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EXPLANATORY NOTES ON THE WALLHALLOW 1:250,000 GEOLOGICAL SHEET SERIES SE53-7, NORTHERN TERRITORY.

Compiled by

K.A.Plumb and J.M.Rhodes

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EXPLANATORY NOTES ON THE WALLHALLOW 1:250,000 GEOLOGICAL SHEET

INTRODUCTION

The Wallhallow 1:250,000 Sheet area lies between latitudes 17°00'S and 18°00'S and longitudes 135°00'E and 136°30'E. It is situated on the northern edge of the Barkly Tableland.

The only permanent settlements in the Sheet area are the homesteads of Creswell Downs, Anthony Lagoon and Wallhallow Stations, and a Police Station at Anthony Lagoon. The permanent population of these stations is about 20 Europeans plus a variable number of aborigines. Access to the Sheet area is by means of graded roads, passable in dry weather only, which link Creswell Downs and Anthony Lagoon to Frewena on the Barkly Highway and Elliott on the Stuart Highway. A graded road passes through the middle of the Sheet area linking Anthony Lagoon and Creswell Downs with Borroloola, (to the north), and a vehicle track links Creswell Downs with Robinson River Homestead to the north-east. Anthony Lagoon and Creswell Downs have a weekly air service from Mount Isa and Tennant Creek.

Maps and air photographs of the Sheet area available during the survey were:-
air photographs at a scale of 1:50,000 flown by the Royal Australian Air Force in 1947 and a planimetric map at a scale of 1:250,000 prepared in 1961 by the Division of National Mapping, Department of National Development from a controlled, photo-scale, slotted template assembly. The accompanying geological map was compiled on the photo-scale assembly and subsequently reduced to 1:250,000 scale.

PREVIOUS INVESTIGATIONS

Woolnough (1912) and Jensen (1914) passed through the area during reconnaissance traverses. Noakes and Traves (1954) carried out brief investigations of the Sheet area during the C.S.I.R.O. Survey of the Barkly Region in 1947-48 and Hossfeld (1954) passed through the Sheet area during his study of the geology of the Northern Territory. Geologists from Mount Isa Mines Limited (Kriewaldt, 1957) touched on areas in the north of the area during surveys of the McArthur River and Robinson River areas.

These notes, and the geological map which they accompany, are based on work carried out during 1961 and 1962 by

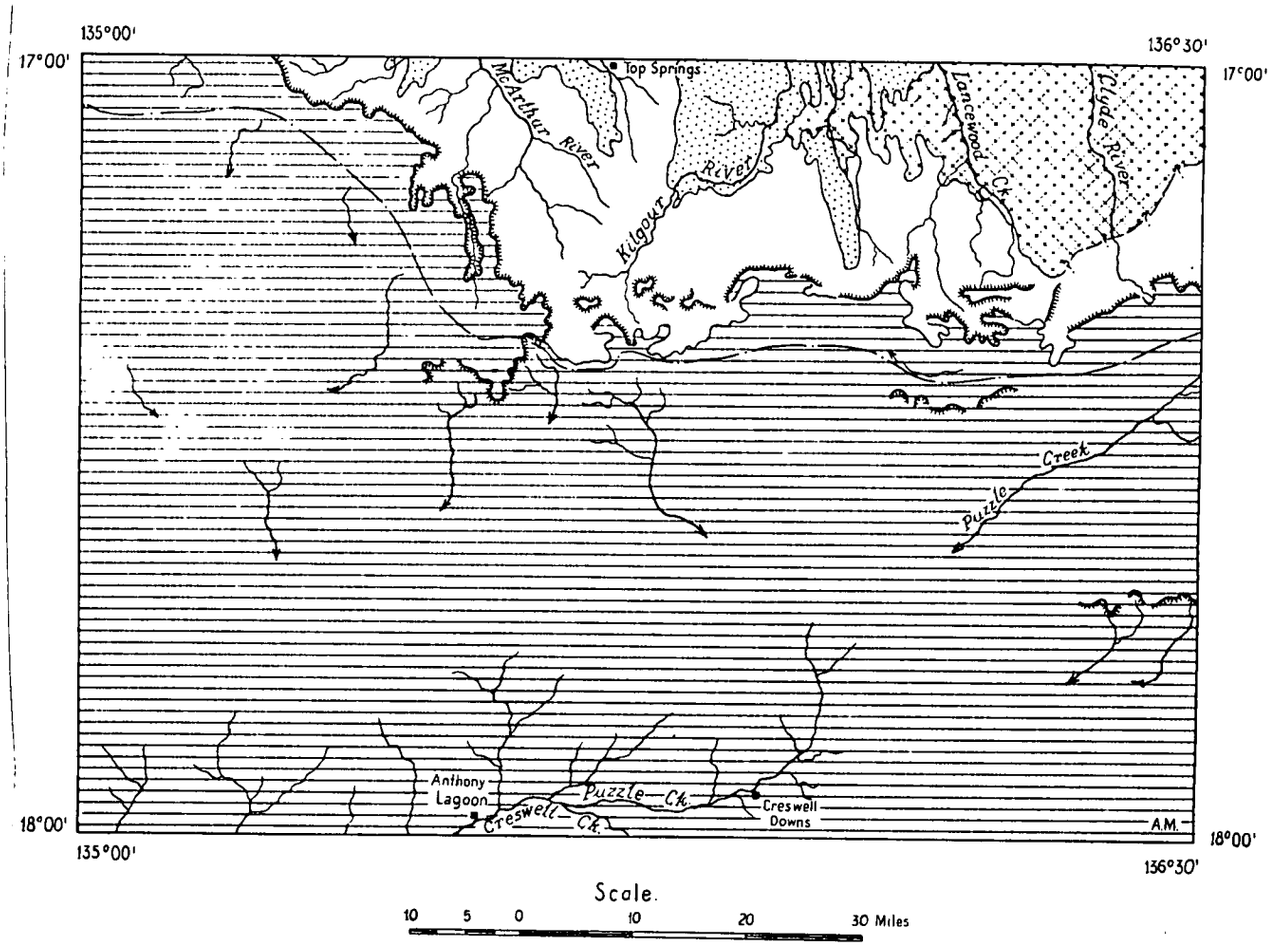
geologists of the Bureau of Mineral Resources. Three of the adjoining Sheet areas - Bauhinia Downs (Smith, 1963), Calvert Hills (Roberts, Rhodes and Yates, 1963) and Brunette Downs (Randal and Nichols) have been mapped by the Bureau.

PHYSIOGRAPHY

Parts of two of the major physiographic units of the Carpentaria Province, the Barkly-Birdum Tableland and the Gulf Fall occur within the Sheet area (Dunn, Smith and Roberts, in preparation). The distribution of the physiographic units is shown in Figure 1.

Fig.1

PHYSIOGRAPHIC SKETCH MAP-WALLHALLOW SHEET AREA



Bureau of Mineral Resources Geology and Geophysics, May 1962

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Drainage: Two distinct drainage systems are found on the Sheet area. The Barkly-Birdum Tableland is drained by a south-flowing, internal drainage system comprised of shallow, meandering, non-perennial streams. Many of the minor streams disappear into the plains of the Tableland, but Puzzle Creek and Creswell Creek join and flow into Tarrabool Lake, 25 miles south-west of Anthony Lagoon Homestead.

The drainage in the Gulf Fall is towards the north and contains the headwaters of the McArthur, Kilgour and Clyde Rivers; the Kilgour and Clyde Rivers join the McArthur River about 30 to 40 miles north of the Sheet area. The latter flows into the Gulf of Carpentaria about 80 miles north of the Sheet area.

The main elements of the stream pattern developed on horizontal Mesozoic and Cambrian rocks and have been subsequently superimposed, in places, on the Proterozoic rocks. Minor subsequent streams are controlled by the structure and lithology of the Proterozoic rocks and the Bukalara Sandstone. The major superimposed streams flow in meandering gorges up to 300 feet deep.

Barkly-Birdum Tableland: The main physiographic unit of the Wallhallow Sheet area is the Barkly-Birdum Tableland, which extends over the southern, central and western parts of the Sheet area. The bed-rock of the northern part of the Tableland, is horizontal Lower Cretaceous sediments; the southern part is underlain by flat-lying Cambrian sediments. Extensive Tertiary laterite caps the Lower Cretaceous rocks and in places the Cambrian rocks. Most of the Cambrian rocks are covered by black soil plains, which, however, also cover areas of Lower Cretaceous rocks where the Ferruginous zone of the laterite profile has been eroded.

The northern edge of the Tableland is marked by a continuous, prominent scarp up to 200 feet high; it shows active scarp retreat. Relief on the Tableland is low. The maximum elevations, up to 1050 feet, occur at the northern edge of the Tableland and gradually decrease southwards to a minimum of 720 feet at Anthony Lagoon Homestead. The laterite outcrops form low rises about 10 to 20 feet above the surrounding areas of soil with small scarps about 30 feet high in places.

The Tableland is a very stable land surface; the present topography is essentially the same as the original Tertiary laterite and black soil plain. The only modification is scarp retreat from the north, initiated by epeirogenic uplift.

Gulf Fall: The Gulf Fall comprises the dissected area to the north of the Barkly-Birdum Tableland; within this area three physiographic subdivisions can be recognised, the Top Springs Erosion Surface, the Bukalara Plateau and the Dissected Gulf Fall.

The Top Springs Erosion Surface is a generally flat area with elevations of about 750 feet. Most of the area is covered by outcrops of the Top Springs Limestone, with small outliers of Mesozoic sandstone and black soil. The southern part of the area is undulating and slopes gradually up to the marginal scarp of the Barkly-Birdum Tableland. Erosional remnants of the Tableland are present as laterite-capped mesas.

The Bukalara Plateau occurs in the north-east corner of the Sheet area. It lies about 30 feet below the lower level of the Top Springs Erosion Surface. The Plateau has been dissected by the Clyde River and Lancewood Creek, and their tributaries, which flow in narrow, steep-sided gorges up to about 150 feet deep. The bed-rock of the Plateau is the horizontal Bukalara Sandstone. This is covered in many places by sand and locally, by a thin veneer of soil derived from the overlying Lower Cretaceous rocks. The Plateau extends onto the adjoining Bauhinia Downs, Robinson River and Calvert Hills Sheet areas where it is bounded by prominent scarps up to 200 feet high. On the Wallhallow Sheet area the boundaries are poorly defined and the Plateau merges imperceptibly into the Top Springs Erosion Surface.

Erosion of the Top Springs Erosion Surface has exposed the underlying folded and faulted Proterozoic rocks within the Dissected Gulf Fall. Near the headwaters of Spellesie Creek and in the area south-west of Top Springs Homestead outcrops of Proterozoic rocks project about 50 feet above the level of the Top Springs Erosion Surface. The present topography results from the differential erosion of the Proterozoic rocks by superimposed drainage. The maximum relief, of about 300 feet, is developed in the superimposed gorges of the Kilgour River.

STRATIGRAPHY

The stratigraphy of the Sheet area is summarized in Table 1. The oldest rocks exposed in the area are part of a thick and widespread sequence of Proterozoic sediments and volcanics; these have been divided into three groups: the Tawallah, the McArthur, and Roper Groups. The South

Nicholson Group is a lateral equivalent of the Roper Group.

These rocks are unconformably overlain by the Bukalara Sandstone, of Lower Cambrian age which is overlain by the Cambrian Top Springs Limestone and Anthony Lagoon Beds with slight unconformity. Lower Cretaceous sediments unconformably overlie the older rocks and large parts of the area are covered by Cainozoic limestone, soils and laterite.

PRECAMBRIAN

PROTEROZOIC

The Proterozoic rocks of the Sheet area were deposited in the McArthur Basin which extends from the Queensland border in the south-east to Arnhem Land in the north (Dunn, Smith and Roberts, in prep.).

Age of the Units: Woolnough (1912) classified all the rocks in the Sheet area, including both the limestones of the Barkly-Birdum Tableland and the underlying dolomites (McArthur Group) and sandstones (Roper Group) as Cambrian. Noakes and Traves (1954) recognised an unconformity in the succession and included the older rocks in their Carpentaria Complex, of Lower Proterozoic age. Hossfeld (1954) considered the dolomites of the McArthur River area (McArthur Group) to be Middle to Upper Proterozoic and this was later supported by Noakes (1956).

On the basis of radiometric age determinations made at the Australian National University (A. W. Webb and I. McDougall, pers. comm.), the oldest rocks of the Sheet area, those of the Tawallah Group, are now regarded as being of Lower Proterozoic age. The McArthur Group is placed tentatively in the Lower Proterozoic and the Roper Group tentatively in the Upper Proterozoic.

LOWER PROTEROZOIC

Tawallah Group: The section of Tawallah Group rocks exposed on the Wallhallow Sheet area is incomplete. The lowest unit, the Westmoreland Conglomerate, crops out in only one isolated locality in the south-east corner of the Sheet area and its identification as Westmoreland Conglomerate is doubtful, being based largely on regional trends.

The Peters Creek Volcanics are confined to one small area of poor outcrop near Spellesie Creek and very little is known about them on the Sheet area. Elsewhere in the Carpentaria Province they consist of altered basalt with

amygdales of quartz, microcline, chlorite and epidote, and are up to 3000 feet thick.

Exposures of the McDermott Formation also are few. In the west there is an incomplete section about 1000 feet thick but in the east it appears to be only about 400 feet.

The Sly Creek Sandstone on the Wallhallow area is unusual in that it contains alternating ferruginous sandstone and quartz sandstone; on the adjoining Sheet area the formation consists almost entirely of flaggy quartz sandstone.

A purple siltstone is usually present at the base of the Settlement Creek Volcanics and tuffaceous sediments are interbedded with the basalt, which is invariably weathered to a red ferruginous rock in which the feldspar is replaced by fine hematite. Elsewhere in the McArthur Basin the rocks are andesine basalt, frequently altered to a chlorite-calcite-uralite-amphibole assemblage.

Immediately north of Kilgour Mine the contact between the Settlement Creek Volcanics and the overlying Wollogorang Formation is gradational: elsewhere it is sharp. A consistent bed of dolomitic siltstone, about 20 feet thick, containing limestone nodules about 4 inches across and underlain by a characteristic bed of algal dolomite occurs in the unit. Similar beds are present 120 miles to the east on the Calvert Hills Sheet area (Roberts, Rhodes, and Yates, 1963).

The Masterton Formation is uniform in lithology over wide areas. It grades from ferruginous sandstone at the base to pink quartz sandstone at the top.

LOWER PROTEROZOIC (?)

McArthur Group: During part of the deposition of the McArthur Group a reef developed along a hinge-line to the north of the Sheet area; fore-reef sediments were deposited in the north-east where subsidence was greatest, and back-reef sediments with evaporites were deposited in the south-west. The Wallhallow Sheet area lies within the shelf area to the south-west; the Tooganinie Formation represents the back-reef facies.

The dominant lithology of the Mallapunyah Formation, the oldest unit of the Group, is flaggy, purple-brown to chocolate-brown siltstone but it rarely crops out; most of the exposures are of flaggy quartz sandstone. Persistent beds within the Formation include an algal chert near the base and, a little higher a bed of flaggy dolomitic

sandstone with halite pseudomorphs. Near the middle of the Formation botryoidal quartz occurs in clusters up to 18 inches across.

The Amelia Dolomite consists mainly of flaggy and massive dolomite with minor interbedded siltstone. Algae are common as irregularly distributed colonies in the dolomite. Massive outcrops of dolomite occur in dissected areas but in areas of poor relief only scattered boulders crop out.

The overlying Tatoola Sandstone is a good marker bed. Dolomite is generally leached from the dolomitic sandstones in outcrop producing porous purple sandstone. The lower half of the formation contains flaggy fine grained sandstone and the upper half is generally medium grained cross-bedded sandstone.

The Tooganinie Formation was deposited in a back-reef environment and contains a wide range of dolomitic sediments. The characteristic feature of the unit is the regularly alternating sequence of algal dolomite, massive dolomite, laminated dolomite, siltstone and flaggy red fine grained sandstone with abundant halite pseudomorphs. The Leila Sandstone Member occurs about 200 feet below the top of the formation and varies in thickness from about 250 feet in the west to 20 feet in the east. In places it is too thin to be mapped. Above the Leila Sandstone Member the Tooganinie Formation consists dominantly of siltstone which crops out poorly.

Although a large part of the Emmerugga Dolomite, especially near the base, contains the same lithologies as the underlying Tooganinie Formation, massive dolomite is more common. The base of the unit is taken as a prominent scarp which forms above the poorly outcropping siltstones at the top of the Tooganinie Formation. Higher in the unit the main rock type is massive fine dolomite, with little bedding and containing large algae up to 2 feet across. The section of Emmerugga Dolomite on the Sheet area is incomplete.

In places the Emmerugga Dolomite is overlain by a facies equivalent, the Billengarrah Formation.

UPPER(?) PROTEROZOIC

South Nicholson Group: A few small, isolated outcrops of quartz sandstone in the extreme south-east corner of the Sheet area have been mapped as Mittiebah Sandstone, the uppermost unit of the South Nicholson Group, which crops out extensively on Mount Drummond 1:250,000 Sheet area to the

south-east (Smith and Roberts, 1963). The South Nicholson Group is considered to be stratigraphically equivalent to the Roper Group; the Mittiebah Sandstone is probably equivalent to the Abner Sandstone.

Roper Group: The section of Roper Group sediments in the Wallhallow Sheet area is incomplete; outcrops are confined to a small area near the Yah-Yah Copper Mine in the north-west corner of the Sheet area. These outcrops are the southerly limit of a line of strike ridges which continue to the Roper River, 180 miles to the north.

The Limmen Sandstone rests on the Emmerugga Dolomite with an angular unconformity. Conglomerate at the base of the unit contain pebbles derived from the underlying McArthur Group sediments and irregularities in the depositional surface can be seen.

The contact between the poorly outcropping Mainoru Formation and the overlying Crawford Formation is gradational. A persistent bed of massive brown quartz greywacke, at the base of a prominent scarp, is taken as the base of the Crawford Formation. The abundance of glauconite is characteristic of the Crawford Formation.

The Arnold Sandstone Member of the Abner Sandstone, consists of massive quartz sandstone and caps the Crawford Formation scarp and is an excellent marker bed.

PALAEOZOIC

LOWER CAMBRIAN

Outcrops of the Bukalara Sandstone are confined to the north-east corner of the Sheet area. It is horizontal and overlies the Proterozoic rocks with strong unconformity. The unit consists of buff coloured, massive, medium-grained feldspathic sandstone and quartz sandstone with lenses of conglomerate in places; large scale cross-bedding is characteristic. A prominent, west striking joint system gives the sandstone a distinct photo-pattern. The Bukalara Sandstone forms a widespread plateau which covers the Proterozoic rocks completely except for small valley inliers. The sandstone is overlain with slight unconformity by the fossiliferous Middle Cambrian Top Springs Limestone; in view of this and in view of its strong unconformity with the Proterozoic strata the unit is assigned to the Lower Cambrian.

CAMBRIAN

The Top Springs Limestone, is a thin, widespread formation of uniform lithology; the main rock type is a massive, yellow-brown, fine-grained limestone with scattered coarse, calcite crystals. Minor brown-grey silty limestone, limestone breccia and algal structures are present.

The formation is horizontal and crops out as massive low boulders. Over most of the area of outcrop the formation sits directly on the Proterozoic rocks with angular unconformity. In the east it overlaps onto the Bukalara Sandstone, which it overlies with apparent slight unconformity; a possible fossil soil profile has been observed at the contact.

Trilobites, found in 1962 in a brown-grey silty limestone near Top Springs Homestead (Randal and Nichols, 1963), have been identified by Dr. A. A. Opik (pers. comm.) as Redlichia, related to Redlichia forresti (Etheridge jun.), from the Negri Sequence of North-west Australia of early Middle Cambrian age; however, he points out that the Negri may extend into the latest Lower Cambrian, and this should be considered in dating the new find.

The Anthony Lagoon Beds crop out very poorly as rubble and isolated boulders within the black soil plains in the southern part of the Sheet area; better exposures occur on the Brunette Downs Sheet area to the south (Randal and Nichols, 1963), where the thickness is estimated to be over 700 feet.

The lithologies observed in outcrop are massive, yellow-brown to buff, interbedded coarse grained dolomite and fine-grained limestone with scattered coarse calcite crystals; massive, grey, fine-grained calcareous sandstone, chert, and silicified limestone also occur.

No fossils have been found on the Sheet area, but algae(?) and trilobite fragments have been found to the north-west of Brunette Downs Homestead (Randal and Nichols, 1963). The Anthony Lagoon Beds possibly overlie the Top Springs Limestone; these units form part of the widespread carbonate rocks of Middle Cambrian age on the Barkly Tableland.

MESOZOIC

LOWER CRETACEOUS

Undifferentiated Lower Cretaceous rocks crop out in the scarp at the northern-edge of the Barkly-Birdum Tableland and extend southwards almost to the southern border of the Sheet area, but outcrop is limited to small scarps and gullies by

extensive soil cover.

In the north scattered, thin outliers of massive white quartz sandstone, with plant remains, sit unconformably on the Bukalara Sandstone and the Top Springs Limestone.

Overlying this sandstone, in the scarp of the Barkly-Birdum Tableland, is a sequence up to 200 feet thick of massive grey calcareous siltstone containing gypsum and claystone with interbeds of massive clayey sandstone, ferruginous sandstone and flaggy micaceous sandstone. Foraminifera from the siltstone include Ammodiscus cretaceous (Reuss) Haplophragmoides dickinsoni Crespin; Haplophragmoides cf. gigas Cushman; Haplaphragmoides cf. wilgunyanensis sp. nov. Crespin M.S.; Trochammina sp. and some unidentified Radiolaria (G. R. J. Terpstra, pers. comm.). These indicate a Lower Cretaceous age; probably Albian.

The Lower Cretaceous rocks have been subjected to intense lateritization and most of the delineated outcrops occur within the pallid zone of the laterite profile; the grey calcareous siltstone has been leached to a porous white siltstone.

CAINOZOIC

TERTIARY

The Brunette Limestone (Noakes and Traves, 1954) crops out as scattered blocks and boulders in black soil at three isolated localities in the southern part of the Sheet area; the unit is more extensive on the Brunette Downs Sheet area to the south (Randal and Nichols, 1963). The main lithology is white to brown, fine to coarsely crystalline limestone and dolomite. It is frequently siliceous, containing chert and opaline nodules and smears; the rocks are frequently nodular or skeletal in appearance. The unit is considered to be of late Tertiary age.

Soils: Large parts of the Sheet area are covered by soil. On the Barkly-Birdum Tableland a laterite profile up to 50 feet thick has developed on Lower Cretaceous rocks and, in the south-west corner of the Sheet area, on Cambrian rocks; a distinct ferruginous zone, mottled zone, and pallid zone can be recognised. The ferruginous zone is about 5 to 10 feet thick and within this zone siltstone textures are completely destroyed, but the original texture can still be seen in sandstone; pisolite structure is rare.

Extensive black soil plains, with a typical gilgai surface, have developed on the Cambrian rocks in the southern part of the Sheet area. Residual black soil is also present

on the Top Springs Limestone and on the Lower Cretaceous calcareous siltstone.

A transition zone, between black soil and laterite, (shown on the map as Czs) is present in which the gilgai surface is preserved but the upper? 12 inches or so of black soil is leached to a yellow soil. These areas are covered with a fine, transported, ferruginous gravel derived from laterite.

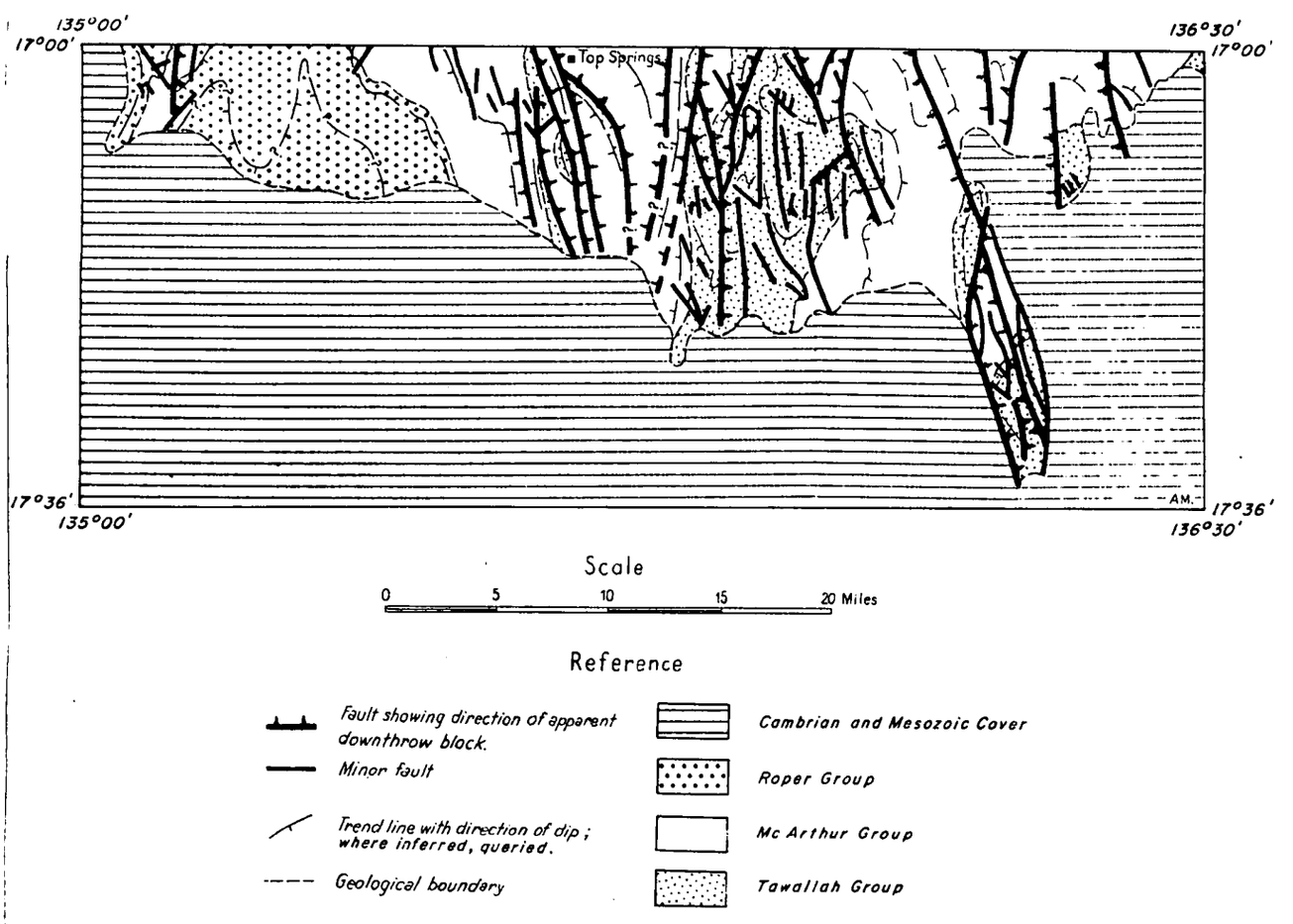
A thin cover of sand occurs on the Bukalara Sandstone and the Top Springs Limestone; alluvium has been deposited along streams to the north of the Tableland.

STRUCTURE

Most of the Wallhallow Sheet area is covered by horizontal undisturbed, Mesozoic and Cambrian sediments (see figure 2).

Fig. 2

TECTONIC SKETCH MAP - NORTHERN PART OF WALLHALLOW SHEET AREA



Bureau of Mineral Resources Geology and Geophysics, May 1962

E53/7/2

The horizontal Bukalara Sandstone, in the north-east corner of the Sheet area, shows minor vertical movements, of the order of 20 to 30 feet, on north-north-west striking, pre-existing Proterozoic faults. A west striking joint system is well developed throughout the formation.

The inliers of Proterozoic rocks in the northern part of the Sheet area are strongly faulted; broad folding occurs, but is largely obscured by the faulting. The faults vary in strike between north-north-west and north-north-east; the main directionsare about 345° and 005°. The faults dip steeply and apparent movements are mainly vertical, although, a strong wrench component can be recognised in places.

The faulting is controlled by large, north-west, wrench faults, the Mallapunyah and Dunganminnie Faults, immediately to the north on Bauhinia Downs Sheet area; these faults change direction and trend into the north striking fault system of the Wallhallow Sheet area.

A large fault block in the area east of Top Springs Homestead represents the downfaulted core of a broad anticlinorium. The total apparent vertical displacement of the block is about 6000 feet; this movement however, is made up of five smaller blocks, the maximum movement on any one fault being about 3000 feet. The structure is bounded by narrow fault blocks with strong bedding drag; the bedding dips inwards at angles up to 70°. Within the core of the block bedding dips are low. Movements on the other fault blocks in the area are relatively slight.

Broad folding is present with axes striking approximately north-north-west. Bedding dips are of the order of 10° to 20°, with occasional dips up to 50° in the vicinity of faults. Generally the folding is closely related to faulting; examples are the numerous small faults in the dome at the headwaters of the Kilgour River, and the large axial faults associated with anticlines near the headwaters of Spellesie Creek and near Kilgour Mine. These faults appear to be mainly wrench faults.

In the south-east corner of the Sheet area small outcrops of Proterozoic sediments strike west; this structure is related to the Murphy Tectonic Ridge on Calvert Hills Sheet area (Roberts et al, 1963).

GEOLOGICAL HISTORY

The Geological History of the Wallhallow Sheet area is summarized in Table 2.

TABLE 2

GEOLOGICAL HISTORY - WALLHALLOW SHEET AREA

AGE		EVENT	REMARKS
CAINOZOIC	Tertiary to Recent.	Epeirogenic uplift. Erosion of area by scarp retreat from north. Soil Formation.	
	Tertiary	Lateritization in north; black soil formation in south. Deposition of lacustrine or marine limestone in south (see Randal & Nichols, 1963)	Area is stable peneplain.
		Slight epeirogenic uplift and erosion.	Area reduced to peneplain.
MESOZOIC	Lower Cretaceous	Freshwater sedimentation followed by marine transgression onto stable shelf.	
		Slight uplift and erosion.	Region is extremely stable.
PALAEOZOIC	Middle (or Lower) Cambrian	Widespread carbonate deposition on stable shelf.	Top Springs Limestone and Anthony Lagoon Beds.
		Slight epeirogenic uplift and erosion.	Slight movement on pre-existing faults.
	Lower Cambrian	Deposition of arenites on stable shelf.	Bukalara Sandstone.
		Orogenic uplift and erosion.	Basement faulting produces faulting and folding of Proterozoic rocks. Surface eroded to give general low relief.
PRE CAMBRIAN	Upper(?) Proterozoic	Deposition of micaceous siltstone/ and sandstone sequence on subsiding shelf.	Roper Group.
		Local uplift and erosion.	
	Lower(?) Proterozoic	Deposition of carbonates with some silt and sand on subsiding shelf. Growth of barrier reef on Bauhinia Downs Sheet area.	McArthur Group.
	Lower Proterozoic	Deposition of sandstone and carbonate sequence and extrusion of volcanics on subsiding shelf.	Tawallah Group.

ECONOMIC GEOLOGY

Two small copper mines are present in rocks of the McArthur Group in the northern part of the Sheet area.

The Yah-Yah Copper Mine, about 18 miles west of Top Springs Homestead, was discovered about 1900. The only recorded production was about 40 tons of ore prior to 1912. A small deposit of copper occurs along a steeply dipping east-west fissure within a dolomitic siltstone near the top of the Tooganinnie Formation. The fissure is only a few feet thick and malachite occurs in the matrix of the breccia formed along the fissure and also as coatings on joint planes within the siltstone. Jensen (1914) records the presence of six small shafts but only two are still present; the others have collapsed.

The Kilgour Mine was discovered towards the end of 1913 and spasmodic mining up to 1955 produced about 125 tons of ore. The mine is 11 miles south-south-east of Top Springs Homestead and occurs within massive, subhorizontal algal dolomite of the Amelia Dolomite. Malachite, with some bornite and minor lead carbonate is scattered over an area of about 150 square feet. The ore occurs as irregular veins, as coatings on joint planes and as massive copper-hematite gossan. The main mineralization occurs in a steeply plunging body, about 10 feet square and consists of malachite - hematite gossan which dies out suddenly at a depth of about 15 feet.

Water:

Surface water, except for waterholes in the Kilgour River Gorge, is very scarce on the Sheet area and the local cattle industry has to rely on subsurface water. Numerous bores have been successful in obtaining water from aquifers within the Cambrian rocks of the Tableland at depths between 150 and 400 feet. Available bore logs are summarized in Appendix 1; the information was supplied by station manager and by the Water Resources Branch, Northern Territory Administration, with which the bores have been registered. The quality of the water is variable; chemical analyses of some of the bore waters and an interpretation of the hydrology of the underground water is given in Randal (1963).

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APPENDIX 1.

WATER-BORE DATA, WALLHALLOW SHEET AREA

Name	Reg. No. (State)	Total Depth (Feet)	Standing Water Level (feet)	Depth of Aquifer (feet)	Supply galls/hr.	Log **	
Wallhallow No. 1	952	363	270		2800	0'-43'	Clay
						43'-194'	Sandstone
						194'-270'	Flint and limestone
						270'-363'	Limestone
Wallhallow No. 2	960	412	304	327	3000	0'-75'	Shale
						75'-110'	Volcanic(?) +
						110'-412'	Limestone
Wallhallow No. 3	961	320	240	240		0'-12'	Clay
				286-312	3200	12'-44'	Shale
						44'-66'	White clay
						66'-198'	Volcanic(?) +
						198'-320'	Limestone and flint
Creswell No. 1	1246	206					
Creswell No. 2	1247	238	205	210-238	1400		
Creswell No. 3	1248	271					
Creswell No. 4	1249	279		187			
				257	2200		
Creswell No. 6	1251	241	184	185			
				220-239	1450		
Creswell No. 7	1252	242		211			
Creswell No. 8	2413	265	206	?-265	1200		
Creswell No. 10	2411	302	223	235-302	1440		
Creswell No. 11	2410	260	225	232-260	1460		
Creswell No. 12	2409	333	210	298			
				305-333	1200		
Creswell No. 14	2746	325	52	72		0'-32'	Grey clay *
				134-325	1300	32'-325'	Fine gr. sandstone *
Creswell No. 16	2749	179	70	70		0'-20'	Soil and clay
				105-176	4000	20'-73'	Sandstone, clay & chert
						73'-126'	Sandstone
						126'-179'	Red sandstone

Name	Reg No. (State)	Total Depth (feet)	Standing Water Level (feet)	Depth of Aquifer (feet)	Supply galls/hr.	Log	
Creswell No. 17	2750	392	140	298		0'-40'	Calcareous clay and silicified * sandstone
				370		40'-392'	Dolomite with bands of * chert and calcareous clay. Solution cavities.
Creswell No. 18	2751	288	120	203		0'-12'	Black soil
				270	1000	12'-20'	Red clay
						20'-29'	Sand
						29'-82'	Grey clay
						82'-103'	Limestone
						103'-200'	Limestone with chert bands
						200'-249'	Limestone, bands of clay and gravel
						249'-288'	Dolomite, * bands clay and sandstone.
Creswell Coolibah	1070						
Kellys	2752	369	140	201		0'-7'	Soil
				328-369	1500	7'-49'	Clay, sand, gravel
						87'-93'	Limestone
						93'-328'	Limestone, chert bands
						328'-369'	Limestone, cavities
Anthony Lagoon 2	605	225	145	162		0'-3'	Clay
				200-220	2500	3'-40'	Limestone and chert
						40'-80'	Volcanic +
						80'-95'	Limestone
						95'-145'	Volcanic +
						145'-156'	Limestone
						156'-173'	Volcanic +
						173'-225'	Limestone
Anthony Lagoon No. 3	598	225	178	145	2700		
				225	2700		
Police (Govt.)	607	212	-	168	1000		

Name	Reg. No. (State)	Total Depth (feet)	Standing Water Level (feet)	Depth of Aquifer (feet)	Supply galls/hr.	Log	
Anthony Lagoon No. 4	599	398	200	208 381	1500	0'-6' 6'-15' 15'-62' 62'-150' 150'-208' 208'-276' 276'-281' 281'-329' 329'-364' 364'-375' 375'-377'	Black soil Clay and limestone Limestone Clay and limestone Limestone Yellow clay rock Limestone Red clay rock Limestone Grey shale Red volcanic +
Anthony Lagoon No. 5	600	331	171	170 289	1800	0'-4' 4'-86' 86'-91' 91'-109' 109'-138' 138'-160' 160'-170' 170'-190' 190'-270' 270'-281' 281'-289' 289'-295' 295'-302' 302'-308' 308'-311'	Soil Clay Limestone Clay and shale Limestone Clay and limestone Brown limestone Green limestone Chocolate shale Limestone Grey shale Grey limestone Grey shale Limestone Grey Shale
Anthony Lagoon No. 6	601	274		171 270	1700	0'-6' 6'-76' 76'-100' 100'-160' 160'-167' 167'-172' 172'-207' 207'-249' 262'-266' 266'-276'	Soil Clay Limestone Clay Limestone Shale Red rock + Limestone Red rock + Grey shale
Anthony Lagoon No. 8 (Adder Bore)	606	309	170	190 297	2400	0'-5' 5'-25' 25'-45' 45'-85' 85'-95' 95'-120' 120'-150' 150'-190' 190'-200' 200'-210' 210'-225' 225'-235' 235'-245' 245'-247' 247'-267' 269'-297' 297'-309'	Black soil Clay Red rock+ Yellow shale Sandstone and conglomerate Clay Claystone Sandstone Hard grey rock Chocolate clay Limestone Chocolate clay Limestone Sandstone Limestone Clay and conglomerate Chocolate claystone

Name	Reg. No. (State)	Total Depth (feet)	Standing Water Level (feet)	Depth of Aquifer (feet)	Supply galls/hr.	Log
Anthony Lagoon No. 15	2158	194		180 194	1800	0'-5' Black soil 5'-25' Conglomerate 25'-70' Soft limestone 70'-80' Sand 80'-120' Clay 120'-140' Conglomerate 140'-153' Cavernous limestone 153'-170' Limestone 170'-184' Conglomerate 184'-189' Limestone 189'-194' Banded chert
Anthony Lagoon No. 25	3148	270		198	1800	0'-2' Black soil 2'-100' Red and yellow clay 100'-112' Sand 112'-150' Yellow clay and sandy clay 150'-210' Brown limestone 210'-219' Grey limestone 219'-225' Brown limestone 225'-250' Red rock + 250'-255' Brown limestone and clay 255'-258' Water bearing sandstone 258'-265' Limestone 265'-270' Red rock +
Barkly Stock Route No. 1	525	242	156	215	1400	
Barkly Stock Route No. 2	524	208	157	180	1300	
Mallapunyah-Darcy's	1067		250			

Note

** Bore logs are drillers logs only.

+ Terms, volcanic and red rock, probably refer to hard red sandstone. No volcanics known from sequence.

* Chips examined by geologist.

STRATIGRAPHIC TABLE WALLHALLOW SHEET AREA

TABLE 1

SYSTEM	AGE	ROCK UNIT AND SYMBOL	THICKNESS in feet	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
	QUATERNARY	Qa	-	Alluvium	Narrow flats bordering streams	Along streams within the Gulf Fall	Gravel bands inter-bedded with alluvial black soil.
CAINOZOIC	TERTIARY TO RECENT	Czs	-	Residual soil, sand cover, transported ferruginous rubble.	Featureless plains	Throughout	Includes leached black soil on Barkly-Bindum Tableland.
		Czb	-	Residual black soil	Featureless plains	Barkly-Birdum Tableland and south of Top Springs Homestead.	Mainly developed on Cambrian limestones, and on Mesozoic rocks.
	TERTIARY	Czl	10	Laterite, laterite rubble.	Slight rises, 10 to 20 feet above level of plain. Mesa cappings.	Northern part of Barkly-Birdum Tableland.	Profile up to 50 feet thick. Best developed on Mesozoic claystone. Some present on Cambrian limestones.
		Brunette Limestone (Tb)	-	White to brown, fine to coarse, crystalline limestone and dolomite.	Scattered boulders in black soil.	South.	Chert and opaline nodules common. Nodular or skeletal in appearance.
		UNCONFORMITY					
MESOZOIC	LOWER CRETACEOUS	Undifferentiated Kl	200	Massive grey calcareous siltstone and claystone containing gypsum, clayey sandstone, ferruginous sandstone. Massive white quartz sandstone. Micaceous sandstone.	Crops out in scarps at edge of and within Barkly-Birdum Tableland. Most of area covered by laterite profile.	Mainly in north.	Siltstone and claystone leached to white siltstone and claystone within pallid zone of laterite profile - affects most outcrops. White sandstone is basal unit - contains plant remains. Siltstone contains marine microfauna.
		UNCONFORMITY					
PALAEOZOIC	CAMBRIAN	Anthony Lagoon Beds (Ca)	700	Massive buff dolomitic limestone, dolomite massive grey fine calcareous sandstone, flaggy chert, silicified limestone.	Poor outcrop. Scattered rubble and some outcrop within black soil plains.	Southern part of Barkly-Birdum Tableland.	No fossils found. Very little known because of poor outcrop.
		Top Springs Limestone (Ct)	30+	Massive yellow-brown fine grained limestone with scattered coarse calcite crystals; massive limestone breccia. Some algal structures.	Low massive outcrops within sandy plain.	North of the Barkly-Birdum Tableland.	Fossils indicate Middle or Lower Cambrian age. Probably overlie Anthony Lagoon Beds. Possible fossil soil profile at contact with Bukalara Sandstone.
		UNCONFORMITY					
	LOWER CAMBRIAN	Bukalara Sandstone (Clb)	200	Massive, buff, medium feldspathic sandstone and quartz sandstone. Cross-bedded, some conglomerate.	Forms dissected plateau.	North-east (Bukalara Plateau).	Prominent west striking joint system developed.

TABLE 1 (Cont.)

SYSTEM	AGE		ROCK UNIT AND SYMBOL	THICKNESS in feet	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
			UNCONFORMITY					
PRECAMBRIAN	UPPER (?) PROTEROZOIC	ROPER GROUP	Arnold Sandstone Member (Brx)	500 + section incomplete	Massive, white, medium to coarse quartz sandstone. Cross-bedded, ripple marked.	Good outcrop. Caps scarp.	Small outcrop west of Yah-Yah Mine.	Lowest member of the Abner Sandstone.
			Crawford Formation (Brr)	700	Blocky quartz sandstone with glauconite; flaggy purple-brown micaceous sandstone.	Scarp beneath Arnold Sandstone Member. Low outcrops at edge of outcrop of Top Springs Limestone.	North-west near Yah-Yah Mine.	Glauconite characteristic of unit.
			Mainoru Formation (Bru)	1800	Flaggy purple-brown micaceous siltstone and fine sandstone.	Poor outcrop. Forms valleys between sandstone ridges.		Contact with Crawford Formation gradational.
			Limmen Sandstone. (Bri)	500 to 1000	Blocky medium quartz sandstone; massive conglomerate with chert pebbles.	Forms prominent ridge.		Overlies Emmerugga Dolomite with angular unconformity.
		SOUTH NICHOLSON GROUP	Mittiebah Sandstone (Bsi)		Cross-bedded, ripple-marked, ferruginous quartz sandstone.	Low outcrops and boulders within soil and laterite.	South-east.	Stratigraphic equivalent of Abner Sandstone.
			UNCONFORMITY					
	LOWER (?) PROTEROZOIC	MCARTHUR GROUP	Billengarrah Formation (Bmb)	800 + section incomplete	Blocky quartz sandstone, chert, dolomitic siltstone, dolomite.	Low rubble covered rises at northern edge of black soil plain.	Immediately east of Top Springs Homestead.	Top not exposed. Facies equivalent of upper part of Emmerugga Dolomite.
			Emmerugga Dolomite (Bmc)	600 + section incomplete	Massive and flaggy, purple, grey and buff, fine dolomite; algal dolomite; dolomitic siltstone; flaggy red fine sandstone with halite pseudomorphs; flaggy, cross-bedded and ripple-marked, medium quartz sandstone. Minor sandy dolomite and dolomite breccia.	Crops out as prominent scarps, especially the massive fine dolomite. Soft beds weather out producing parallel ridges.	Extreme north.	Complete section not exposed on Sheet area. Distinguished from Tooganinie Formation by dominance of massive dolomite and algal dolomite.
			Tooganinie Formation (Bmt)	1500 +	Regularly alternating sequence of purple to grey algal dolomite; flaggy to massive grey to purple dolomite with chert bands; laminated silty dolomite; flaggy purple dolomitic siltstone; flaggy red fine sandstone with halite pseudomorphs. Minor medium quartz sandstone, sandy dolomite, fissile green siltstone, dolomite breccia, oolitic dolomite.	In areas of low relief rocks crop out poorly; do not rise above general level of plain. Forms prominent scarps in deeply dissected areas such as Kilgour Gorge; soft siltstones form valleys.		Regularly alternating sequence is characteristic feature. Upper 200 to 300 feet has large amounts of siltstone which crops out poorly and accentuates scarp at base of overlying Emmerugga Dolomite. Deposited in back-reef environment.

TABLE 1 (Cont.)

SYSTEM	AGE		ROCK UNIT AND SYMBOL	THICKNESS in feet	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER (?)	MACARTHUR GROUP	Leila Sandstone Member (Bmi)	20 to 250	Flaggy medium quartz sandstone, dolomitic sandstone, sandy dolomite. Cross-bedded, ripple-marked, clay pellet impressions.	Low rubble covered ridges.		Member of the Tooganinie Formation. Thins eastwards. Not always mappable.
			Tatoola Sandstone (Bmd)	200 to 300	Flaggy, purple-brown to pale grey fine dolomitic sandstone; flaggy to blocky, white to purple brown, medium quartz sandstone and ferruginous sandstone. Cross-bedded and ripple-marked. Minor feldspathic sandstone, sandy dolomite, siltstone.	Rubble covered ridges.	Extreme north	Excellent marker bed. Dolomite leaches out of dolomitic sandstone in weathered outcrop.
	PROTEROZOIC		Amelia Dolomite (Bma)	400	Uniform sequence of interbedded grey, yellow-brown and purple, flaggy dolomite with chert bands, massive dolomite and algal dolomite. Minor fissile green siltstone near base; interbeds of oolitic dolomite in middle of unit; fine sandy dolomite at top. Some dolomite breccia and dolarenite.	Poor outcrop in areas of low relief. Forms prominent scarps in deeply dissected areas.		Algae irregular in distribution; form scattered biostromes.
			Mallapunyah Formation (Bml)	500 to 900	Flaggy purple to chocolate-brown siltstone; flaggy, cross-bedded and ripple-marked, medium quartz sandstone; flaggy dolomitic sandstone with halite pseudomorphs; flaggy dolomite; massive dolomite; algal dolomite; oolitic dolomite; sandy dolomite; chert; cherty siltstone; botryoidal quartz.	Poorly outcropping unit. Forms low areas with rounded hills and		Siltstone rarely outcrops but is dominant lithology when outcrop is good. Chert is largely secondary - structures of dolomite (algae etc.) preserved. Beds of botryoidal quartz, algal chert and dolomitic sandstone with halite pseudomorphs provide valuable markers. Unit thins eastwards. Conformably overlies Tawallah Group.

TABLE 1 (Cont.)

SYSTEM	AGE	ROCK UNIT AND SYMBOL	THICKNESS in feet	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER PROTEROZOIC	Masterton Formation (Btn)	500 to 750	Flaggy to blocky, white, pink and purple-brown, medium quartz sandstone and silicified sandstone; flaggy friable fine ferruginous quartz sandstone; feldspathic quartz sandstone. Ripple-marks, cross-bedding and clay pellet impressions.	Good outcrop. Forms prominent ridges.		Three divisions recognised. Top is blocky, silicified, pink quartz sandstone. Bottom is friable, fine, ferruginous quartz sandstone. Unit thickens to east.
		Wollogorang Formation (Bto)	250	Flaggy grey and purple silty dolomite, dolomite sandstone, sandy dolomite, dolomitic sandstone, ferruginous sandstone. Algae, limestone nodules.	Poorly outcropping.	Extreme north.	Dies out near Top Springs Homestead. Gradational contact with Settlement Volcanics in the west.
		Settlement Creek Volcanics (Bte)	400	Massive basalt, flaggy to fissile purple and green (tuffaceous?) siltstone, flaggy white tuff and tuffaceous breccia.	Poorly outcropping. Forms valleys.		Lateral variation in amount of tuffaceous siltstone.
		Sly Creek Sandstone (Btl)	About 1000	Alternating, flaggy to massive, purple-brown, medium ferruginous quartz sandstone and pink medium quartz sandstone. Ripple-marks, cross-bedding and clay pellet impressions.	Good outcrop. Forms prominent ridges.	Extreme northern part of Sheet area east of Top Springs Homestead.	
		McDermott Formation (Btd)	400 to 1000 + very poor.	Coarsely flaggy, reddish-purple, medium crystalline dolomite; flaggy purple dolomitic siltstone; flaggy grey-brown dolomite.	Poorly outcropping Forms valleys.		Very limited outcrop on Sheet area.
		Peters Creek Volcanics (Btp)	-	Massive basalt and amygdaloidal basalt.		Near Spellesie Creek.	Very limited outcrop on Sheet area.
		Westmoreland Conglomerate (Btw)	-	Blocky, white, medium quartz and feldspathic sandstone. Massive blue silicified sandstone.	Projects as ridges above general level of plain.	Isolated outcrop in south-east.	Outcrop is on strike with extensive outcrops of Westmoreland Conglomerate to the east on Calvert Hills Sheet area.

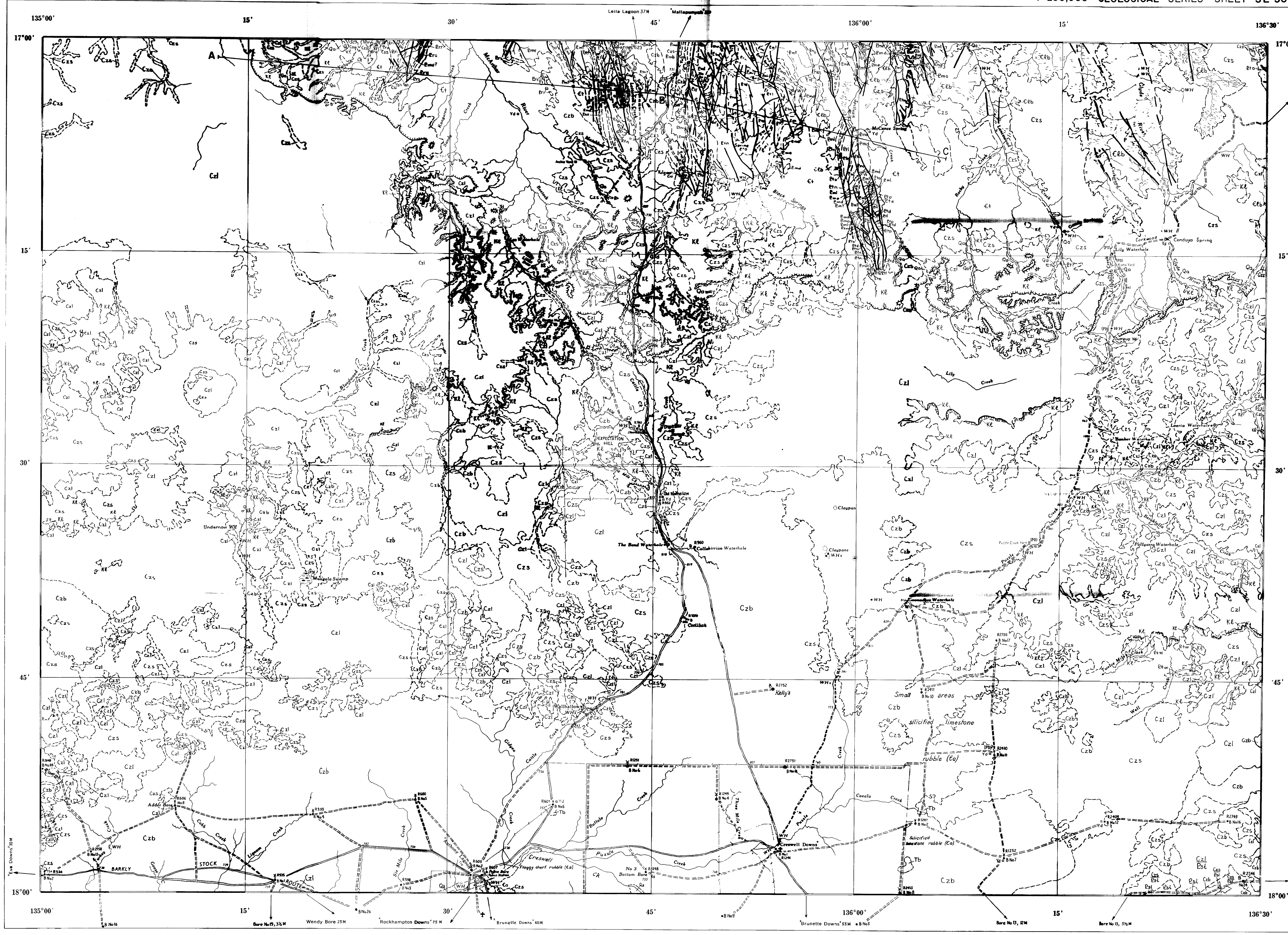
NOTE: No measured sections are available from the Wallhallow Sheet Area.
Thicknesses in Table are estimated from:-
(a) Measurements of distances on maps.
(b) Visual estimates in the field.
(c) Information available from Bauhinia Downs Sheet Area.

AUSTRALIA 1:250,000

WALLHALLOW

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SE 53-7



Reference

CAINOZOIC

- QUATERNARY — Qa — *Alluvium*
- UNDIFFERENTIATED — Czs — *Residual soil, sand*
- Czb — *Residual black soil*
- Czl — *Laterite, Laterite rubble and soil*
- TERTIARY — Brunette Limestone — Tb — *White nodular and siliceous limestone*

MESOZOIC

- LOWER CRETACEOUS — Undifferentiated — Kℓ — *Massive grey calcareous siltstone, white leached siltstone massive white quartz sandstone with plant remains*

PALAEOZOIC

- CAMBRIAN — Anthony Lagoon Beds — Єa — *Buff dolomitic limestone, silicified limestone, massive grey calcareous sandstone, chert*
- MIDDLE OR LOWER CAMBRIAN — Top Springs Limestone — Єt — *Massive grey to buff fossiliferous limestone. Some algae*
- LOWER CAMBRIAN — Bukalara Sandstone — Єℓb — *Massive, jointed, medium, buff feldspathic sandstone, and quartz-sandstone*

PRECAMBRIAN

UPPER (?) PROTEROZOIC

Roper Group

- Abner Sandstone, Arnold Sandstone Member — Ꝑrx — *Massive, white, jointed, medium to coarse quartz sandstone*
- Crawford Formation — Ꝑrr — *Blocky glauconitic sandstone, flaggy purple micaceous sandstone*
- Mainoru Formation — Ꝑru — *Flaggy purple micaceous siltstone and fine sandstone*
- Limmen Sandstone — Ꝑri — *Blocky medium quartz sandstone, conglomerate*

South Nicholson Group

- Undifferentiated — Ꝑs
- Mittiebah Sandstone — Ꝑsi — *Cross-bedded ripple marked ferruginous quartz sandstone*

LOWER (?) PROTEROZOIC

McArthur Group

- Billengarrah Formation — Ꝑmb — *Blocky quartz sandstone, chert, siltstone, dolomite*
- Emmerugga Dolomite — Ꝑme — *Massive fine dolomite, interbedded dolomite, algal dolomite, flaggy dolomite siltstone, flaggy fine sandstone*
- Tooganinie Formation — Ꝑmt — *Alternating dolomite, algal dolomite, purple siltstone quartz sandstone, Minor sandy dolomite, oolitic dolomite*
- Leila Sandstone Member — Ꝑmi — *Flaggy medium quartz sandstone, coarse dolomitic sandstone and sandy dolomite*
- Tatoola Sandstone — Ꝑmd — *Flaggy purple to white medium sandstone and dolomitic sandstone Minor siltstone and sandy dolomite*
- Amelia Dolomite — Ꝑma — *Flaggy silty dolomite, massive dolomite and algal dolomite Minor fissile green siltstone, oolitic dolomite*
- Mallapunyah Formation — Ꝑml — *Purple siltstone, medium quartz sandstone, dolomite, sandy dolomite, algal dolomite; oolitic dolomite chert*

LOWER PROTEROZOIC

Tawallah Group

- Masterton Formation — Ꝑtn — *Flaggy to blocky, pink to purple medium quartz sandstone and feldspathic sandstone, flaggy friable fine ferruginous sandstone.*
- Wollogorang Formation — Ꝑtc — *Flaggy purple and grey dolomite, dolomitic siltstone, dolomitic sandstone sandy dolomite and ferruginous sandstone*
- Settlement Creek Volcanics — Ꝑte — *Basalt. Minor tuff and tuffaceous siltstone*
- Sly Creek Sandstone — Ꝑtl — *Massive to flaggy pink and purple-brown medium quartz sandstone, ferruginous sandstone*
- McDermott Formation — Ꝑtd — *Flaggy purple dolomite and dolomitic siltstone*
- Peters Creek Volcanics — Ꝑtp — *Basalt*
- Westmoreland Conglomerate — Ꝑtw — *Blocky medium quartz sandstone, feldspathic sandstone, silicified sandstone*

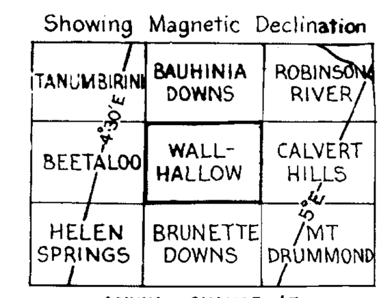
Undifferentiated — Ꝑ

- Geological boundary
- 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*
- Strike and dip of strata.
- Trend lines, Joint pattern } air-photo interpretation
- Macrofossil locality
- Microfossil locality
- Copper mine
- Scarp
- Windpump
- Bore (All bores on this sheet are subartesian)
- Registered bore-number
- Waterhole
- Spring
- Dam
- Road
- Vehicle track
- Fence
- "Wallhallow" Homestead
- Yd Yard
- Landing ground
- Astronomical station
- .623 Height in feet, barometric: datum, mean see level
- PD Position doubtful

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

INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



ANNUAL CHANGE 1'E

Scale 1:250,000

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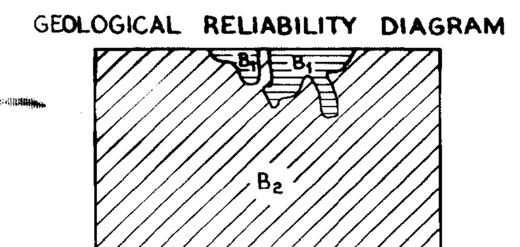
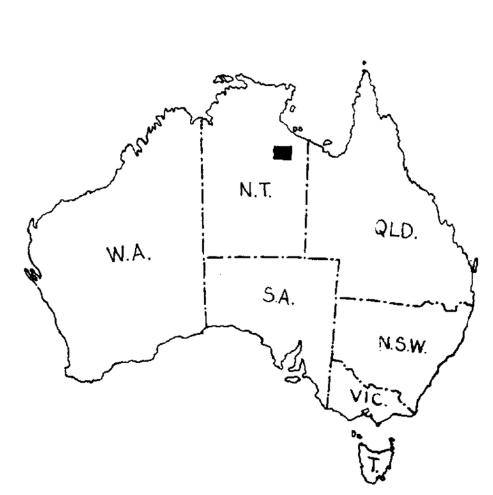
GEOLOGICAL RELIABILITY DIAGRAM



B1 Detailed reconnaissance–numerous traverses with air-photo interpretation

B2 Reconnaissance — some ground and helicopter traverses with air-photo interpretation

Geolgy, 1961-1962, by: K.A.Plumb, J.M.Rhodes, M.A.Randal, R.A.H. Nichols.
Compilation, 1962, by: K.A.Plumb, M.A.Randal, J.L.McGovern
Drawn by: J.L.McGovern



Section

(Cainozoic units omitted from section)

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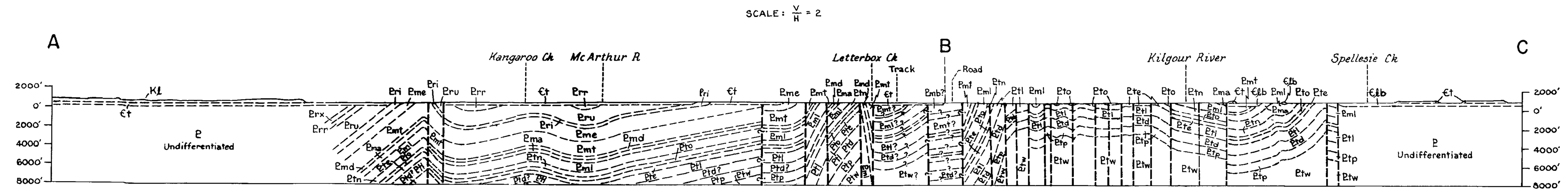
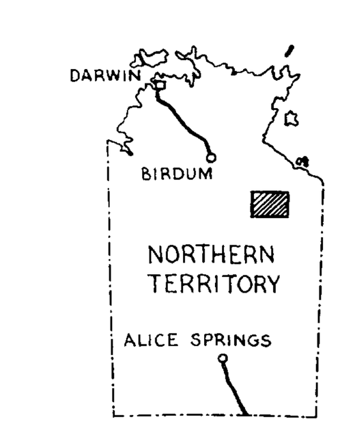
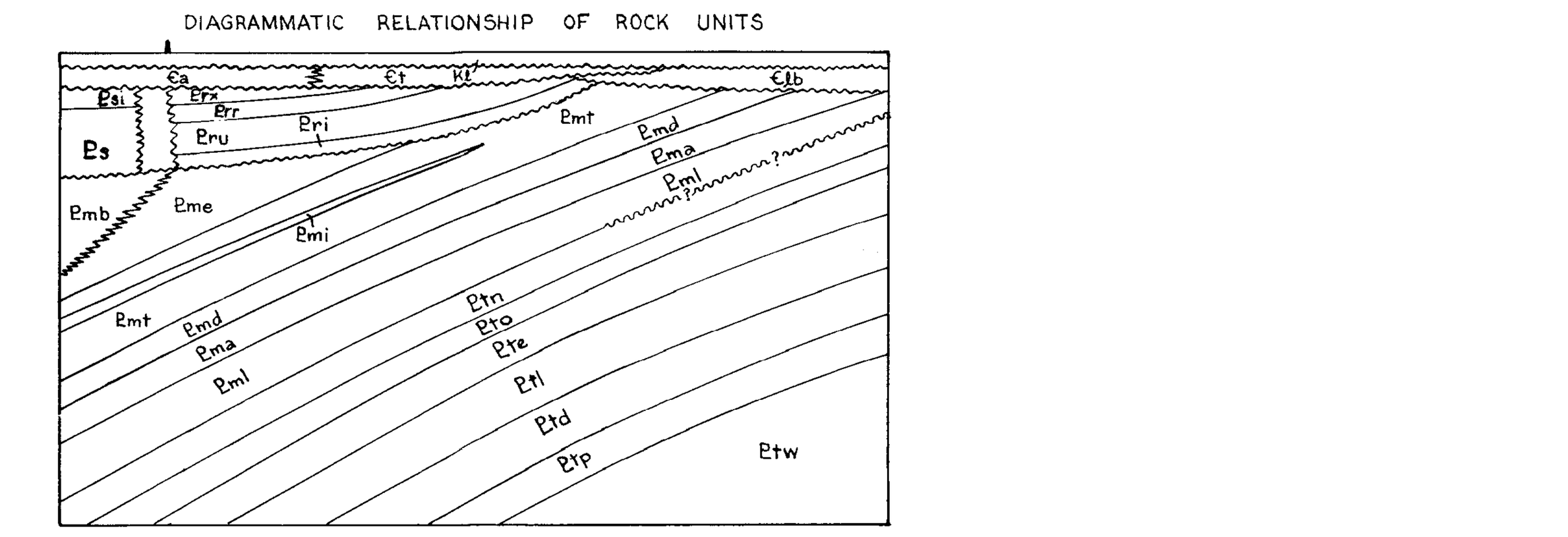


(All faults shown are steeply dipping but angles and direction of dip are not known)



WALLHALLOW
SHEET SE 53-7

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity