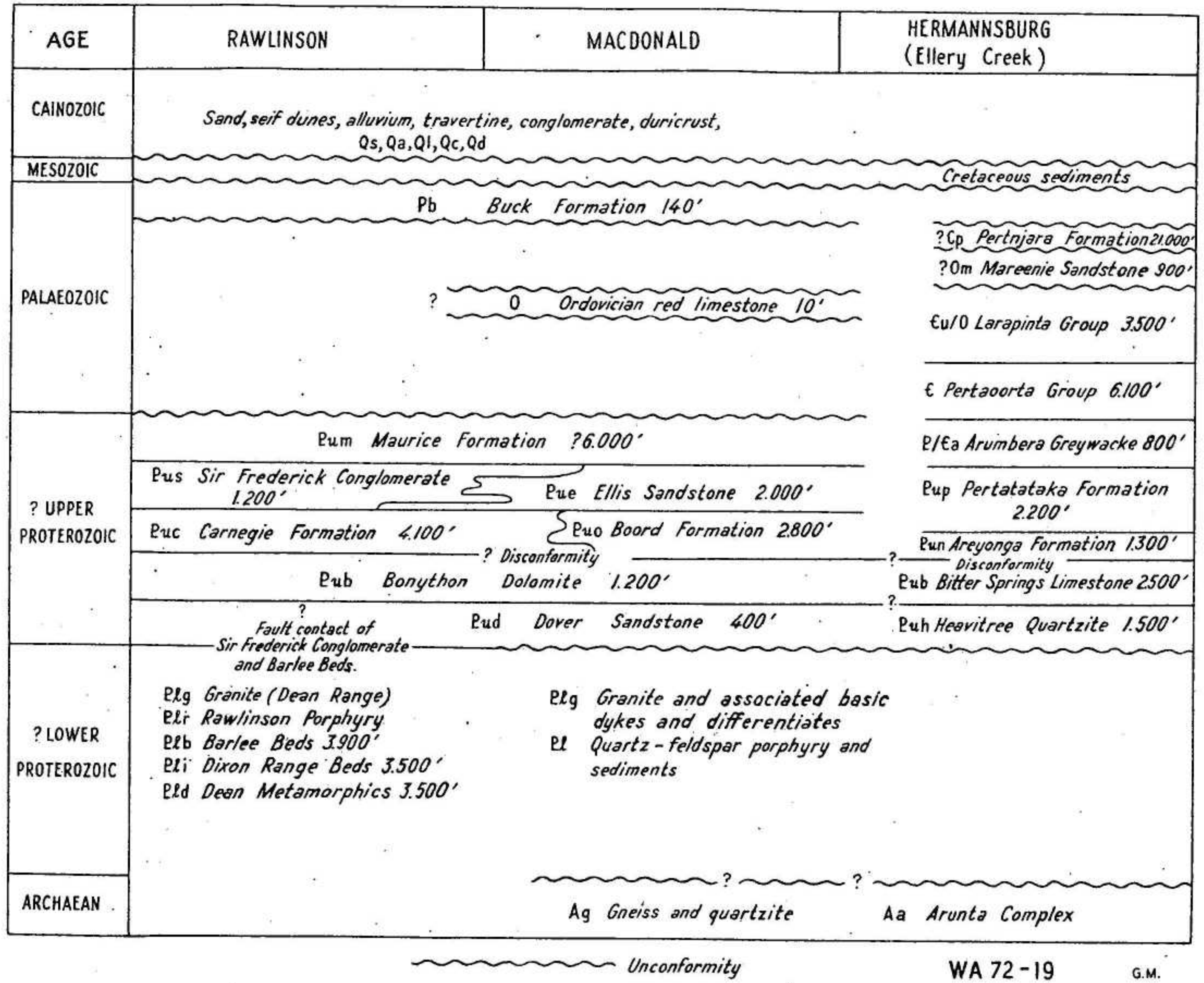


Figure 43. Relationship of formations to those at Ellery Creek, MacDonnell Range Area.

Upper Proterozoic.

Probably the most important unit for correlation is the boulder bed at the base of the Boord Formation. Similar beds occur in the Areyonga Formation. The Areyonga Formation is 1300 feet thick near Ellery Creek and Prichard and Quinlan consider that "the whole of the Areyonga Formation is the product of a glacial environment".

The units above the boulder bed cannot be correlated with formations in the Ellery Creek area and in the absence of fossils, their age is problematic.

The units below the boulder bed are the Bonython Dolomite and the Dover Sandstone. These are correlated with the Bitter Springs Limestone and the Heavitree Quartzite.

Palaeozoic.

The Ordovician calcarenite on the Macdonald area is correlated with the Orthis leviensis beds of the Stokes Formation in the MacDonnell Range.

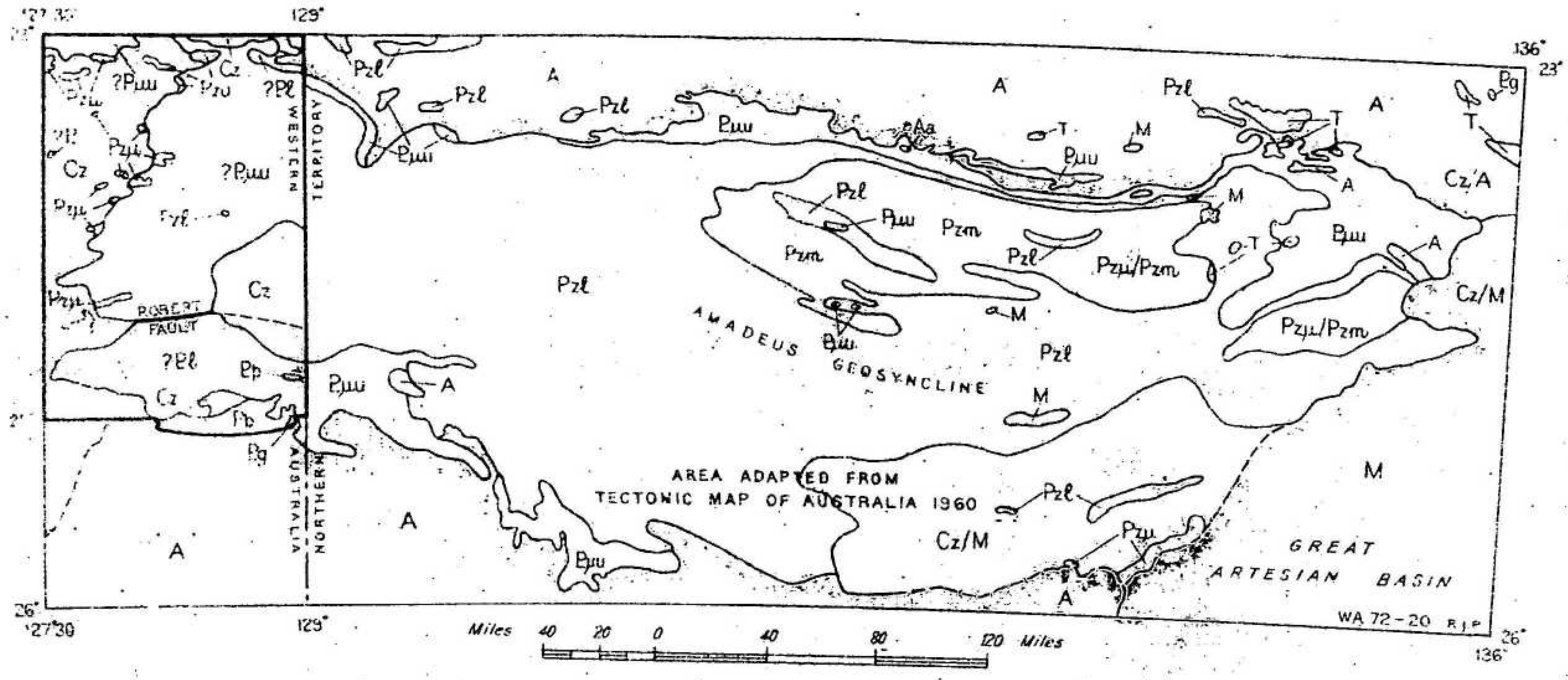
No glacial beds similar to the Buck Formation have been described in the central Amadeus Geosyncline.

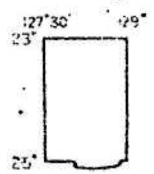
STRUCTURE.

The Upper Proterozoic and Orodovician sediments are contained within a structural depression, 450 miles long by 100 miles wide, which has been given the following published names: Lake Amadeus Sunkland (Chewings, 1935); MacDonnell Trough (Andrews, 1938); MacDonnell Geosyncline (Andrews, 1938); Amadeus Trough (David, 1950); Amadeus Depression (Joklik, 1952); Amadeus Geosynclinc (Hossfeld, 1954); Amadeus Basin (Bureau of Mineral Resources, Geology and Geophysics, map published in the International Stratigraphic Lexicon of Queensland).

The term "Amadeus Geosyncline" as used in this report refers to the area of Upper Proterozoic and younger rocks which have been preserved by faulting and folding, and crop out in the area shown in Figure 44. The term is not intended to have any environmental or tectonic significance.

The possible Lower Proterozoic rocks which crop out in the Rawlinson-Macdonald area appear to be restricted to the known western end of the Amadeus Geosyncline. These rocks are considered to form a part of the basement on which the younger sediments of the Amadeus Geosyncline were deposited.





AREA MAPPED 1960

REFERENCE

Cz	*Cainozoic Undifferentiated*
T	*Tertiary*
M	*Mesozoic*
Pzμ	*Upper Palaeozoic*
Pzm	*Middle Palaeozoic*
Pzl	*Lower Palaeozoic*
Pμu	*Upper Proterozoic*
g	*Granite*
Pp	*Proterozoic Acid Porphyry*
Pl	*Lower Proterozoic*
A	*Archaean Undifferentiated*

AMADEUS GEOSYNCLINE

Figure 44. Sketch Map of the Amadeus Geosyncline.

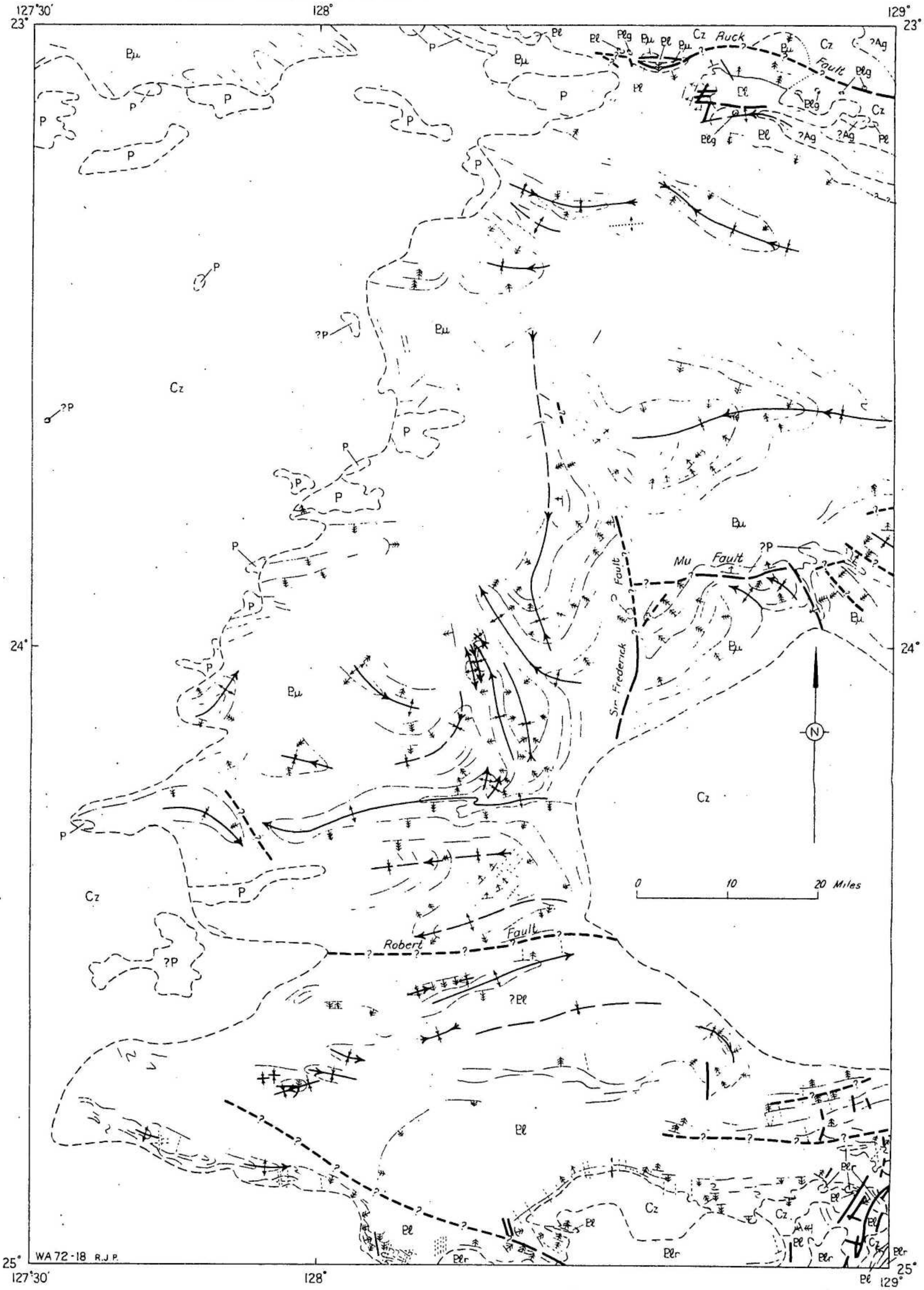


Figure 45. Structure map, Rawlinson-Macdonald area.

The following is a brief description of the main structural features of the Rawlinson and Macdonald areas. The structure of the granite on the Scott and Bloods Range sheets (see Figure 47) is included here for completeness.

Lower Proterozoic.

(a) Granite: The granite is dominantly a coarse, even-grained granite in which no platy flow or foliation is evident. The granite body west of the Dean Range (see Figure 47) is foliated and lineated near its margin. The foliation and lineation is parallel to that developed in the nearby Dean Metamorphics and Rawlinson Porphyry.

(b) Rawlinson Porphyry: The Rawlinson Porphyry is generally foliated and in some places lineated. In many places the foliation is parallel to that developed in the adjacent Dean Metamorphics.

Two lineations are developed. One is a recrystallization lineation trending at 30°, the other is a fracture lineation trending at 340°.

(c) The possible Lower Proterozoic of the north-east Macdonald area: The porphyritic dacite and rhyolite and minor sediment in this area crops out in the core of an eroded anticline in the Upper Proterozoic rocks. The core of this structure is made up of gneiss and quartzite (correlated with the Arunta Complex). The porphyry and minor sediment occurs outside this core and is unconformably overlain on the flanks and nose of the anticline by Upper Proterozoic sediments.

The porphyry ranges from massive to foliated. Outcrop of sedimentary beds within the porphyry sequence is rare and consequently the detailed structure is unknown.

(d) Dean Metamorphics, Dixon Range Beds and Barlee Beds: The Dean metamorphics are foliated and doubly lineated in many places. Where foliation and bedding are visible in the same outcrop they are generally parallel.

Two lineations are visible on bedding and foliation planes. The earliest lineation trends at 30°. It is a recrystallization lineation and the same lineation may be seen in the foliated margin of the intrusive granite. The second lineation is caused by the intersection on bedding and foliation planes of a near vertical fracture cleavage. In places minute displacements may be seen on these fractures, elsewhere the bedding and foliation planes are bent into tiny monoclines whose axes parallel the fracture direction. It is probable that this lineation parallels a series of regional north-north-west to northerly trending faults.

The recrystallization lineation is extensively developed in the Dean Metamorphics and has been noted in the Dixon Range Beds. The fracture lineation is developed in the Dean Metamorphics and Dixon Range Beds and is probably represented in the Robert Range Beds by a prominent joint system.

A system of northerly trending faults has been mapped in the south-eastern corner of the Rawlinson area. Major east-west trending faults have been deduced from stratigraphic considerations but these are concealed beneath the sand plain, some of these are shown in Figure 45. A major curved fault is interpreted between the Dean Range and the quartzite outcrop to the west.

There are three types of fold within the sedimentary rocks: Near vertical isoclinal folds whose axes lie parallel to the trend of the ranges in which they occur; broad regional folds such as the syncline between the Robert Range and the Walter James Range and the domal structure of the Dean Range-Petermann Range area; recumbent folds seen but not mapped in the Rawlinson Range, Dean Range and the area of quartzite hills west of Livingstone Pass.

The recumbent folds may be the result of thrusting, incompetent folding or slumping. The vertical isoclinal folds appear to be older than the broad regional folds; both trend in a general east-west direction.

Joints are very common in the possible Lower Proterozoic rocks. The most common joints are a set of master joints and a joint which trends at about 340°.

Upper Proterozoic.

The Upper Proterozoic rocks are contained within the Amadeus Geosyncline. The southern margin is bounded by the Robert Fault (see Figure 45) which may have been active during deposition of the Carnegie Formation, Ellis Sandstone and Maurice Formation. The northern margin is marked by the unconformity between the Dover Sandstone and the possible Lower Proterozoic rocks. Between the northern and southern margins the

Upper Proterozoic sediments are folded and faulted.

Figure 45 is a tectonic sketch of the Rawlinson and Macdonald areas showing trends, established faults, inferred faults, inferred concealed faults and established anticlines and synclines. Some of the faults are named for ease of reference.

The major faults trend in two general directions, west and north. The fault planes do not crop out and their presence has been deduced from stratigraphic relationships. The Robert Fault, Mu Fault and Buck Fault trend in a westerly direction. The Robert Fault has a throw of at least 7000 feet and separates the Maurice Formation on its downthrown side and the Barlee Beds on its upthrown side.

Along the Mu Fault the Maurice Formation is adjacent to the Bonython Dolomite and possible Permian sediments on the upthrown side dip north at 40°.

The Buck Fault has downthrown the Bonython Dolomite against the Lower Proterozoic.

The Sir Frederick Fault trends north-south. At its southern end the Sir Frederick Conglomerate and overturned Carnegie Formation appear to be downthrown to the east against the Bonython Dolomite. However, on its northern extension the Ellis Sandstone is downthrown to the west against probable Bonython Dolomite. This relationship of the units to the fault is not as simple as it might appear because: the sediments on either side of the Sir Frederick Fault are folded; there may have been a certain amount of transcurrent movement and the Mu Fault has divided the block on the eastern side of the Sir Frederick Fault into two independently moving blocks.

The fold structures may be seen on Figure 45. The strata are inclined at angles of 15° to 80° about the regional fold axes. The folds trend in two general directions: One parallel to the margin of the Amadeus Geosyncline, viz. westerly, the other northerly. The northerly trending structures probably developed later than the westerly trending folds. It is probable that the parallelism of fold and fault structures is not coincidental and that they are products of similar stresses.

The age of these fold and fault structures is not precisely known. Intrusion of granite and porphyry and consequent folding and faulting took place after deposition of the possible Lower Proterozoic sediments and was followed by a period of erosion. The Upper Proterozoic sediments covered a much larger area than the present limits of the Amadeus Geosyncline. During or soon after the deposition of the Carnegie Formation the Robert Fault became active and the greywacke type sediments and conglomerate of the Maurice Formation and Sir Frederick Conglomerate were laid down. It is probable that at this stage the southern limits of the depositional area were similar to the present southern limits of the Amadeus Geosyncline. (In the area mapped.) Much of the folding and faulting which followed took place before the Upper Ordovician when there was an incursion of the sea. The Permian Buck Formation is a continental deposit but marine equivalents may occur beneath the sand cover on the western side of the area. Some bedded dolomite breccia, boulder conglomerate and quartz greywacke to the north of the Mu Fault, has been correlated with the Buck Formation. Moderate dips in some of these outcrops suggests there was movement along the fault during or after the Permian.

Aeromagnetic Reconnaissance.

Between 21st October and 26th October 1960 the geophysical section of the Bureau of Mineral Resources flew aeromagnetic traverses from Alice Springs to Giles and other flights from Giles shown on Figure 46.

On the traverse from Alice Springs to Giles the smooth magnetic profile indicated that any fluctuations in magnetic intensity of the basement rocks were obscured by a considerable thickness of sediments. The smooth profile suddenly changed to a profile of moderate magnetic variation, as the plane flew over the Bloods Range sheet area, at a point which coincided with the photo interpreted faulted boundary between Upper Proterozoic and possible Lower Proterozoic rocks.

The regional geology of the area south, east and west of the Rawlinson area is largely unknown but it seems probable that sharp fluctuations in the magnetic profile are caused by rocks of Archaean age and basic and ultrabasic intrusions, moderate fluctuations by rocks of possible Lower Proterozoic age and smooth profiles by large thicknesses of sedimentary rock.

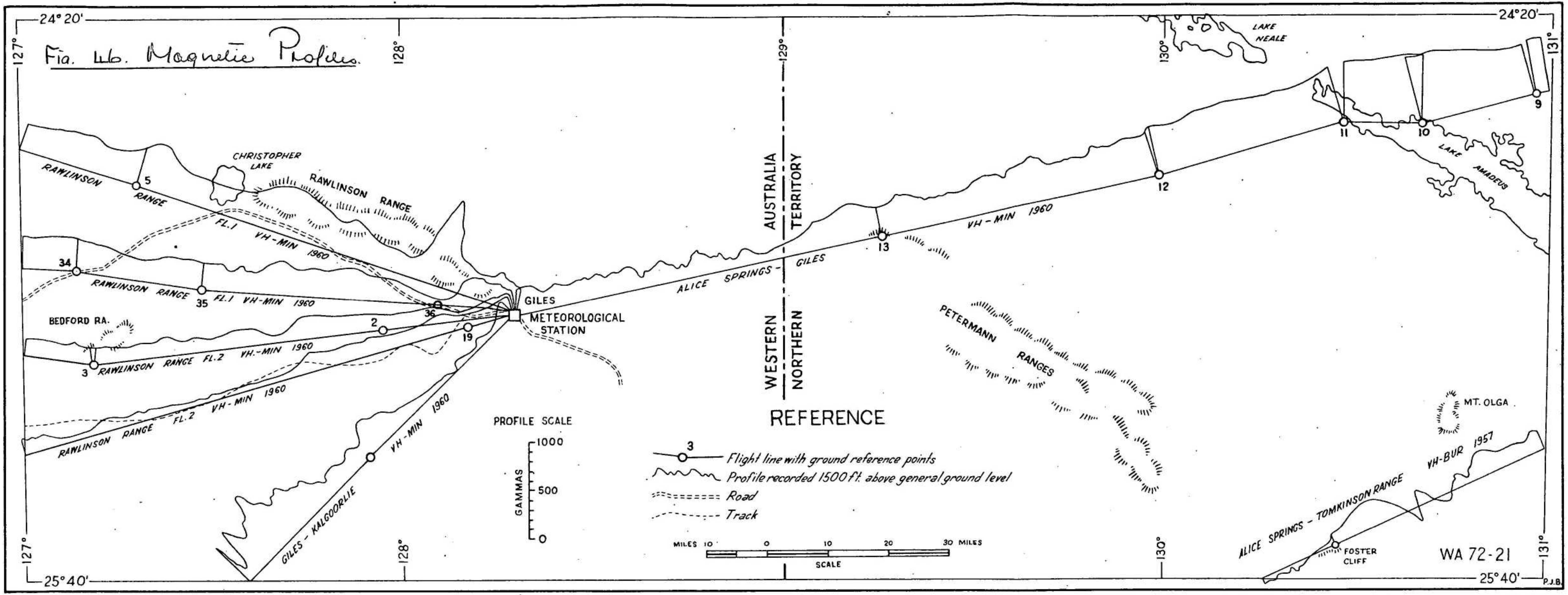


Fig. 46. Magnetic Profiles.
24° 20'
25° 40'
127°
128°
129°
130°
131°
LAKE NEALE
LAKE AMADEUS
CHRISTOPHER LAKE
RAWLINSON RANGE
RAWLINSON RANGE FL.1 VH-MIN 1960
RAWLINSON RANGE FL.1 VH-MIN 1960
BEDFORD RA.
RAWLINSON RANGE FL.2 VH-MIN 1960
RAWLINSON RANGE FL.2 VH-MIN 1960
GILES - KALGOORLIE VH-MIN 1960
GILES
METEOROLOGICAL STATION
ALICE SPRINGS - GILES VH-MIN 1960
WESTERN AUSTRALIA
NORTHERN TERRITORY
PETERMANN RANGES
MT. OLGA
ALICE SPRINGS - TOMKINSON RANGE VH-BUR 1957
FOSTER CLIFF
PROFILE SCALE
GAMMAS
1000
500
0
REFERENCE
Flight line with ground reference points
Profile recorded 1500 ft. above general ground level
Road
Track
MILES 10 0 10 20 30 MILES
SCALE
WA 72-21
P.J.B.

At a point approximately 10 miles west-north-west of Giles an isolated magnetic anomaly of 600 gammas was recorded. The rocks causing this anomaly are obscured by Quarternary deposits.

GEOLOGICAL HISTORY

The older rocks of the area include those of Archaean and Lower Proterozoic age in the north-east Macdonald area and the Lower Proterozoic rocks of the southern half of the Rawlinson area. These rocks acted both as basement and source rocks for younger sediments deposited in the Amadeus Geosyncline.

The first geological record of deposition in the southern part of the region is the thick sequence of predominantly arenaceous rocks laid down in the Lower Proterozoic. No comparable thicknesses of Lower Proterozoic rocks are present in exposures at the northern margin of the Amadeus Geosyncline.

The Lower Proterozoic sediments were deposited in a comparatively shallow water environment. The intrusion of the Rawlinson Porphyry may have been in part contemporaneous with sedimentation. Subsequent intense folding, minor thrusting, faulting and intrusion of granite in the Lower Proterozoic produced a very complex structural pattern in these rocks, and complicated stratigraphic sequences.

In Upper Proterozoic time parts of the basement began to sink slowly to form an elongated east-west depression in which sediments were deposited unconformably over the Lower Proterozoic and Archaean rocks. Sedimentation progressed more or less equally with subsidence. This depression is known as the Amadeus Geosyncline and its limits are defined by the sediments now preserved. Movements along the Robert Fault probably initiated the Amadeus Geosyncline but there is no evidence of the early history of this fault.

In the early Upper Proterozoic uniform conditions of sedimentation probably prevailed over the major part of the basin when the Bonython Dolomite was laid down. However during the latter part of the Upper Proterozoic high mountains of Lower Proterozoic rocks probably existed in the southern half of the Rawlingon sheet as a result of renewed movements on the Robert Fault. This is indicated by the Upper Proterozoic sediments which are coarse-grained in areas towards the Robert Fault and become progressively fine-grained to the north. Current bedding indicates derivation of the sediments from source in the quadrant south-west to south-east.

Glaciation occurred during deposition of the basal beds of the Boord Formation and in this time there was some erosion of exposed areas of the Bonython Dolomite and Dover Sandstone.

Because of the high land areas that existed in the south Rawlinson area in the Upper Proterozoic, the Robert Fault may have been the southern limit of sedimentation. The northern limits of sedimentation are unknown and at least the Bonython Dolomite and Dover Sandstone transgressed for an unknown distance into the Webb sheet area.

At the end of the Precambrian and probably before the Ordovician the Upper Proterozoic rocks were subjected to at least two periods of faulting and folding and the area was elevated to a land surface. Deep dissection took place before the Ordovician transgressive sea. The deposition of the fossiliferous Ordovician sandstone and limestone was probably in shallow agitated water but the direction of transgression is not known. The absence of other early Palaeozoic deposits suggests either that the Amadeus Geosynclinal zone for the most part remained a surface of denudation until the Permian times, or alternatively that most of the Lower Palaeozoic sediments had been eroded before the Permian transgressions. In the interval between the Ordovician and Permian it seems most likely that the area was a land surface and in this time nearly all of the Ordovician deposits were removed in the western part of the Amadeus Geosyncline.

The early Permian landscape probably had some relief. This is indicated by the glacial deposits now abutting quite steep hills and breakaways. The possible glacial pavement in the north-east Macdonald area indicates the presence of glaciers or even ice sheets. Mapping of neighbouring areas to the west suggests that the Permian glacial deposits of the western part of the Rawlinson Macdonald area are contiguous with those of the Canning Basin. The Permian glacials were deposited as far as the Northern Territory - Western Australian border. The only deposits younger than Permian are thin superficial Cainozoic deposits.

All of the region has been a land surface after the Permian. There is no evidence of Mesozoic deposits and presumably the otherwise widespread epeirie Cretaceous sea did not reach this area. Large areas of horizontal Cretaceous sediments occur to the west in the Canning Basin. After the Permian period the area probably still possessed some relief to allow the stripping of the large cover of Permian rocks in a further prolonged period of erosion that followed. Some mild renewed movements along fault zones in the Upper Proterozoic rocks produced local tilting in the Permian rocks.

Some lateritization took place in the Tertiary Period but was not extensive and only thin profiles were developed. They are mostly on the more friable Permian sediments and the Precambrian arenaceous rocks were for the most part unaffected, or have been subsequently eroded.

The present cycle of erosion then commenced after the Permian and the landscape is probably only a slightly modified exhumed Permian landscape. The alluvium and sand accumulated by subaerial erosion have been modified by deflation with the production of vast areas of seif dunes.

The salt lakes were probably formed in the same arid period as the sand dunes. No integrated system of drainage is present. The origin of the depressions in which the lakes have formed is not known. They may have originated by unequal erosion of the areas of Bonython Dolomite which underlies the lakes.

ECONOMIC GEOLOGY

No economic mineral deposits are known on the Rawlinson or Macdonald areas.

Underground water.

Good quality water is being obtained from bores south of the Rawlinson Range near Giles. These bores are sited along the creek which flows north from near Giles through the Pass of the Abencorrages . It is probable that the water is being obtained from alluvium which overlies the Rawlinson Porphyry.

By direct analogy with Giles, two other places recommend themselves as possible sites for an aquifer. These are Withers Pass, south of the Schwerin Mural Crescent and Rebecca Creek, south of the Schwerin Mural Crescent near Gill Pinnacle and Conical Hill.

