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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/140

EXPLANATORY NOTES ON THE MOUNT MARUMBA 1:250,000 GEOLOGICAL SHEET

Compiled by

H.G.Roberts and K.A.Plumb

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The Mount Marumba 1:250,000 Sheet area lies mostly within the Arnhem Land Aboriginal Reserve, in the north-eastern part of the Northern Territory. It is bounded by latitudes 13° and 14°S and longitudes 133°30' and 135°E.

A graded track from Mainoru Homestead to the Bulman mines provides the only access to the area. The mines are 30 miles north-north-east of Mainoru, which is 180 road miles from Katherine. Rainfall averages 25 inches per annum and occurs mainly during the period November to April. The area is uninhabited, but is visited occasionally by itinerant aborigines.

Maps and air photographs covering the Sheet area and available during the course of the surveys were - air photographs at 1:50,000 scale flown by the Royal Australian Air Force in 1950; a photomosaic at a scale of 4 miles to 1 inch, prepared by the Division of National Mapping, Department of National Development in 1952; and a 1:250,000 topographic map prepared by the Royal Australian Survey Corps in 1961. The accompanying Geological Sheet was compiled by transferring information from photographically reduced overlays to the Survey Corps base.

Previous Investigations

In 1845 Leichhardt (1847) travelled through part of the western sector of the Sheet area and described the sandstones of the present Kombolgie Formation. Lindsay (1884) traversed several parts of the area in 1883 and recorded numerous geological observations.

The Bulman zinc-lead deposits were discovered about 1910 when a company was formed to exploit them. The company failed when the field was given an unfavourable report by a consultant (A.R.G.N.T., 1910). The activity in the Bulman area lead to mineral search in surrounding areas; Love (1911) and Murphy (1912) made long journeys through Arnhem Land in search of minerals, but without success. Interest in the Bulman field was renewed in 1925 (A.R.G.N.T., 1925) but it

was short lived. In 1952 the Enterprise Exploration Company examined the deposits (King, 1952; Knight, 1952; Sturmfels,1952), and subsequently tested them by diamond drilling (Patterson, 1954). "Opik and Walpole examined the deposits in 1952 ("Opik, 1952). In 1954 the Broken Hill Proprietary Company mapped a large segment of Arnhem Land including the eastern part of the Mount Marumba Sheet area (Crohn, 1956). Later, Campbell (1956) mapped the rocks in the vicinity of the Bulman field, and Patterson (1958) made a helicopter reconnaissance of a large part of the Mount Marumba Sheet area for the Enterprise Exploration Company; the company engaged botanists to conduct geobotanical investigations in the Bulman district in 1962.

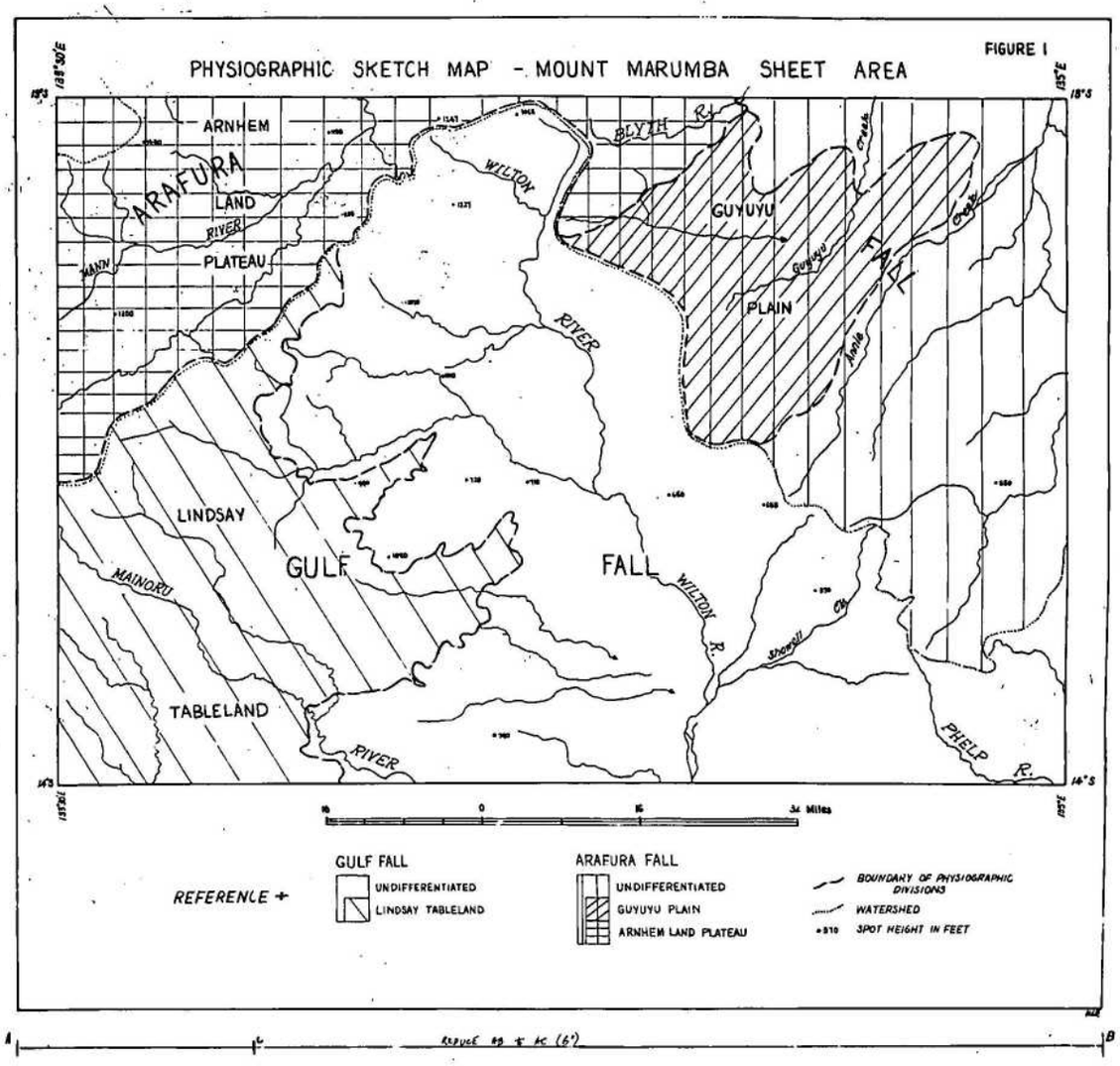
The accompanying map is based on field work undertaken by the Bureau of Mineral Resources during 1962 as part of a survey of Arnhem Land. Prior to the field mapping Ruker (1962) prepared a photogeological map of the Sheet area with accompanying notes. The adjoining 1:250,000 Sheet areas have been mapped by the Bureau of Mineral Resources; Mount Evelyn was mapped between 1954 and 1958 (Walpole, 1963); Urapunga in 1958 and 1959 (Dunn, 1963) and Milingimbi and Blue Mud Bay - Port Langdon in 1962 (Rix, 1963; Plumb and Roberts, 1963).

PHYSIOGRAPHY

The Sheet area contains parts of two of the three major physiographic divisions of Arnhem Land, viz. the Gulf Fall and the Arafura Fall (Roberts and Dunn, in prep.). The distribution of the divisions is shown in Figure 1.

Gulf Fall: The Gulf Fall includes all the country drained by streams flowing into the Gulf of Carpentaria and occupies the central and southern parts of the Sheet area. Most of the Gulf Fall consists of hilly, dissected country, but in the west a flat, elevated area, has been named the Lindsay Tableland, (Figure 1.).

The topography in the main part of the Gulf Fall, (i.e. excluding the Tableland) is controlled to a marked degree by the differential resistance to erosion of the various underlying strata. In the headwaters of the Wilton



River arenites of the Katherine River Group form strong strike ridges and plateaux while the less resistant lutites, carbonates and volcanics tend to occupy valleys and depressions. Relief in this area is locally up to 400 feet; elevations are up to 1250 feet, but gradually decrease to the south-east, along the course of the Wilton River, to about 300 feet near the southern margin of the Sheet area. Rocks of the Dook Creek Formation generally form rounded hills, in contrast to the rocks of the Roper Group which form cuestas and hogback ridges with low, gently undulating country between.

The Lindsay Tableland is bounded to the north by the Arnhem Land Plateau; elevations along the watershed separating the Tableland and Plateau are about 1300 feet. To the south-east elevations decrease to about 1000 feet. The Tableland is mostly flat and soil covered but contains numerous hills and rises of Precambrian and Mesozoic rocks. Most of the Tableland is underlain by horizontal Mesozoic strata, which are exposed along water-courses and in small scarps both within the Tableland and along its margin.

The marginal scarp is more pronounced in the headwaters of the Wilton River (where it is up to 50 feet high) than in the south.

Arafura Fall: The Arafura Fall occupies the north-western and north-eastern sectors of the Sheet area and is bounded to the south by the Gulf Fall; it comprises the country drained by streams flowing into the Arafura Sea. Two subdivisions - the Arnhem Land Plateau and the Guyuyu Plain are shown on Figure 1.

The Undifferentiated Arafura Fall is in the eastern part of the Sheet area and is underlain mainly by rocks of the Roper Group. The topography, although similar to that in the corresponding part of the Gulf Fall adjoining to the south, is more subdued; local relief rarely exceeds 100 feet. Elevations range from about 600 feet in the south to 250 feet in the north.

The Guyuyu Plain adjoins the Undifferentiated Arafura Fall. The Plain has an elevation of about 650 feet at its southern margin and slopes gently to 250 feet at its northern boundary. Most of the area is sand and soil covered; numerous sink holes suggest that carbonate rocks of the Dook Creek Formation (mainly) may underlie much of the Plain.

The Arnhem Land Plateau occupies the north-western part of the Sheet area and a small area adjoining the Guyuyu Plain. It extends northwards onto the Milingimbi Sheet area (Rix, 1963) where its northern boundary is clearly defined. In the Mount Marumba Sheet area the Plateau ranges in elevation from 500 feet in the east to over 1400 feet in the west; local relief, however, rarely exceeds 300 feet. Most of the rocks exposed on the Plateau are arenites of the Katherine River Group; they occur as low rises, mesas and broad craggy hills and ridges. Narrow gullies and clefts, which have developed along joints, are common in the Plateau.

Drainage: The Gulf Fall is drained by the Wilton, Phelp and Mainoru River systems. The principal drainage is through the Wilton River which flows southwards to join the Roper River on the Urapunga Sheet area. The Wilton River flows through wide alluvial plains over most of its length; anabranchs are common. The Arafura Fall is drained by the north-flowing Mann, Blyth and Goyder River systems. The

Goyder River system includes Annie Creek, Guyuyu Creek and several un-named streams in the eastern part of the Sheet area.

In both the Arafura and Gulf Falls the major streams are superimposed consequent streams; the minor streams are largely controlled by the structure and lithology of the underlying rocks.

STRATIGRAPHY

The stratigraphy of the Sheet area is summarized in Table 1. The stratigraphic nomenclature used will be fully defined and in some cases re-defined in Dunn, Smith & Roberts, (in prep.) and Roberts and Dunn, (in prep.).

PRECAMBRIAN

Precambrian rocks crop out extensively in the Sheet area. They have been assigned to various intervals of the Precambrian time scale solely on the basis of their local and regional structural and stratigraphic relationships. No absolute ages are known, but the Katherine River Group is assigned to the Lower Proterozoic on the basis of its correlation with the Tawallah Group (Dunn, et al, in prep.), rocks of which have been dated by radiometric methods at the Geochronology Laboratory of the Australian National University (A.W. Webb, I. McDougall and J.A. Cooper (1963).

AGICONDIAN SYSTEM (LOWER PROTEROZOIC)

The Jimbu Granite is the oldest unit exposed in the Sheet area. It is unconformably overlain by rocks of the Katherine River Group, and is probably related to the similarly disposed rocks of the Agicondian System in the Katherine-Darwin region (Walpole et al, in prep.).

The most common rock type exposed is a pink porphyritic microgranite consisting of phenocrysts of potash feldspar and quartz embedded in a medium grained groundmass of micrographic quartz-feldspar, quartz, potash feldspar and chlorite. Dykes of pegmatite and granophyre cut the granite mass.

STRATIGRAPHIC TABLE — EXPLANATORY NOTES TO THE MAP (A GEOLOGICAL SURVEY)

ERA	AGE	ROCK UNIT AND SYMBOL	MAXIMUM THICKNESS IN FEET *	LITHOLOGY	PHYSIOGRAPHIC EXPRESSION	DISTRIBUTION	STRATIGRAPHIC RELATIONSHIPS	REMARKS
CAINOZOIC	Quaternary	(Qa)	20+	Alluvium	Level to gently sloping plains along main watercourses; isolated flats.	Mainly along Wilton River and Annie Creek		
	Undifferentiated	(Czs)	20+	Sand, residual soil	Lies on hill slopes, plateaux and plains.	Widespread		
		(Czl)	20	Laterite, lateritic soil, ferricrete.	Laterite in scarps; lateritic soil - plains; ferricrete - beds of watercourses.	Western sector		Bauxite in places
	Tertiary(?)	Annie Creek Limestone (Ta)	20+	Massive, buff to grey	Low rubbly rises.	Along Annie Creek	Relationship to laterite not known.	No fossils found.
MESOZOIC	Lower Cretaceous	Mullaman Beds (Klm)	50+	Massive, white to yellow, sandy siltstone and claystone; quartz sandstone, clayey sandstone.	Broad, soil-covered plateaux; where dissected - mesa topography.	Widespread	Probably unconformably overlain by the Annie Creek Limestone.	Contains shelly fossils.
PRECAMBRIAN	Upper (?) Proterozoic	(Bdl)	370	Fine to coarse-grained dolerite, porphyritic and vesicular dolerite.	Poorly resistant; forms low plains and valleys. Produces "black" soil.	Widespread in eastern half.	Intrudes Roper Group strata, unconformably overlain by the Mullaman Beds.	Sills and dykes.
		Bessie Creek Sandstone (Bre)	50	Massive, fine to medium-grained, white friable, ripple marked, cross-bedded quartz sandstone.	Moderately resistant - low cuestas.	Broad north-north-east trending zone in East	Unconformably overlain by Mullaman Beds.	Jointed.
		Corcoran Formation (Bro)	400	Flaggy, micaceous quartz sandstone and quartz greywacke; shale, siltstone.	Poorly resistant - soil covered valleys.		Conformably overlain by the Bessie Creek Sandstone.	Very poorly exposed.
		Munyi Member (Brm)	150	Ferruginous sandstone and siltstone; minor quartz sandstone and micaceous shale.	Poorly resistant - low slightly undulating country.		Conformably overlain by the Corcoran Formation.	Strongly ferruginous in places.
		Hodgson Sandstone Member (Prh)	150	Blocky to massive friable medium grained quartz sandstone, cross bedded ripple marked.	Resistant - low cuestas		Conformably overlain by the Munyi Member.	Jointed
		Jalboi Member (Prj)	400	Flaggy green, white and purple glauconitic micaceous sandstone and siltstone; quartz greywacke; blocky white quartz sandstone. Cross bedded, ripple marked.	Moderately resistant -		Conformably overlain by the Hodgson Sandstone Member.	Abundant sedimentary structures.
		Arnold Sandstone Member (Brx)	100	Blocky to massive, friable, medium-grained, white cross bedded, ripple-marked quartz sandstone.	Moderately resistant - low cuestas.		Conformably overlain by the Jalboi Member. Lenses out in places.	Jointed
		Crawford Formation (Brr)	400	Blocky to massive pink micaceous quartz greywacke; flaggy, purple, micaceous sandstone, siltstone; micaceous glauconitic sandstone. Cross bedded.	Moderately resistant - undulating, benched, hilly country.	Broad north-east trending zone in East and south-east.	Conformably overlain in places by the Arnold Sandstone Member, in otherwise by the Jalboi Member.	Characteristic weathering habit.
		Mainoru Formation (Bru)	500	Flaggy laminated cherty siltstone and dolomitic siltstone, calcareous siltstone, micaceous glauconitic sandstone; minor sandy limestone lenses.	Poorly resistant - undulating hills, often benched soil covered valleys.		Conformably overlain by the Crawford Formation.	Lower half of unit very poorly exposed.

ROPER GROUP — Abner Sandstone

ERA	AGE	ROCK UNIT AND SYMBOL	MAXIMUM THICKNESS IN FEET *	LITHOLOGY	PHYSIOGRAPHIC EXPRESSION	DISTRIBUTION	STRATIGRAPHIC RELATIONSHIPS	REMARKS
PRECAMBRIAN		Roper Group (cont.) Limmen Sandstone (Pri)	200	Massive to flaggy, fine to medium-grained, white quartz sandstone; minor pebble conglomerate. Cross-bedded, ripple-marked.	Moderately resistant - low sand-covered hills; small basal scarp in places.		Conformably overlain by the Mainoru Formation.	
	Lower (?) Proterozoic	MT. RIGG GROUP Dook Creek Formation (Poo)	1000	Dolomitic siltstone, algal dolomite, sandy and silty dolomite and limestone; oolitic dolomite and chert, cherty siltstone, quartz, sandstone, chert breccia.	Moderately resistant - undulating hills.	Mainly in central part of Sheet area.	Unconformably overlain by the Limmen Sandstone.	Contains algal structures. Host to Bulman Pb - Zn mineralisation.
		Bone Creek Formation (Pon)	250	Flaggy to blocky, finetto medium-grained, white to purple, quartz sandstone; minor glauconitic sandstone Cross bedded, ripple marked.	Resistant - cuestas	North east trending zone in west; mainly around head-waters of Wilton River.	Conformably overlain by the Dook Creek Formation.	Glauconitic towards top.
	Lower Proterozoic	KATHERINE RIVER GROUP West Branch Volcanics (Phw)	300+	Basalt, medium-grained, purple quartz greywacke.	Poorly resistant - low slightly undulating country.	Central west and southwest.	Unconformably overlain by Bone Creek Formation.	Very poorly exposed.
		Gundi Greywacke (Phg)	300	Massive and blocky purple to red brown quartz greywacke, feldspathic sandstone and quartz sandstone. Cross-bedded, ripple marked.	Resistant - elevated plateaux, where dissected forms rough hills.	Irregular zone from Blyth River in north to south-west corner of Sheet area.	Conformably overlain by West Branch Volcanics.	Strongly jointed
		McCaw Formation (Pha)	500+	Dolomitic siltstone, sandstone and quartz greywacke (some glauconitic) algal dolomite, dolutite, sandy and silty dolomite, basalt, sandstone, siltstone.	Poorly resistant - low undulating hills.	Mainly around head-waters of Wilton River.	Unconformably overlain by McCaw Formation.	Contains algal structures Numerous glauconitic beds present.
		Shadforth Sandstone (Phs)	350	Blocky medium grained white quartz sandstone, feldspathic quartz sandstone minor glauconitic sandstone. Cross bedded, ripple-marked.	Very resistant - strong cuestas.		Conformably overlain by McCaw Formation	Glauconitic towards top.
		Cottee Formation (Phc)	1000	Purple flaggy to dolomitic siltstone, algal dolomite, glauconitic dolomitic quartz greywacke dolarenite, sandy and silty dolomite, sandstone, siltstone, shale, basalt.	Poorly resistant - low undulating hills.		Unconformably overlain by Shadforth Sandstone.	Contains algal structures. Glauconitic in lower half.
		McKay Sandstone (Phm)	700	Ferruginous flaggy to blocky fine to medium grained purple-brown sandstone, feldspathic sandstone blocky white quartz sandstone, quartz greywacke.	Moderately resistant - undulating hills, occasional strike ridges.		Conformably overlain by Cottee Formation. In places overlaps Kombolgie Formation.	Laterally equivalent to upper part of Kombolgie Formation on the Milingimbi Sheet area.

ERA	AGE	ROCK UNIT AND SYMBOL		MAXIMUM THICKNESS IN FEET±	LITHOLOGY	PHYSIOGRAPHIC EXPRESSION	DISTRIBUTION	STRATIGRAPHIC RELATIONSHIPS	REMARKS
PRECAMBRIAN	Lower Proterozoic	KATHERINE RIVER GROUP	Kombolgie Formation (Bhk)	2,100	Excluding Member: Massive to flaggy, white, medium-grained quartz sandstone; feldspathic quartz sandstone; minor pebble-conglomerate. Cross-bedded ripple marked.	Very resistant - rough, elevated hills.	Large areas in North West.	Conformably overlain by McKay Sandstone.	Forms most of Arnhem Land Plateau strongly jointed.
			Nungbalgarri Volcanic Member (Bhn)	170	Fine to medium grained basalt; vesicular and amygdaloidal in places.	Poorly resistant - soil covered valleys.		Nungbalgarri Volcanic Member is underlain and overlain by arenites of the Formation.	Possibly andesite
	Lower Proterozoic (Agicondian System)	Jimbu Granite (Bgj)			Massive pink porphyritic microgranite; minor granophyre, pegmatites.	Poorly resistant - low sand covered rises.	Jimbu Creek, and in two domes to east.	Unconformably overlain by Kombolgie Formation and McKay Sandstone.	

McARTHUR BASIN SUCCESSION (PROTEROZOIC)

A sequence of about 10,000 feet of sedimentary and volcanic rocks unconformably overlies the Jimbu Granite. The rocks were deposited in the McArthur Basin which extended from beyond the Queensland-Northern Territory border in the south to the Arafura Sea, in the north. The thickest accumulations of sediments occurred in a narrow north-south zone trending through the Arnhem Bay and Blue Mud Bay Sheet areas and several Sheet areas to the south, (Dunn, et al, in prep.). On the Mount Marumba Sheet area, which was a relatively stable part of the McArthur Basin, the succession is divided into three Groups - the Katherine River, Mount Rigg and Roper Groups. The Katherine River Group is now regarded as Lower Proterozoic in age, but it was formerly thought to be Upper Proterozoic (Walpole, 1963; Randal, 1963; Ruker, 1962). The Mount Rigg Group is tentatively assigned to the Lower Proterozoic and the Roper Group tentatively to the Upper Proterozoic.

LOWER PROTEROZOIC

Katherine River Group: The Katherine River Group unconformably overlies the Jimbu Granite and is exposed in the north-western part of the Sheet area. Topographic relief in the basement and local tectonism affected the distribution of the sediments during the initial stages of sedimentation; the basal unit of the Group (the Kombolgie Formation) has been overlapped in places by the McKay Formation, which locally rests directly on the Jimbu Granite.

The Kombolgie Formation consists dominantly of medium and coarse-grained quartz sandstone, but basic intermediate volcanic flows occur in the middle part of the unit; the flows constitute the Nungbalgarri Volcanic Member. The Member is only poorly exposed but probably represents several separate lava flows; vesicular and amygdaloidal lavas are common. The sandstone beds above and below the Volcanic Member are similar; both are characteristically massive to flaggy, medium and coarse grained, cross-bedded, ripple-marked, and locally pebbly. Minor amounts of detrital feldspar occur in some beds.

The McKay Sandstone conformably overlies the Kombolgie Formation in the Mount Marumba Sheet area, but in the adjoining Milingimbi Sheet area the Sandstone grades laterally into the upper part of the Kombolgie Formation (Rix, 1963).

The unit consists dominantly of interbedded fine to medium-grained, purple-brown, ferruginous, flaggy to blocky sandstone, and fine-grained, flaggy, feldspathic, brown quartz sandstone. In general, the unit is more thinly bedded than the Kombolgie Formation, contains much more non-quartz detritus and is mostly finer-grained.

Rocks of the Cottee Formation conformably overlie the McKay Sandstone. The lower part of the unit consists of interbedded flaggy to fissile purple dolomitic siltstone and shale, glauconitic dolomitic quartz greywacke, quartz sandstone, dolarenite, sandy and silty dolomite, siltstone, shale and basalt. The upper part of the unit consists dominantly of purple algal dolomite composed almost entirely of hemispherical algal mounds with radii up to 30 feet (fig. 2). The mounds consist of concentric layers of laminated dolomite up to a few inches thick; the laminae are "wavy" and of algal origin.

Figure 2: Algal mounds in Cottee Formation

The Shadforth Sandstone overlies the Cottee Formation with slight angular unconformity; the unit consists essentially of blocky, medium-grained, white quartz sandstone with minor feldspathic zones. Thin beds of glauconitic quartz sandstone occur at the top of the unit.

The McCaw Formation conformably overlies the Shadforth Sandstone. The superphositional sequence within the unit is obscured by faulting and by the overlap of unconformably overlying strata, but purple dolomitic siltstone, fine-grained dolomitic sandstone and fine-grained, dolomitic, glauconitic quartz greywacke constitute a major portion of the unit; algal dolomite, silty and sandy dolomite, and dolutite are interbedded, and occasional beds of sandstone, siltstone and amygdaloidal basalt occur. The purple dolomitic siltstone beds locally contain halite pseudomorphs.

Arenites of the Gundi Greywacke unconformably overlie rocks of the McCaw Formation. The unit was first mapped by Ruker (1959) in the north-western part of the Katherine 1:250,000 Sheet area, where it contains much more non-quartz detritus than in this Sheet area. Ruker termed the unit the Gundi Greywacke Member of the Diljin Hill Formation; this nomenclature was subsequently used by Walpole (1963) and Randal (1963). The unit is here given formation status because of the wide areal extent of the unconformity at its base. In the Mount Marumba Sheet area the unit consists of massive and blocky arenites containing varying amounts of feldspar. At the base, red-brown quartz greywacke and feldspathic quartz sandstone are dominant but upwards white to red quartz sandstone becomes more prominent. Large scale cross beds and strong joints are features of the unit (Figure 3); ripple-marking is common.

Figure 3: Exposures of the Gundi Greywacke. Low areas are gullies incised along joint planes.

The West Branch Volcanics are poorly exposed and occur only in the centre-western part of the Sheet area. The Volcanics were formerly classified as a member of the Diljin Hill Formation on adjoining areas (Ruker, 1959; Randal, 1963; Walpole 1963). The unit is treated here as a formation and will be fully defined by Roberts & Dunn, (in prep.). The nature of the exposures of the unit on the Mt. Marumba Sheet area precludes establishing its basal relationship but Ruker (1959) reported a local unconformity between the unit and the underlying Gundi Greywacke. The only rocks of the unit exposed are basalt and medium-grained purple quartz greywacke.

LOWER (?)PROTEROZOIC

Mount Rigg Group. The Katherine River Group is unconformably overlain by the Mount Rigg Group. In the Mount Marumba Sheet area the latter consists of two units - the Bone Creek and Dook Creek Formations.

The Bone Creek Formation lies unconformably on the West Branch Volcanics; it contains conglomerate beds in the Katherine 1:250,000 Sheet area (Ruker, 1959; Randal, 1963), but on the Mount Marumba Sheet area the unit consists entirely of flaggy to blocky, fine to medium-grained, white to purple quartz sandstone with minor beds of flaggy, glauconitic sandstone near the top. The rocks are cross-bedded and ripple-marked.

The Dook Creek Formation conformably overlies the Bone Creek Formation. The unit contains cherty siltstone, dolomitic and calcareous siltstone, dolomite, limestone, silty and sandy dolomite and limestone, chert, quartz sandstone and chert breccia. The carbonate component of the 'liney' strata usually has the composition of a slightly calcitic dolomite, although dolomitic limestones occur in parts of the unit.

Algal structures are common in the relatively pure dolomites and limestones; the rocks are frequently exposed as discrete biohermal mounds or as groups of bioherms, particularly near the base of the sequence (west of Mt. Jean) and near the top, in the Bulman district (Figure 4). The thickness of the unit is difficult to estimate but is probably between 1000 and 2000 feet.

Figure 4: Algal structures in a bioherm of the Dook Creek Formation, Bulman district.

UPPER (?) PROTEROZOIC

Roper Group. Öpik (1952) recognised an unconformity in the Bulman district at the base of the present Roper Group. The unconformity has since been recognised over extensive areas of the McArthur Basin (Dunn, Smith & Roberts, in prep.). The Roper Group is a conformable sequence of arenites and lutites and has been divided into numerous stratigraphic units which show great lateral lithological consistency; many of the units have been mapped throughout the McArthur Basin.

The Limmen Sandstone is the basal unit of the Roper Group and unconformably overlies the Dook Creek Formation. A conglomerate occurs locally at the base of the unit and contains pebbles of chert, quartz sandstone and algal chert. Quartz sandstone overlies the conglomerate and forms the bulk of the unit. The sandstone is fine to medium-grained cross bedded and ripple-marked.

The Mainoru Formation consists of laminated, cream to buff, cherty siltstone, dolomitic and calcareous siltstone, sandy and silty limestone, and fine grained micaceous glauconitic sandstone. The latter forms the upper part of the unit. The carbonate-cherty siltstone sequence, which forms the lower part of the unit, is only poorly exposed; on the adjoining Urapunga Sheet area (Dunn, 1963) a limestone member (the Mountain Valley Member) has been differentiated in this part of the unit.

The Crawford Formation comprises interbedded blocky to massive, pink, micaceous quartz greywacke, flaggy purple micaceous sandstone and siltstone and micaceous glauconitic sandstone. Cross beds are common in the unit.

The overlying Abner Sandstone contains four Members. The lowest, the Arnold Sandstone Member, is lenticular, and consists of medium-grained quartz sandstone. The Jalboi Member overlies the Arnold Sandstone Member and is lithologically similar to the Crawford Formation. It is overlain by the Hodgson Sandstone Member, which consists of white, medium-grained quartz sandstone. The Munyi Member overlies the Hodgson Sandstone Member and consists of interbedded ferruginous sandstone and siltstone, with minor beds of quartz sandstone and micaceous shale. Cross-beds and ripple marks are common in the Abner Sandstone particularly in the three lower Members.

Rocks of the Corcoran Formation conformably overlie the Munyi Member. The Formation is poorly exposed in the Mount Marumba Sheet area; outcrops of flaggy micaceous quartz sandstone and quartz greywacke, shale, and siltstone occur, but represent only parts of the unit.

The Bessie Creek Sandstone, is a massive, medium-grained, white quartz sandstone; cross-beds and ripple marks are common.

Intrusive Rocks. Numerous dolerite sills and dykes intrude the Precambrian rocks. The sills extend over wide areas and are closely concordant with the bedding; their thickness is difficult to estimate from exposures, but in the Bulman district a drill intersected a sill 370 feet thick (Patterson, 1954). Some differentiation has occurred in the dolerite. Dykes are comparatively rare; the only one of mappable dimensions intrudes along a fault plane east of the Wilton River.

LOWER CRETACEOUS

The Mullaman Beds are exposed mainly in the south-west but outlying remnants occur at widely separated localities throughout the remainder of the Sheet area. Shelly fossils have been collected from one locality (TT64) north-west of Mount Jean; Skwarko (1963) has tentatively placed them in the Neocomian. Sandy siltstone and claystone, quartz sandstone, and clayey sandstone are the main rocks exposed.

CAINOZOIC

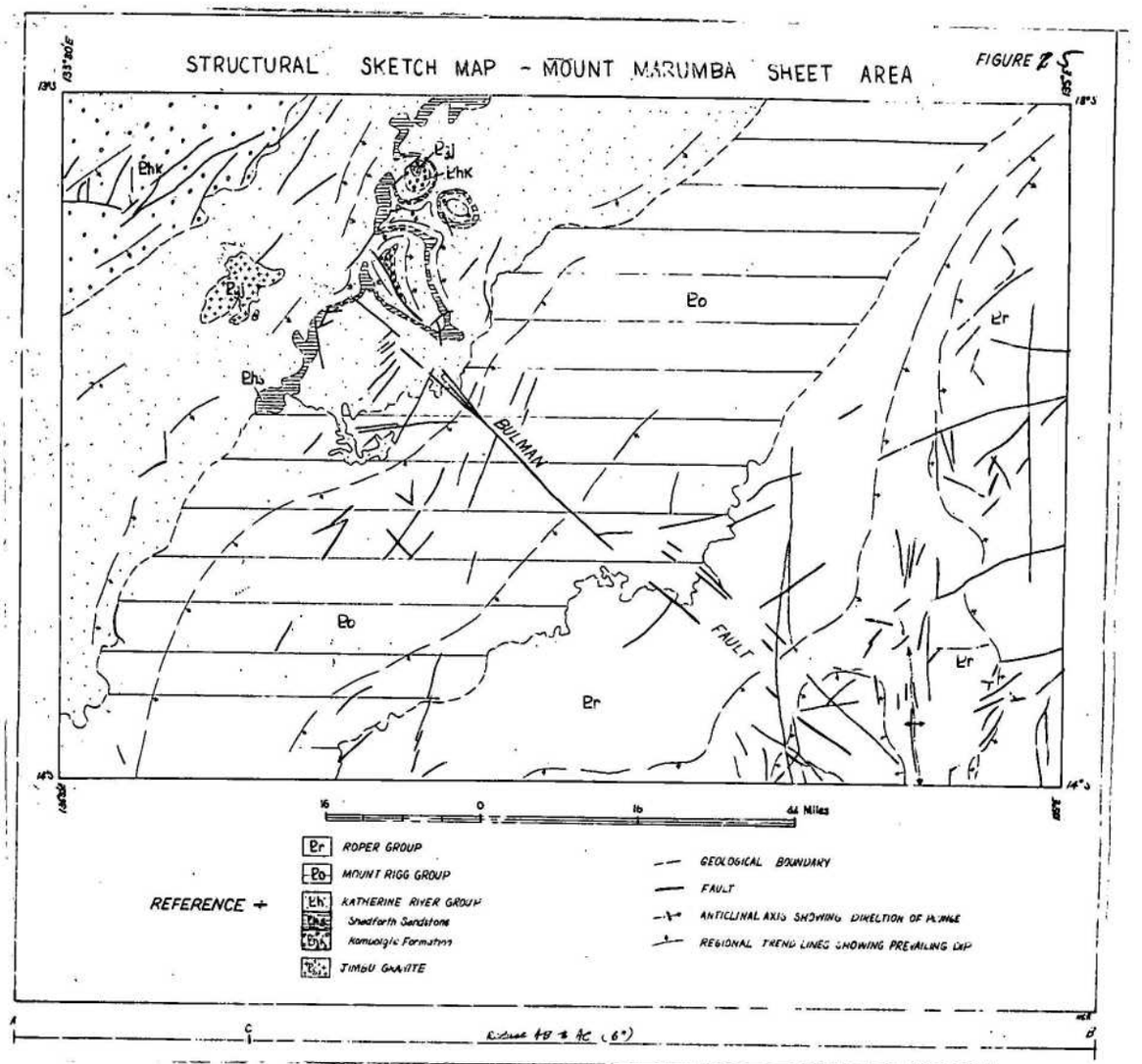
The Annie Creek Limestone is exposed in small areas along Annie Creek in the north-eastern part of the Sheet area. It lies unconformably on the Mainoru Formation, but its distribution in relation to Annie Creek suggests that it may also post-date the Lower Cretaceous strata. By analogy with similar deposits elsewhere in the Carpentaria Province the limestone is tentatively regarded as being of Tertiary age. The unit consists of massive, buff to grey limestone with a characteristic fluted weathering habit.

Considerable parts of the Sheet area are covered by laterite, lateritic soil and ferricrete (map symbol Czl), sand and residual soil (Czs), and alluvium (Qa). The laterite has developed on a number of rock units but mainly on the Mesozoic strata; in places pisolitic material is abundant. An analysis of a single sample of pisolitic laterite developed on Mesozoic clayey sandstone a few miles west of the main dome in the north-western part of the Sheet area showed it to contain 24.5% SiO_2, 43.3% Fe_2O_3 and 18.3% Al_2O_3; loss on ignition was 12.6% (R. Beevers, pers. comm.).

STRUCTURE

In the Mount Marumba Sheet area the rocks of the McArthur Basin succession, although faulted and locally folded retain the broad features assumed upon their deposition; they form a south-east dipping sequence with the oldest rocks, those of the Katherine River Group, exposed in the north-west and the youngest, those of the Roper Group, in the south-east (Figure 5).

Faulting. The most prominent fault in the Sheet area is the Bulman Fault which trends at 310°. The fault has a wrench component and probably also a slight vertical component; the southern block has moved to the west, but the displacement does not at nay point appear to be great.



Subsidiary faults parallel to the Bulman Fault also have wrench components.

A major set of faults trends between 360° and 025°; these are probably mostly normal faults; displacement rarely exceeds 200 feet. A second group of normal faults trend roughly north-east and similarly show little vertical displacement; the faults are usually less persistent than the former set.

Folding. Three domes occur in the north-western part of the Sheet area. The largest is about 12 miles long and 6 miles wide; the long axis trends about north-north-west. The smaller domes are almost circular and are from 4 to 6 miles wide. Dips on the limbs of the three domes are mostly between 15 and 25°. The presence of such prominent structures in an otherwise shallowly dipping sequence is anomalous. Exposures of basement rocks in the core of two of the domes and the abutment unconformity between the basement rocks and the overlying sediments suggests that the structures may be due partly to initial topographic irregularities in the basement - the attitude of the various stratigraphic units

indicates that the most of the doming occurred before the deposition of the Gundi Greywacke; slight movements subsequent to its deposition are indicated by curved joints in the Greywacke in the triangle between the domes.

A broad anticline with shallowly dipping limbs occurs in the south-eastern part of the Sheet area. The axis trends at 350° and is parallel to faults which may be responsible for the structure.

Jointing. Jointing is a common feature in many of the stratigraphic units. The most conspicuous joints are in the arenites of the Kombolgie Formation, particularly where the rocks are horizontal or gently dipping. Joints are also conspicuous in the Gundi Greywacke (Figure 3), the Dook Creek Formation, and Limmen Sandstone, the Arnold and Hodgson Sandstone Members of the Abner Sandstone, and in the dolerite sills.

GEOLOGICAL HISTORY

The oldest rocks in the Sheet area are those of the Jimbu Granite; they possibly intruded sedimentary rocks of the Agicondian System. A period of erosion subsequent to the intrusion of the Jimbu Granite was succeeded by the subsidence of a vast area (the McArthur Basin) extending from Arnhem Land, south-eastwards to beyond the Queensland border. The subsidence was accompanied by the accumulation of thick deposits of clastic, bioclastic, biogenic and chemical sediments and, locally, the extrusion of basic or intermediate lavas. Areas of relatively high topographic relief in the basement initially persisted as non-depositional surfaces, but were ultimately buried under substantial thicknesses of sediment. The Sheet area was a relatively stable part of the McArthur Basin; the maximum thickness of strata, deposited was about 10,000 feet whereas 35,000 feet of equivalent strata were deposited further east in the Blue Mud Bay Sheet area.

Local unconformities developed in the Mount Marumba Sheet area in response to slight tectonic adjustments, but to the east sedimentation proceeded without interruption. The only unconformity which can be traced to the east is at the base of the Roper Group. Slight, but widespread, erosion of the Mount Rigg Group and its equivalents resulted from positive regional epeiregenic movements. The deposition of the Roper

Group was followed by the intrusion of extensive dolerite sills and dykes. Faulting and minor folding in Precambrian times was followed by erosion. The next recorded event was the deposition of the Mullaman Beds in the Lower Cretaceous. Epeirogenic uplift or marine regression exposed the Mullaman Beds to lateritisation either in the late Cretaceous or early Tertiary. Either prior to the lateritisation or more likely, subsequent to it, the Annie Creek Limestone was deposited, probably in a freshwater lacustrine environment. Further uplift induced the present erosion cycle.

ECONOMIC GEOLOGY

Zinc and Lead. Deposits of zinc and lead were discovered in the Bulman Waterhole district about 1910. The deposits were worked briefly in 1910-11 and again in 1925, and although no records are available, the extent of the workings suggests that production was not very substantial. The Enterprise Exploration Company became interested in the deposits in 1952, and has subsequently conducted numerous investigations of the mineralized area.

The known deposits occur within an area, 8 miles by 4 miles, west of Mount Marumba. The host rocks are near-horizontal beds of dolomite, limestone, and chert, in the upper part of the Dook Creek Formation. The three largest groups of deposits occur about 1 mile west of the Wilton River. Here a cellular crust composed of oxidised zinc and lead minerals is the main surface expression of the deposits. The crust is from 1 to 2 feet thick and is underlain by horizontally bedded rocks containing relatively higher proportions of zinc than lead. The mineralization extends to depths ranging from 17 to 25 feet; the ore shoots are bounded by vertical walls which suggests that they may be localized along joints and fractures. It is possible that the lead and zinc minerals were deposited syngenetically and were mobilized by a dolerite sill which was intruded less than 60 feet stratigraphically below the mineralised pockets. Subsequent erosion, leaching and oxidation has left the deposits in their present form. Knight (1952) estimated the Bulman deposits to contain 375,000 tons of ore averaging 2% lead and 15% zinc.

Water. No bores have been sunk specifically for water, but the Enterprise Exploration Coy's number 2 Bore, drilled in 1953 to test mineralisation in the Bulman district, encountered artesian water at 400 feet at the contact of a dolerite sill with underlying dolomitic strata (Patterson, 1954). Patterson suggests that the artesian water is derived from a local depression coinciding with the maximum thickness of the dolerite sill; the initial flow was 360 gallons per hour, but it has diminished and in 1963 amounted to less than 50 gallons per hour.

Permanent surface water is confined mainly to isolated waterholes along the lower part of the Wilton River and along the Mann River.

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AUSTRALIA 1:250,000

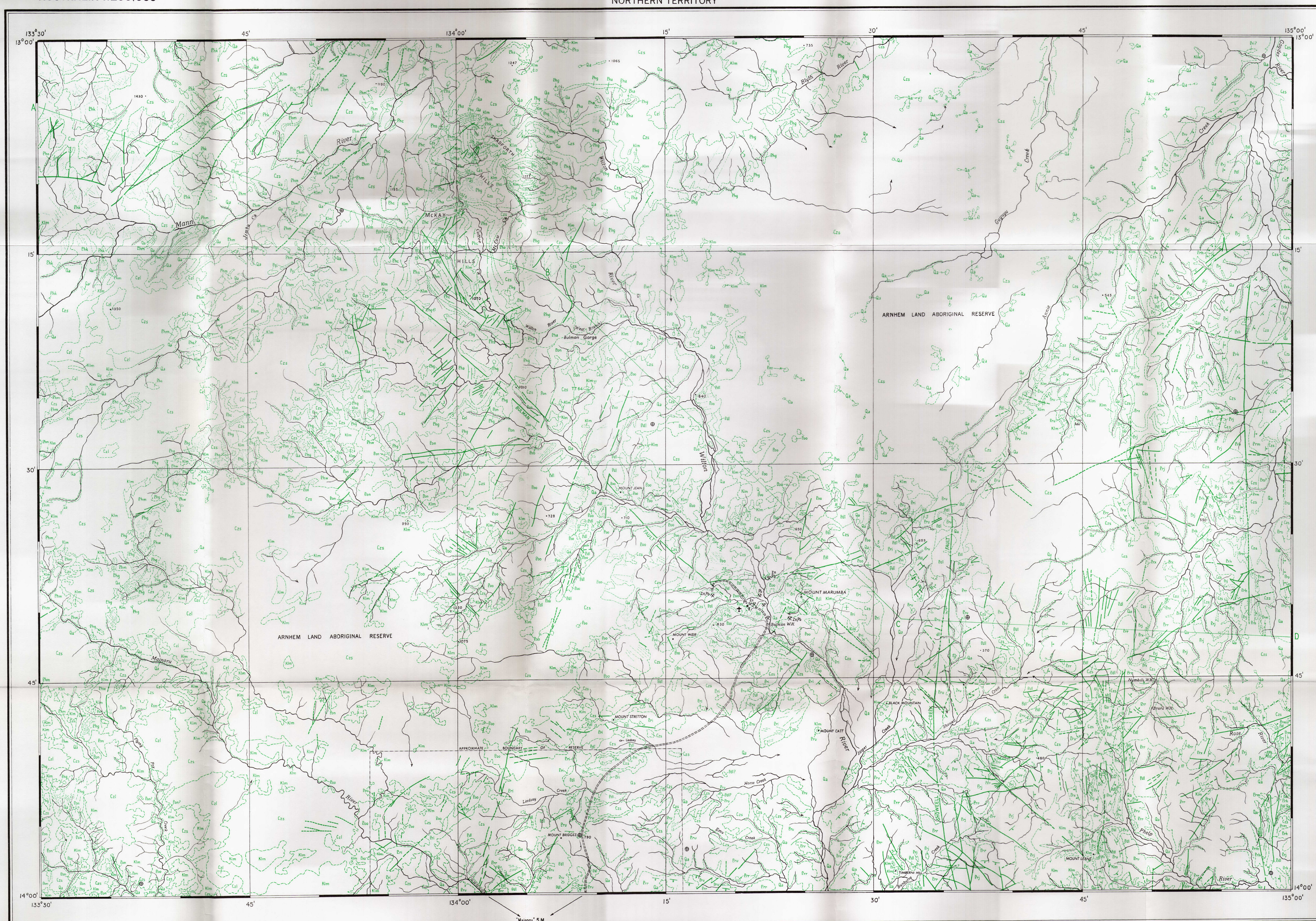
MOUNT MARUMBA

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SD 53-6

PRELIMINARY EDITION, 1963

SUBJECT TO AMENDMENT



Reference

			Symbol	Description
CAINOZOIC	QUATERNARY		Qa	*Alluvium*
	UNDIFFERENTIATED		Czs	*Sand, residual soil*
			Czl	*Laterite, lateritic soil*
	TERTIARY ?	Annie Creek Limestone	Ta	*Massive buff to grey limestone*
MESOZOIC	LOWER CRETACEOUS	Mullaman Beds	Klm	*Massive white to yellow sandy siltstone and claystone; quartz sandstone, clayey sandstone*
PRECAMBRIAN	UPPER(?) PROTEROZOIC		Ꝑdl	*Fine to coarse dolerite; porphyritic and vesicular dolerite*
		Roper Group: Bessie Creek Sandstone	Ꝑre	*Massive, fine to medium, friable quartz sandstone*
		Corcoran Formation	Ꝑro	*Flaggy micaceous quartz sandstone, micaceous quartz greywacke, shale, siltstone*
		Abner Sandstone: Munyi Member	Ꝑrm	*Ferruginous sandstone and siltstone; minor quartz sandstone, micaceous shale*
		Hodgson Sandstone Member	Ꝑrh	*Blocky to massive, friable, medium-grained quartz sandstone*
		Jalboi Member	Ꝑrj	*Flaggy glauconitic micaceous sandstone and siltstone, quartz greywacke, blocky, white quartz sandstone*
		Arnold Sandstone Member	Ꝑrx	*Blocky to massive, medium quartz sandstone*
		Crawford Formation	Ꝑrr	*Blocky to massive pink micaceous quartz greywacke; flaggy purple micaceous sandstone, siltstone; micaceous glauconitic sandstone*
		Mainoru Formation	Ꝑru	*Flaggy laminated cherty siltstone and dolomitic siltstone, purple micaceous shale and glauconitic sandstone*
		Limmen Sandstone	Ꝑri	*Massive to flaggy, fine to medium quartz sandstone; minor pebble conglomerate*
	LOWER(?) PROTEROZOIC	Mt Rigg Group: Dook Creek Formation	Ꝑoo	*Dolomitic siltstone, algal dolomite, sandy and silty dolomite, chert, cherty siltstone, quartz sandstone, chert breccia*
		Bone Creek Formation	Ꝑon	*Flaggy to blocky, fine to medium quartz sandstone; minor glauconitic sandstone*
	LOWER PROTEROZOIC	Katherine River Group: West Branch Volcanics	Ꝑhw	*Amygdaloidal basalt, tuff, medium to coarse-grained greywacke*
		Gundi Greywacke	Ꝑhg	*Massive and blocky purple to red-brown quartz greywacke, feldspathic sandstone and quartz sandstone*
		McCaw Formation	Ꝑha	*Dolomitic siltstone, sandstone and quartz greywacke (some glauconitic); dolomite, dolutite, sandy and silty dolomite, basalt, sandstone, siltstone*
		Shadforth Sandstone	Ꝑhs	*Blocky medium white quartz sandstone, some feldspathic; minor glauconitic sandstone*
		Cottee Formation	Ꝑhc	*Purple flaggy dolomitic siltstone, algal dolomite, glauconitic dolomitic quartz greywacke, dolarenite, sandy and silty dolomite, sandstone, siltstone, shale, basalt*
		McKay Sandstone	Ꝑhm	*Ferruginous flaggy to blocky fine to medium sandstone, feldspathic sandstone, blocky white quartz sandstone*
		Kombolgie Formation	Ꝑhk	*Massive to flaggy white medium quartz sandstone, some feldspathic; minor pebble conglomerate*
		Nungbalgarri Volcanic Member	Ꝑhn	*Fine to medium-grained basalt*
	LOWER PROTEROZOIC (AGICONDIAN SYSTEM)	Jimbu Granite	Ꝑgi	*Massive pink porphyritic microgranite*

Geological boundary
Anticline showing plunge
Fault
Where location of boundaries, faults and folds is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes
10 *Strike and dip of strata*
Horizontal strata
Dip < 15° } *air-photo interpretation*
Trend lines
Joint pattern

TT64 *Macrofossil locality*
x2 *Age determination sample locality*
dl *Dyke: dl = dolerite*

Pb *Mine: Pb = Lead, Zn = Zinc*
B *Bore*
Spring
WH *Waterhole*

Vehicle track
Approximate boundary of Aboriginal Reserve
Landing ground
Astronomical station
.1075 *Height in feet, barometric; datum, mean sea level*

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Royal Australian Survey Corps. Aerial photography by the Royal Australian Air Force; complete vertical coverage at 1:50,000 scale. Transverse Mercator Projection.

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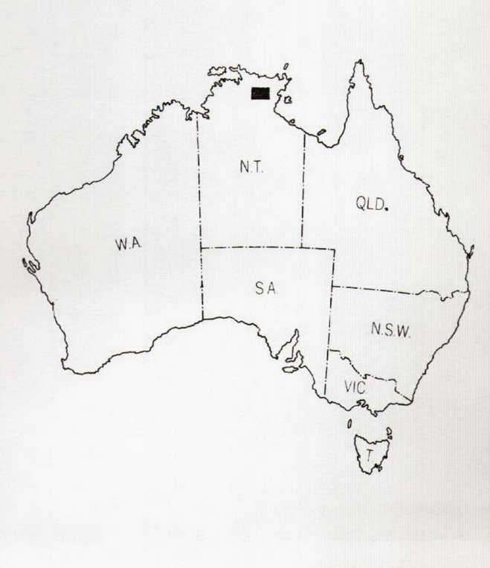
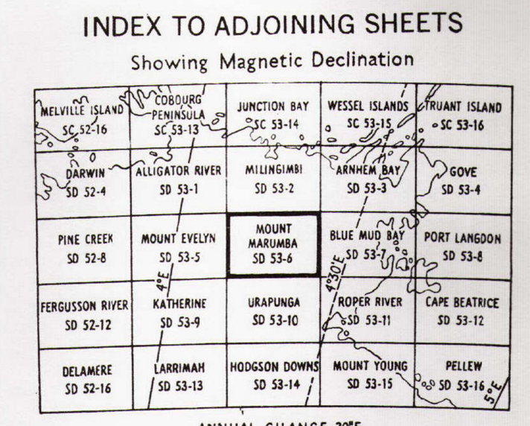
Drawn by: A.S. Mikolajczak and G. Matveev



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination

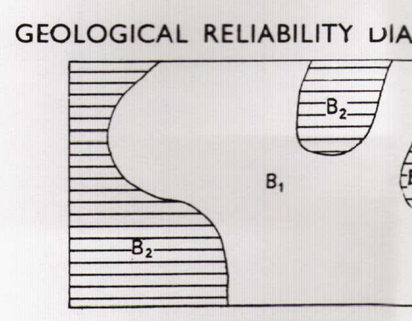


Scale 1 : 250,000

5 0 5 10 15 MILES

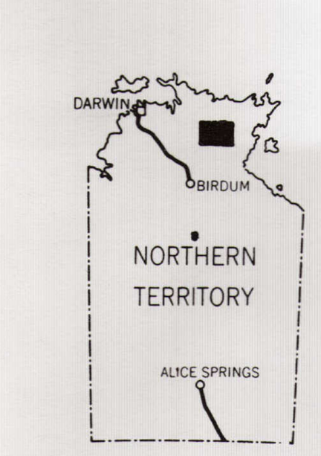
5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM

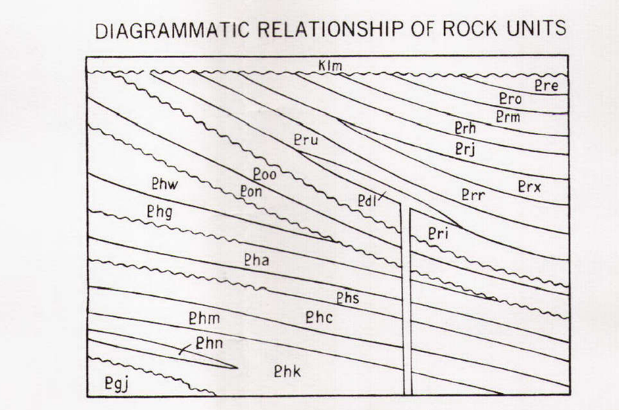


B₁ *Numerous traverses with air-photo interpretation*

B₂ *Helicopter traverses with air-photo interpretation*



DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

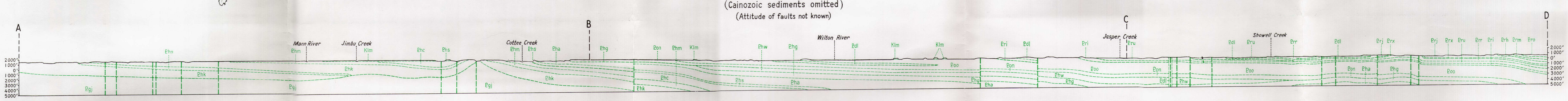


Section

Scale: $\frac{V}{H} = 2$

(Cainozoic sediments omitted)

(Attitude of faults not known)



MOUNT MARUMBA

SD 53-6