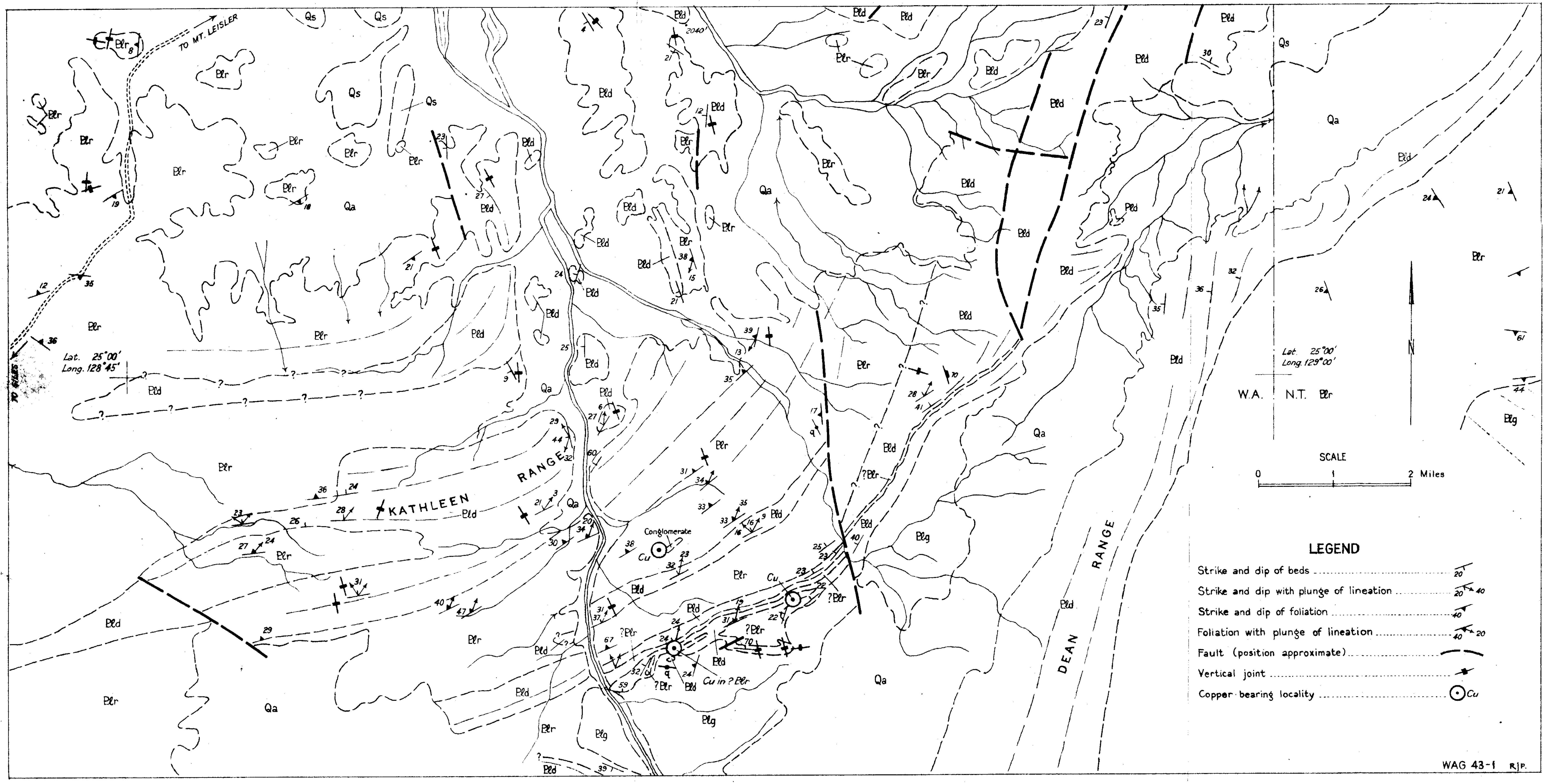


Figure 47. Geological map of the Kathleen Range Area, showing localities of small copper deposits (Cu); Dean Metamorphics, (Eld); Rawlinson Porphyry (Elr); Granite (Elg).

The Ellis Sandstone, Sir Frederick Conglomerate and the Dover Sandstone may be permeable at depth. These units have never been tested and hence it is not known whether or not they may contain supplies of good water.

Surface water occurs in permanent and semi-permanent native rock holes and soaks. The largest of these is Bungabiddy Rock Hole in the Walter James Range which has several large pools and is fed by a permanent spring.

Evaporite deposits

Lakes Hopkins, Macdonald, Anec and Orantjugurr contain deposits of gypsum and sodium chloride. Remoteness from markets is sufficient to make these deposits uneconomic at this stage.

Copper

Malachite occurs in quartz-mica schist 3 miles south-east of the Kathleen Range (see Figure 47). A specimen of the highest grade material assayed 2.3% copper. The deposits are small and uneconomic.

Petroleum prospects.

The Bonython Dolomite is a possible source rock for petroleum. Marine Permian sediments on the western side of the area could occur but present indications are that they are probably thin aqueoglacial or fluvioglacial deposits, overlying Proterozoic sediments.

The Lower Palaeozoic sediments of the Central Amadeus Geosyncline have not been proved to extend across the Western Australian border except as a small outlier. As the main hopes of oil accumulation are in these sediments, the petroleum prospects of the area are negligible.

Bore No.	Locality from Giles.	Date Commenced.	Depth of hole below surface in feet.	Water Cut Feet below surface.	Water Level Feet below surface.	Gallons per hour.	How tested.	Analysis. Total saline matter Grains per gallon.	
10	300 yards north	10/7/56	120	90	65	300	2 hours bailer D.D.L. 90'	75.83	Dry at end of 1959 (Drought year.)
9	1 mile north	2/7/56	75	38	34	700	1 hour bailer D.D.L.39'	43.72	"
11	Lat.25°02'07" Long128°17'48" Giles Aerodrome	4/8/56	130	98	59	300	2 hours	87.3	
8	2 miles north	18/6/56	70	28	28	1000	9 hours pump test	73.38	
7B	Giles	8/6/56	20	D R Y	H O L E				
7A	¾ mile south	5/5/56	182	80	40	150 estimated	1 hour bailer	227.01	
7	1 mile south	23/4/56	42	D R Y	H O L E				
6	3 miles north	30/5/56	63	30	30	700	2 hours bailer	119.81 or 347.78	
5	4.9 miles north	16/5/56	60	8	6	1100	2 hours bailer	347.78 or 119.81	

TABLE 3. WATER SUPPLY, GILES BORES.

REFERENCES.

ANDREWS, E.C., 1938 - The Structural History of Australia during the Palaeozoic. J. & Proc.Roy.Soc. N.S.W. 71

BAGNOLD, R.A., 1941 - The Physics of Blown Sand and Desert Dunes. New York: William Morrow & Company.

BASEDOW, H., 1929 - Geological Report on the Petermann Ranges, Central Australia. Geogr. J., 73.

BUREAU OF MINERAL RESOURCES, Geology and Geophysics, 1956 - Map of the elements of geology and structure of Australia. Lexique int.strat., 6(5a), opp.p.12

CARNEGIE, D.W., 1898 - Spinifex and Sand. London: C.Arthur Pearson Ltd.

CHEWINGS, C., 1935 - The Pertatataka Series in Central Australia with Notes on the Amadeus Sunkland; Trans.Roy.Soc.S.Aust., 59, 141-163

DAVID, T.W.E., ed. BROWN, W.R., 1950 - The Geology of the Commonwealth of Australia. London: Arnold.

ELLIS, H.A., 1937 - Report on some observations made on a journey from Alice Springs, N.T. to the country north of the Rawlinson Ranges in W.A. Ann. Prog. Rept. Geol.Surv. W.Aust.for 1936.

GARDNER, C.A., 1941 - The Vegetation of Western Australia J.Roy.Soc.W.Aust.28

GEORGE, F.R., and MURRAY, W.R., 1907 - Journal of the Government Prospecting Expedition to the South-western Portions of the Northern Territory, prepared by W.R. Murray. S.Aust. Parl. Pap. 50.

GILES, E., 1889 - Australia Twice Traversed. London: Sampson Low, Marston, Searle and Rivington.

GILLESPIE, I., 1959 - The Southwest Amadeus Basin Geological Reconnaissance Survey.Unpub.Rep. for Frome Broken Hill Co.Pty.Ltd.4300-G-23.

GLAESSNER, M.F. et al, 1958 - The Geology of South Australia.J.Geol.Soc.Aust. 5(2)

HOSSFELD, P.S., 1954 - Stratigraphy and structure of the Northern Territory of Australia. Trans. Roy. Soc. S. Aust. 77

JOKLIK, G.F., 1952 - Geological reconnaissance of the south-western portion of the Northern Territory Bur.Min.Resour.Aust. Rep. 10.

MACKAY, D., 1934 - The Mackay Aerial Survey Expedition, Central Australia. Geogr. J., 84 (6)

MURRAY, W.R., 1904 - In Extracts from Journals of Explorations, by R.T. Maurice. Fowler's Bay to Cambridge Gulf. S.Aust.Parl.Pap. 43

PRITCHARD, C.E. and Quinlan, T., 1960 - The Geology of the southern part of the Hermannsburg 4-mile sheet. Bur.Min.Resour.Aust.Rec. 1960/104. (Unpubl.)

TERRY, M., 1931 - Two Journeys Westward from Horseshoe Bend and Codnadatta, Central Australia. Geogr.J.78, pp.341-346

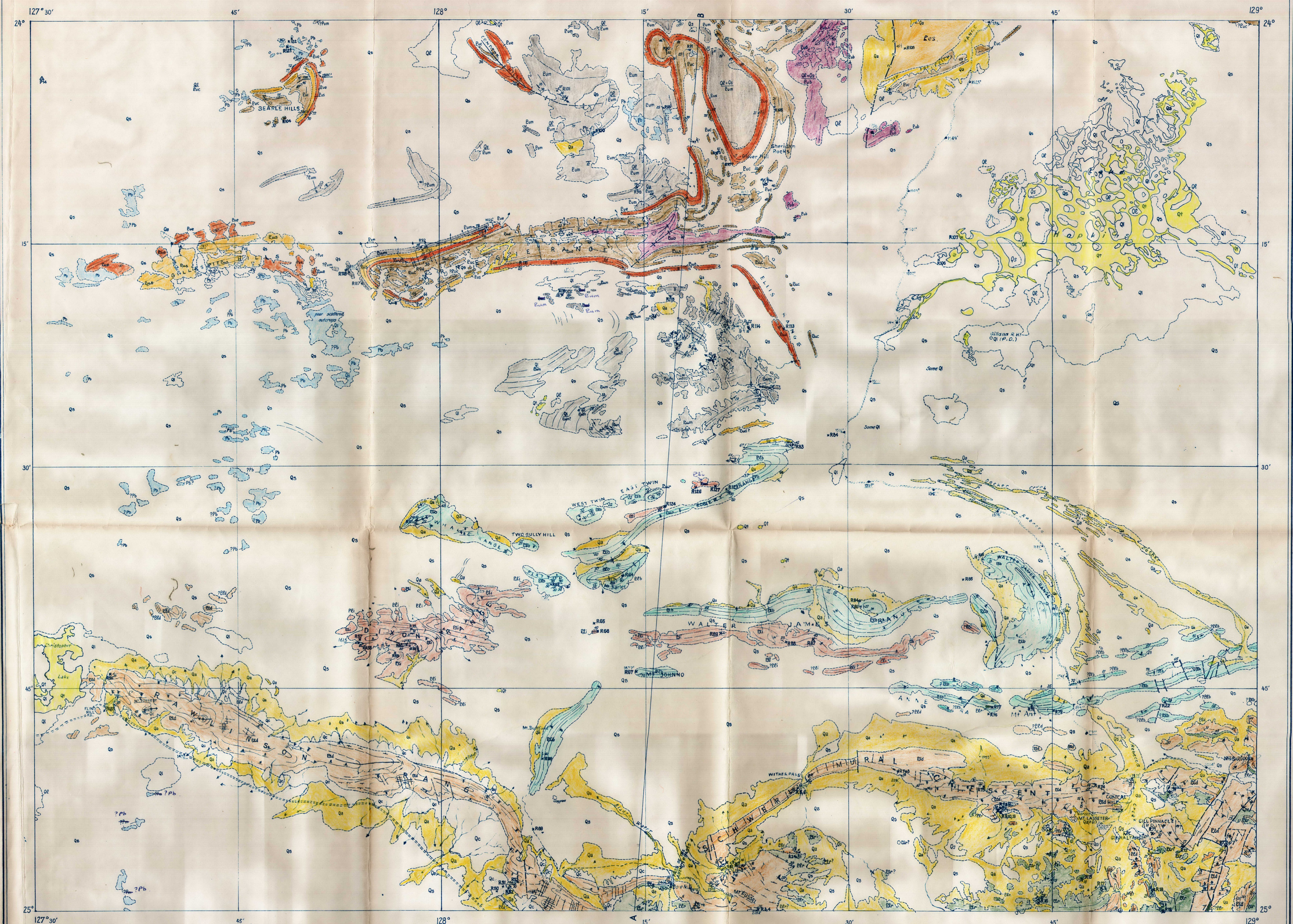
TIETKENS, W.H. 1891 - Journal of Central Australian Exploring Expedition, with map and section. Adelaide: Government Printer.

VEEVERS, J.J. and WELLS, A.T., 1961 - The Geology of the Canning Basin. Bur.Min.Resour.Aust.Bull. 60. (in press)

RAWLINSON
WESTERN AUSTRALIA

AUSTRALIA

1 : 250,000 GEOLOGICAL SERIES SHEET G 52-2



Reference

QUATERNARY		Qs	Aeolian sand, self dunes
		Qa	Alluvium
		Qt	Evaporites
		Qℓ	Travertine
		Qc	Conglomerate
PERMIAN	Buck Formation	Pb	Poorly sorted, coarse sandstone, tillitic sandstone, boulder beds and siltstone
	Angular Unconformity		
UPPER PROTEROZOIC	Maurice Formation	Pum	Quartz greywacke, cross-bedded sandstone and micaceous siltstone
	Ellis Sandstone	Pue	Quartz sandstone and minor interbedded calcareous sandstone, few rounded pebbles
	Sir Frederick Conglomerate	Pus	Boulder conglomerate
	Carnegie Formation	Puc	Quartz greywacke, shale and siltstone
	Bonython Dolomite	Pub	Dolomite with chert, minor limestone, calcilutite, and siltstone. Stromatolites
LOWER PROTEROZOIC		Pℓg	Granite (section only)
	Rawlinson Porphyry	Pℓr	Quartz-feldspar porphyry
	Barlee Beds	Pℓb	Quartz sandstone and some fine conglomerate
	Dixon Range Beds	Pℓi	Quartz sandstone, siltstone, arkose and minor quartz-mica schist
	Dean Metamorphics	Pℓd	Quartzite, quartz-mica schist, and some quartz sandstone

Geological boundary

Syncline, showing plunge

Anticline, showing plunge

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

Prevailing dip

Vertical strata

Horizontal strata

Dip > 15° }
Dip 15°—45° }
Dip > 45° } *air-photo interpretation*
Trend of bedding }
Joint pattern }

Strike and dip of joints

Vertical joints

Strike and dip of foliation

Vertical foliation

Plunge of lineation

Measured section

×R21 *Text reference to specimen locality*

·1710 *Height in feet, instrument levelled* } *datum: mean sea level,*
·1624 *Height in feet, barometric* } *Port Augusta*

====== *Road*

○ R.H. *Rockhole*

● B *Bore*

P.D. *Position doubtful*

Astro station

Trig. station

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled from controlled maps at photo scale supplied by the West Australian Department of Lands and Surveys. Spot heights underlined from levels supplied by Department of the Interior. Air photography, vertical coverage at scale 1:40,000

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

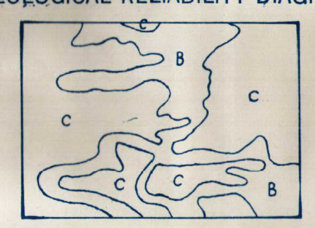
RYAN	MACDONALD	Mt. RENNIE
COBB	RAWLINSON	BLOODS RANGE
BENTLEY	SCOTT	PETERMANN RANGES

Scale 1 : 250,000

5 0 5 10 15 Miles

5 0 5 10 15 20 25 Kilometres

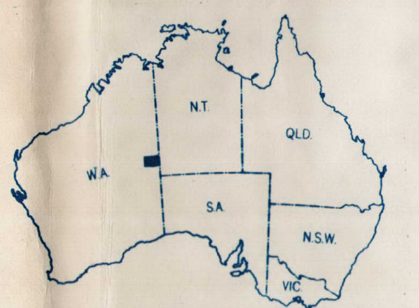
GEOLOGICAL RELIABILITY DIAGRAM

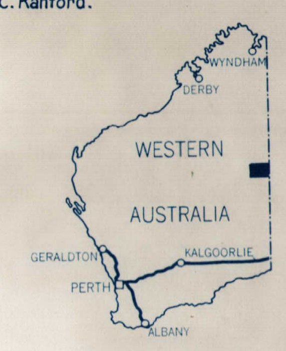


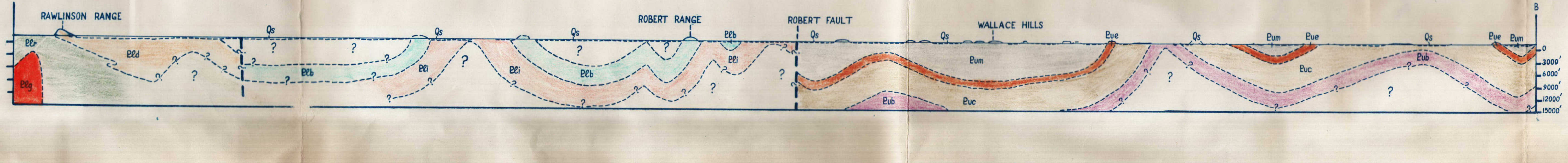
B Reconnaissance regional traverses and air photo interpretation

C Sketchy-air-photo-interpretation

Geology and compilation by: A.T. Wells, D.J. Forman, L.C. Ranford.







AUSTRALIA

MACDONALD

WESTERN AUSTRALIA

1 : 250,000 GEOLOGICAL SERIES SHEET F 52 - 14

Reference

QUATERNARY

Qs	Aeolian sand
Qa	Alluvium
Qt	Evaporites
Qℓ	Travertine

PERMIAN

	P	Undifferentiated
Buck Formation	Pb	Poorly sorted, coarse sandstone boulder beds and siltstone

Angular Unconformity

ORDOVICIAN

O	Fossiliferous red limestone, some siltstone and medium sandstone

Angular Unconformity

UPPER PROTEROZOIC

Maurice Formation	Pum	Quartz greywacke, cross-bedded sandstone and micaceous
Ellis Sandstone	Pue	Quartz sandstone and minor interbedded calcareous sandstone, few rounded pebbles
Sir Frederick Conglomerate	Pus	Boulder conglomerate
Carnegie Formation	Puc	Quartz greywacke, sandstone and siltstone
Boord Formation	Puo	Calcarenite, calcilutite, dolomitic limestone with stromatolites. Some interbedded shale and siltstone, tillite and calcareous sandstone near base.
Bonython Dolomite	Pub	Dolomite with chert, minor limestone, calcilutite, and siltstone. Stromatolites
Dover Sandstone	Pud	Quartz sandstone with shale siltstone and fine conglomerate
	Pu	Undifferentiated quartz sandstone and siltstone

Angular Unconformity

LOWER PROTEROZOIC

Pℓg	Undifferentiated quartz-feldspar porphyry and sediments
Pℓ	Granite

Angular Unconformity

ARCHAEAN

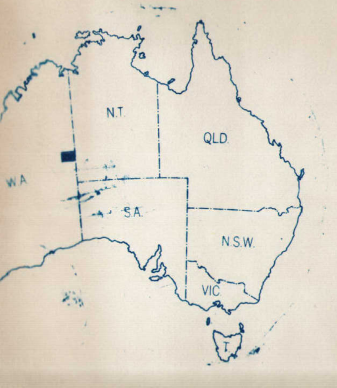
Ag	Gneiss and quartzite

Geological boundary
Syncline, showing plunge
Anticline, showing plunge
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
Overturned strata
Prevailing dip }
Vertical strata }
Dip > 15° } *air-photo interpretation*
Dip 15°—45° }
Dip > 45° }
Trend of bedding
Joint pattern
Strike and dip of joints
Vertical joints
Strike and dip of foliation
Vertical foliation
Macrofossil locality
Quartz vein
MFX8 *Measured section*
× M 85 *Text reference to specimen locality*
·1710 *Height in feet, instrument levelled* } *datum: mean sea level,*
·1624 *Height in feet, barometric* } *Port Augusta*
Road
Trig. station

Compiled by the Bureau of Mineral Resources Geology and Geophysics, Department of National Development. Topographic base compiled from an uncontrolled assembly of air photographs supplied by the West Australian Department of Lands and Surveys. Spot heights underlined, from levels supplied by Department by the Interior. Air photography, vertical coverage at scale 1: 40,000.



INDEX TO ADJOINING SHEETS

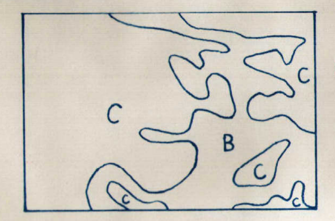
WILSON	WEBB	LAKE MACKAY
RYAN	MACDONALD	MT RENNIE
COBB	RAWLINSON	BLOODS RANGE

Scale: 1:250 000

5 0 5 10 15 Miles

5 0 5 10 15 20 Kilometres

GEOLOGICAL RELIABILITY DIAGRAM



B *Reconnaissance regional traverses and air-photo-interpretation*

C *Sketchy-air-photo interpretation*

Geology and compilation by: A.T. Wells, D.J. Forman L.C. Ranford.

Drawn by: