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EXPLANATORY NOTES ON THE ARNHEM BAY - GOVE 1:250,000
GEOLOGICAL SHEET SD53-3/4.

Compiled by

D. Dunnet

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INTRODUCTION

The Arnhem Bay-Gove Geological Sheet is bounded by latitudes 12°S and 13°S and by the longitudes 135°E and 137°E. It includes the Arnhem Bay Sheet area and the western third of the Gove Sheet area of the Australian National Grid and lies within the north-eastern part of Arnhem Land Aboriginal Reserve.

The only permanent settlements in the area are at Elcho Island and at Yirrkala; Mission stations operate at both localities. At Yirrkala several newly constructed houses have been built for the staff of Duval Holdings Pty.Ltd., a company investigating the bauxite deposits of the Gove Peninsula.

There are no access roads, but 4-wheel drive vehicles have entered the area, during the dry season, from Mainoru Station on the Urapunga Sheet area to the south-west, and from Rose River Mission to the south. An all weather airstrip at Gove is in good condition, and roads run from the airstrip to a jetty at Dundas Point and to Yirrkala Mission. Aircraft services Gove and Elcho Island weekly, and a vessel lands stores at intervals of several months.

Maps and air photographs of the Sheet area available during 1962 were: air photographs at a scale of 1:50,000 flown by the Royal Australian Air Force in 1950; photo mosaic sheets at 4 miles to the inch; two 1:250,000 topographic maps produced by the Royal Australian Army Survey Corps in 1961 (Arnhem Bay; Gove) from controlled photoscale slotted template assemblies. The accompanying geological map was compiled on the Survey Corps photoscale bases and reduced subsequently to 1:250,000 scale.

PREVIOUS INVESTIGATIONS

In 1803 Flinders (1914) charted parts of the coast of Arnhem Land, recorded details of the coastal physiography, and made some geological observations. King (1826) made further observations. Fitton obtained rock samples from Flinders and King and described them in an appendix to King (1826); some relating to the Arnhem Bay-Gove Sheet area.

A map accompanying a report on the Northern Territory by Tate (1882) indicates that the granite and sandstone around Melville Bay were known. The first recorded land expedition in the area was made by Lindsay (1883) who made note of the rocks encountered. The coastal parts of the Sheet area were visited by Brown (1908), who recorded sandstones and shales on Elcho Island, and laterite and granite between Melville and Caledon Bays; he mentioned that the granite might be auriferous. This prompted two exploration parties to visit the Caledon Bay district; the activities of the first were described by Love (1911) and the second by Murphy (1912). Wade (1924) recorded observations on the rocks of the north coast.

Bauxite was discovered in the Wessel Islands, to the north of the Arnhem Bay-Gove Sheet area, during 1949. The Gove bauxite deposits were delineated by Owen (1954) and Puckey and Richardson (1952) and further investigated by Gardner (1955, 1957), Dickinson (1961) and Dunn, P.G., (1962). During 1954 a reconnaissance survey of the western part of the Arnhem Bay-Gove Sheet area was made by the B.H.P. Co. Ltd. (Crohn, 1956). Williams and Waterlander (1958) carried out a submarine gravity survey of the Arnhem Land coast.

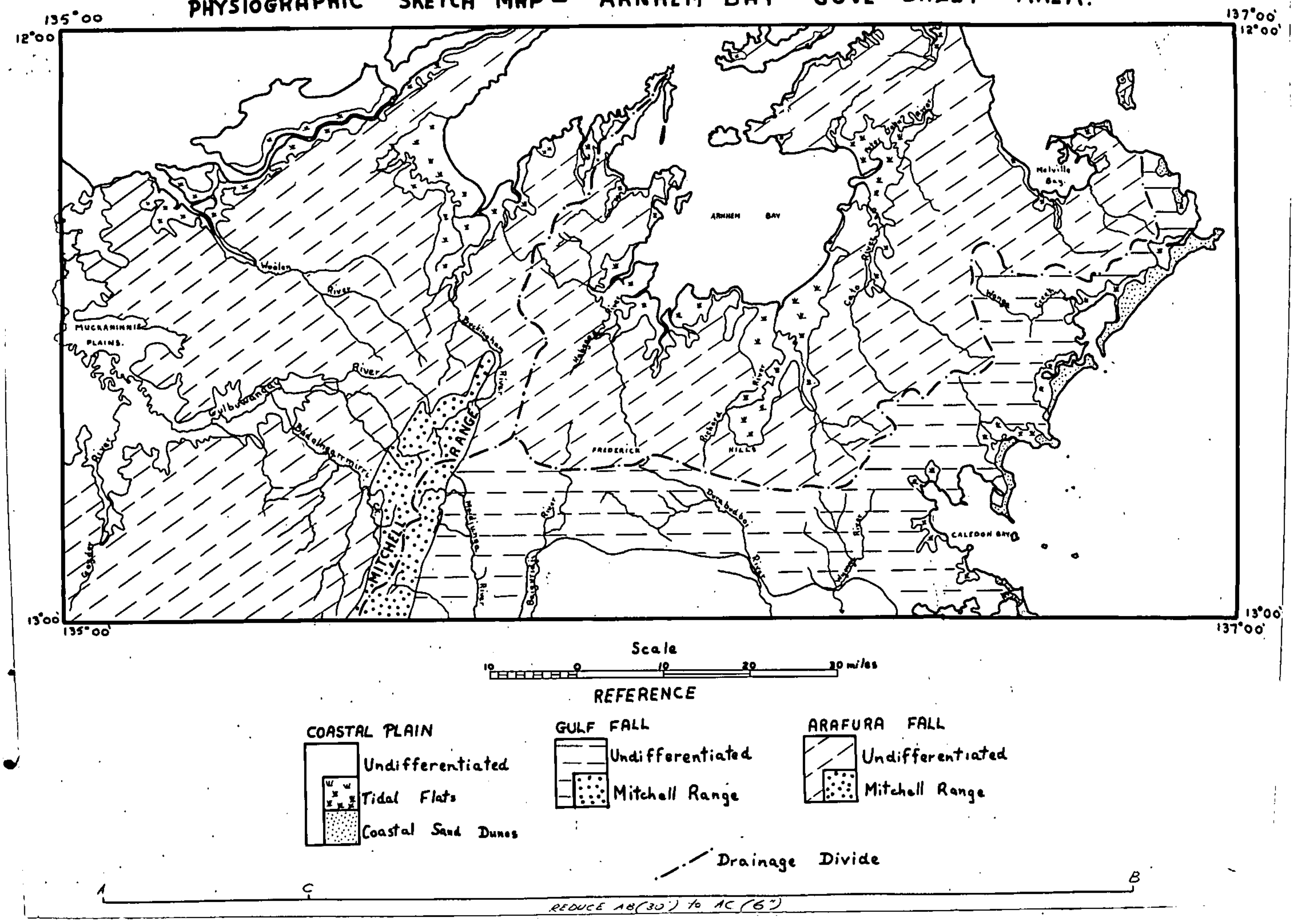
The accompanying map is based on field work undertaken by geologists of the Bureau of Mineral Resources during 1962; prior to the field work a photogeological sheet of the area was prepared by Perry (1962). The adjoining sheet areas - Milingimbi (Rix, 1962), -Truant Island (Plumb, 1963) and Blue Mud Bay - Port Langdon (Plumb and Roberts, 1963) were mapped by the Bureau of Mineral Resources during 1962. An aeromagnetic survey of the Gulf of Carpentaria, including part of the Arnhem Bay-Gove Sheet area was made by contractors to the Delhi Australian Petroleum Co. (Hartman, 1962.).

PHYSIOGRAPHY

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

fig. 1

PHYSIOGRAPHIC SKETCH MAP - ARNHEM BAY- GOVE SHEET AREA.



Gulf Fall and Arafura Fall.

The Gulf and Arafura Falls have a maximum relief of about 600 feet. The major streams are consequent, and superimposed on bedrock, an indication of the original wide extent of Mesozoic sediments in the Sheet area.

The divide between Arafura Fall, and Gulf Fall in the central and eastern part of the Sheet area appears to parallel an axis of warping of the Mesozoic peneplain. A difference in elevation of the base of the Mesozoic in the order of 200 feet is evident, rising to the north-east.

Drainage on the east coast is by means of short, steep consequent streams which dissect the lateritised Mesozoic plateau, producing scarp retreat, the streams dropping to a narrow coastal plain. Subsequent patterns have developed locally where dissection has exposed the Bradshaw and Caledon Granites.

The Cato River which flows through the Arafura Fall, has a similar style to the east coast streams, but a shallower gradient: the Peter John River is broadly subsequent, paralleling the strike of the Upper Proterozoic rocks.

The physiography of the western part of the Arafura Fall in this Sheet area is largely controlled by the shallow-dipping rocks of the Wessel Group, which are dissected by dendritic drainage. In the southern part a marginal scarp, up to 200 feet, has formed adjacent to the Gulbuwangay River.

The drainage into Arnhem Bay, similar to that in the Gulf Fall to the south, is by means of a series of consequent streams with subsequent, dendritic tributaries in their headwaters where they cut back into the lateritized Mesozoic surface of the Fredrick Hills.

The Mitchell Range consists of dipping and faulted Proterozoic sandstones, giving rise to a series of fault-bounded north and north-east trending strike ridges. These define a strong subsequent drainage pattern for the headwaters and tributaries of Badalngarrmirri Creek, Maidjunga River, and to a lesser extent, the Buckingham River. The main streams, however, are consequent and superimposed, crosscutting the Proterozoic strike.

Maximum relief is 600 feet in this area; the peaks being of a fairly uniform height, suggesting dissection of an old peneplain. Within the Mitchell Range, valleys are steep-sided, up to 300 feet deep, and generally bounded by faults.

Coastal Plain: a discontinuous (broad) plain borders the coast except in the vicinity of Flinders, Napier and Gove peninsulas. Its width is in the order of 40 miles, the most extensive being the Muckaninnie Plains in the north-western part of the Sheet area and extending onto the adjoining Milingimbi Sheet area. These Coastal Plains are mainly developed on flat lying Proterozoic, and Mesozoic sediments, and represent an emergent coastline.

The plains, maximum elevation of 150 feet, consist of salt rich soils covered in places with laterite, ferricrete and sand.

Tidal Flats consist of a narrow band of coastal sediments which are subjected to either tidal or seasonal flooding and are cut by meandering tidal streams. On the east coast many of these flats represent emerged lagoons. On the seaward side they are bounded partly by sand- and shell-dunes, representing ancient off-shore bars and wind blown sand dunes.

The physiography of the north coast, especially Arnhem Bay, suggests an initial submerged coastline which has subsequently undergone slight emergence.

Sand dunes of aeolian origin are present on the east coast; in the vicinity of Port Bradshaw they are up to 200 feet high. Their trend reflects the dominant south easterly wind direction of this region.

STRATIGRAPHY

The stratigraphy of the Sheet area is summarised in Table 1. The stratigraphic nomenclature will be fully described by Roberts et al., (in prep.).

PRECAMBRIAN

The oldest rocks in the Sheet area are foliated granites and gneisses exposed along the coast between Melville and Caledon Bays, and in a small area west of the Mitchell Range; they have been tentatively assigned to the Archaean. They are intruded by granite along the coast, and by gabbro, quartz-felspar porphyry and dolerite in the Mitchell Range area. These younger intrusive rocks have been assigned to the Lower Proterozoic. In the Mitchell Range an arenite-acid volcanics succession over 20,000 feet thick lies in faulted contact with the Archaean rocks. They were laid down unconformably on the Archaean rocks (assumed from the structural disparity), but their relation to the gabbro and quartz-feldspar porphyry is not certain, although dolerite intrudes them. The arenite-acid volcanic succession is unconformably overlain by up to 35,000 feet of dominantly clastic sediments. The lower part of the succession (the Parsons Range Group and its supposed equivalents) is placed in the Lower Proterozoic; the overlying McArthur Group and the partly or wholly equivalent Habgood Group are placed tentatively in the Lower Proterozoic; the uppermost strata (the Roper and Malay Road Groups) are tentatively assigned to the Upper Proterozoic. These are unconformably overlain by sediments of the Upper Proterozoic Wessel Group.

The rocks have been assigned to various intervals of the Precambrian time scale solely on the basis of their local and regional structural and stratigraphic relationships, substantiated by several radiometric dates determined at the Australian National University in Canberra. The Tawallah Group (Dunn, Smith and Roberts, in prep.) a regional correlate of the Parsons Range Group from the Carpentaria region to the south has been dated (Webb, McDougall and Cooper, 1963), together with the Roper Group and dolerites intruding the Roper Group (McDougall pers. comm.). The results indicate that the Parsons Range Group should be assigned the lower of the two divisions of the Proterozoic at present widely in use in Northern Australia.

A preliminary radiometric date from sediments in the Upper Wessel Group indicates an age high in the Upper Proterozoic (McDougall, pers. comm.)

ARCHAEAN(?)

The Bradshaw Granite consists of garnetiferous granite and gneiss; generally foliated or banded in outcrop. The foliation includes a primary gneissic composition banding and a post-crystallisation foliation associated with re-crystallisation and retrogressive metamorphism.

The granite and granodiorite are porphyritic with phenocrysts of orthoclase or microcline. They invariably contain garnet, or biotite after garnet. Schistose and gneissic inclusions are common in the south-east of the Sheet area, with mineral assemblages of the pyroxene and hornblende hornfels facies. To the north in the vicinity of Gove Peninsula the granites are associated with and intrude migmatitic gneisses with mineral assemblages of the almandine amphibolite and granulite facies.

In the vicinity of Mt. Alexander the Bradshaw Granite is intruded by the Caledon Granite, and in the headwaters of the Giddy River probably by the Giddy Granite.

ARCHAEAN(?) AND LOWER PROTEROZOIC

Rocks of at least two distinct ages occur in close association in the Mirarrmina Complex, the oldest probably Archaean. These older rocks include garnetiferous and porphyritic granite and gneiss similar to the Bradshaw Granite. They crop out poorly in the southern part of the Complex, and are intruded by gabbroic rocks. A late tourmaline pegmatite phase is present with microcline phenocrysts up to 6" across. No high grade metamorphics are exposed; low grade metamorphics have been noted from two isolated outcrops.

The younger part of the Mirarrmina Complex includes a series of rocks of Lower Proterozoic age, which intrude the garnetiferous granite/gneiss. The sequence of their intrusion is as follows:-

1. Gabbro and microgabbro, and associated hybrid diorite and tonalite, intrude the granite gneiss. They are massive to weakly foliated, homogeneous in outcrop, but with varying colour index. Mafic inclusions are common and pyrite and chalcopyrite are present. Contacts against granite are chilled, but local incorporation of granite has produced hybrid rocks.
2. The granite and gabbroic rocks are intruded and incorporated by a quartz-felspar porphyry, with large, (1.5 cm.) rounded, resorbed and embayed quartz, anomalous blue-grey felspar, possibly sanadine (R12718), and smaller, more euhedral albite in a micrographic quartz-K-felspar groundmass. Where gabbro is intruded hybrid rocks result with marked reaction rims about the phenocrysts. The porphyry is generally massive, but locally strongly sheared. It is intruded as small stocks and dykes.
3. The final phase is the intrusion of dolerite dykes along shear zones within the Complex and into the overlying Ritarango Beds and Fagan Volcanics. The dykes may have been intruded prior to the deposition of the Parsons Range Group, but may possibly be much younger, intrusion being in Upper (?) Proterozoic times when similar dolerite sills were intruded into rocks of the Roper Group.

LOWER PROTEROZOIC

The Caledon Granite is a medium to coarse even-grained granite cropping out south of Caledon Bay on the east coast. It intrudes the Bradshaw Granite, is massive and is a distinct pink to red in hand specimen. In thin-section quartz albite/oligoclase and orthoclase microperthite are associated with biotite and, in one specimen, fayalite. Fluorite is a common accessory. Aplitic dykes and a fine ferruginous late phase granite intrude the main granite body.

The Giddy Granite is a massive pink slightly porphyritic granite very similar to the Caledon Granite, and probably comagmatic with the Spencer Creek Volcanics, The Giddy Granite is closely associated spatially with a porphyritic leucocratic granite, part of the Bradshaw Granite, which it probably intrudes.

The Ritarango Beds crop out in the central part of the Mitchell Range and are composed of a sequence of sandstones estimated to be up to 10,000 feet thick. The area of outcrop is bounded by faults except in the south-west where the sandstone appears to rest unconformably on the Mirarrmina Complex.

Dips range up to 80°, and the bedding is obscured by faulting. The lowest part of the sequence observed contains coarse to very coarse quartz sandstone and pebble conglomerate overlain by fine medium grained quartz sandstone and, towards the top, felspathic sandstone. The intense faulting which obscures bedding has produced fault-bounded pseudo-strike ridges.

The Fagan Volcanics unconformably overly the Ritarango Beds, and consist of acid volcanics, ashstone, felspathic sandstone and shale. The Mitchell Range is an upward culminating syncline with the Fagan Volcanics cropping out to the north and south of the central range of Ritarango Beds. The volcanics extend southwards onto the Blue Mud Bay-Port Langdon Sheet area, where they are unconformably overlain by the Parsons Range Group.

The components of the Fagan Volcanics exhibit considerable variation in both thickness and lithology. The base of the Formation can be recognised in the field by the presence of a coarse red porphyritic rhyolite. In the southern area of outcrop this rhyolite changes laterally to a soft purple tuffaceous sandstone and ashstone. Above the base is a series of feldspathic sandstones with some interbedded discontinuous rhyolitic flows. The top of the southern sequence consists of a red shale sequence which is unconformably overlain by the Parsons Range Group. The top of the exposed sequence in the north is a 500 feet thick series of flows, Field relationships suggest the rhyolites are ash-flow tuffs; no ignimbrite textures were observed in thin section. The total thickness in the south is estimated to be about 2,000 feet, but in the north only 1,500 feet is exposed.

The Fagan Volcanics are correlated with the Spencer Creek Volcanics and with the Bickerton Volcanics in the Blue Mud Bay - Port Langdon Sheet area (Plumb and Roberts, in prep.).

The Spencer Creek Volcanics crop out in the vicinity of Spencer Creek and rest unconformably on the Giddy Granite. They are interbedded with quartz sandstone and slightly feldspathic sandstone, and in thin section are seen to be spherulitic and porphyritic rhyolites.

McARTHUR BASIN SUCCESSION

A thick sequence of sedimentary rocks unconformably overlies the older rocks of the Sheet area (see Table 1). These sediments were deposited in the McArthur Basin which extends from the northern coast of Arnhem Land, southwards to beyond the Northern Territory - Queensland border (Roberts et al., in prep.) In the south central part of the Sheet area the succession has been divided into three major groups, the Parsons Range, McArthur and Roper Groups.

To the north and east of the Sheet area the lateral equivalents of these three groups appear to be as follows:-

1. The Parsons Range Group is correlated with the Mt. Bonner Sandstone, and possibly the basal Habgood Group.

2. The McArthur Group is correlated with the upper part(?) of the Habgood Group, and to the east, the Wilberforce Beds. The Baralminar Beds may be equivalent to either the Mount Bonner Sandstone, or the basal Wilberforce Beds.

3. The Roper and Malay Road Groups are considered stratigraphic equivalents.

These sediments of the Parsons Range and McArthur Groups have been deposited in a central more deeply subsiding , north-south trending zone within the McArthur Basin; the Habgood Group deposited in the northern part of this trough. The Mount Bonner Sandstone, Baralminar Beds and Wilberforce Beds were deposited on a marginal shelf to the east. To the west a similar thin shelf sequence is present in the Mount Marumba Sheet area (Roberts and Plumb, in prep.).

LOWER PROTEROZOIC

Parsons Range Group: This Group crops out in the Arafura Fall west of the Mitchell Range, in a south-easterly dipping sequence estimated to be 7,800 feet thick. Faulting along the western margin has concealed the base of the Group; the full sequence exposed on the Blue Mud Bay-Port Langdon Sheet area (Plumb and Roberts, in prep.) is about 29,000 feet thick.

The Group, consists mainly of flaggy and blocky medium grained quartz arenites. The lowermost unit, the Mattamurta Sandstone is not exposed on this Sheet area, but consists chiefly of quartz sandstone, as does the uppermost unit, the Fleming Sandstone. The latter is a resistant, jointed white to pink medium to coarse grained quartz sandstone. The Badalngarrmirri Formation, overlying the Mattamurta Sandstone is a series of medium grained quartz sandstones interbedded with siltstone and fine grained sandstone, with some beds of ferruginous sandstone and minor beds of algal chert and dolomitic sandstone. The Marura Siltstone is a poorly exposed sequence of fine-grained siltstone and dolomitic siltstone .
Mount Bonner Sandstone: Cropping out south of the Peter John River and south of Arnhem Bay, the Mount Bonner Sandstone rests unconformably on the Spencer Creek Volcanics, and is considered to be a stratigraphic equivalent of the Parsons Range Group. Its total thickness is about 500 feet, indicative of a continuation of the McArthur Basin shelf and trough relationships observed in the Blue Mud Bay - Port Langdon Sheet area (Plumb and Roberts in prep.) between the Groote Island Beds and Parsons Range Group respectively. The Mount Bonner Sandstone is a massive and blocky jointed, medium - to coarse - grained quartz sandstone with some local cobble conglomerate at the base.

LOWER (?) PROTEROZOIC

McArthur Group: Sparse outcrops of McArthur Group sediments occur on the southern margin of the Sheet area, between the Mardjunga and Baiguridji Rivers. These sediments are a continuation of an extensive area of outcrop on the Blue Mud Bay - Port Langdon Sheet area (Plumb and Roberts, in prep.). The softer units do not crop out in this Sheet area.

The basal Koolatong Siltstone conformably overlies the Parsons Range Group to the west of the Mitchell Range. It crops out as low rubble covered hills of chert, dolomitic siltstone, and dolomite. Traces of pyrite and magnesite have been noted. Four other formations crop out poorly in the Maidjunga River area, and consist of chert, dolomitic siltstone, chert fragment sandstone, chert breccia, algal chert, and some quartz sandstone.

The full sequence is exposed on the Blue Mud Bay - Port Langdon Sheet area. These sediments are a trough facies of the dolomitic shelf sediments on the Mount Marumba Sheet area (Roberts & Plumb in prep.).

Habgood Group: The Group crops out only in the area extending southwards from Flinders Peninsula to Lake Evella. Neither the base nor the top is exposed; poor outcrop to the south and lack of marker units makes correlation difficult. Within the limits of exposure six formations totalling about 12,750 feet of sediment have been mapped.

The basal Kurala Sandstone and Slippery Creek Sandstone may be equivalent to the upper part of the Parsons Range Group. No direct correlation is possible. The Upper four formations are equivalent wholly, or in part to the McArthur Group, being composed of dolomite, dolomitic siltstone, chert and cherty sandstone.

The lowest unit, the Kurala Sandstone, is similar to sandstones of the Parson Range Group, i.e. white, medium-grained cross-bedded, massive to blocky, medium- to thin-bedded quartz sandstone. A finer green, micaceous, flaggy silicified quartz sandstone occurs in the upper 20 feet.

The overlying Slippery Creek Siltstone shows no lithological similarity to other rocks in the Sheet area. The dominant lithology is an interlaminated shaly siltstone and shale of distinctive red-brown to purple colour. The upper 700 feet tend to be more arenaceous and includes thin beds of purple shaly siltstone and brown fine-grained thinly bedded quartz sandstone.

The Yarawoi Formation crops out poorly as dolomitic shale, siltstone, chert, algal chert and, at the top, massive dolomite and dolomitic sandstone.

The overlying <u>Darwarunga Sandstone</u> consists of about 1,000 feet of white to brown medium-grained, ripple-marked and cross-bedded quartz sandstone with minor cherty sandstone. The unit crops out as prominent strike ridges.

Siltstone, silty sandstone and dolomitic siltstone comprise the major portion of the <u>Ulunourni Formation</u>. Outcrop is poor and the rocks are deeply leached. Claystone is abundant in the lower part of the unit. Chlorite-rimmed dolomitic marble pods up to 1 inch across are found associated with minor barytes.

The <u>Gwakura Formation</u> the uppermost unit consists of dolomitic quartz sandstone, with minor cherty and leached dolomitic siltstone interbeds. A 50 feet bed of pebble to cobble conglomerate occurs in the lower part of the unit.

<u>Arnhem Bay Succession</u>: The eastern extension of the Habgood Group is bounded by a major fault whose lateral extension south onto the Blue Mud Bay - Port Langdon Sheet area is a hinge line effecting Proterozoic sedimentation. Correlation across the fault in this Sheet area is difficult and has necessitated the erection of two rock units of uncertain stratigraphic position.

Of the four units exposed inthe eastern area, the Spencer Creek Volcanics at the base, and overlying Mount Bonner Sandstone are, on lithological grounds, equatable with the Fagan Volcanics and Parsons Range Group.

The upper Wilberforce Beds are thought to be equivalent to the McArthur and Habgood Groups, and the Baralminar Beds probably equivalent to the basal Wilberforce Beds.

The total thickness of sediment in this succession is not as great as their supposed equivalents; equated with them occupying a shelf environment adjacent to the central trough, and controlled by the hinge line.

<u>Wilberforce Beds</u>: Only the upper four hundred feet of the Wilberforce Beds crop out unconformably beneath the scarp at the base of the Mallison Sandstone, and are inferred to underly the superficial cover in the valley of the Peter John River. They are thought to conformably overly the Mount Bonner Sandstone and are tentatively correlated with the upper portion of the Habgood Group and the McArthur Group. Much of the unit is not exposed and may be dolomitic. Fine-to medium-grained sandstone and siltstone are exposed in the top of the sequence.

Baralminar Beds: The Baralminar Beds crop out poorly to the south of Arnhem Bay as almost flat-lying beds of massive to blocky quartz sandstone, interbedded with fine micaceous sandstone and siltstone. Their stratigraphic position is unknown, but lithologically they resemble the middle units of the Parson Range Group. They are thought to be stratigraphic-aly equivalent to the basal Wilberforce Beds, or Mount Bonner Sandstone.

UPPER(?) PROTEROZOIC

Roper Group: The upper Group of the McArthur Basin sequence consists of alternating sandstone and siltstone. The Group has a maximum thickness of 6,000 feet to the south on the Urapunga Sheet area (Dunn, 1962). It is represented in this Sheet area by only one unit, the Mainoru Formation which crops out in the south-west of the Sheet area as low rubble covered hills of flaggy purple and brown micaceous siltstone and sandstone. The Formation is faulted against the Parsons Range Group in the east, but to the south on the Blue Mud Bay - Port Langdon Sheet area, the Group may unconformably overly rocks of the Parsons Range Group. The Roper Group is unconformably overlain by the Wessel Group.

Malay Road Group: On Inglis Island and the mainland coast to its south, a north-west dipping sequence of shale and micaceous sandstone unconformably overlies the Wilberforce Beds and are unconformably overlain by the Wessel Group. Due to the similarity in lithology and order of superposition this Malay Road Group is correlated with the Roper Group.

The basal Mallison Sandstone crops out well as a pink and brown fine-to medium-grained quartz sandstone with cross-bedding and regular jointing.

Only part of the Wigram Formation is exposed. The base is flaggy, fissile, greenish-grey fine-grained sandstone, overlain by a dolomitic (?) black shale. This is overlain by 100 feet of grey and red shales and fine- to medium-quartz sandstone, interbedded towards the top with a slightly micaceous fine grained quartz sandstone and fissile, micaceous, fine grained sandstone.

The Pabasso Formation consisting of purple, slumped quartz greywacke and micaceous siltstone with flaggy to laminar bedding, is the top of the Malay Road Group exposed in this Sheet area.

UPPER PROTEROZOIC

Wessel Group: This Group rests with strong unconformity on the older Proterozoic rocks of the Sheet area. Wade (1924) described part of the Group in the sequence on Elcho Island, and considered it to be of Lower Cambrian or Precambrian age. The "Fossils" he described are probably surface markings; no definite fossils have been found, except for well developed "Pipe-rock" (Scolithus?) in the basal Buckingham Bay Sandstone.

A preliminary absolute age determination on glauconite from the upper Elcho Island Formation assigns the Group to the Upper Proterozoic (Webb, McDougall and Cooper, pers. comm.).

The Group lies in an isolated sedimentary basin the Arafura Basin. The Mitchell Range and its northern extension to Flinders Peninsula was a topographic high during deposition of the Group and partly defines the south-eastern margin of the Basin. This is most evident where the basal Wessel Group crops out against the back slope scarp of the Parsons Range Group.

The thickness of the Wessel Group is impossible to accurately estimate but is in excess of 4,500 feet, The basal unit, the Buckingham Bay Sandstone consists of strongly cross-bedded friable medium-grained quartz sandstone (with a basal conglomerate in places), This is overlain by blocky to massive reddish-brown fine sandstone with clay pellets and purple brown quartz greywacke.

The Raiwalla Shale is a succession of fissile grey, green and purple shale and flaggy, fine-grained sandstone, overlain by the ripple-marked thinly-bedded quartz sandstone of the Marchinbar Sandstone.

The Elcho Island Formation crops out poorly, and is extensively lateritized. Cliff sections at Elcho Island Mission Station expose 50 ft. of flaggy and blocky, dark brown, fine-grained ferruginous sandstone. These are overlain by 50 ft. of interbedded flaggy green-grey, slightly micaceous glauconitic fine-grained sandstone, and fissile green micaceous sandstone and shale. Dolomitic siltstone and chert with abundant slump structures and lenses of chert breccia occur at the top of the exposed section.

MESOZOIC

LOWER CRETACEOUS

Thin outliers of Mullaman Beds unconformably overlie the Precambrian rocks throughout the Sheet area. They are erosional remnants of an almost continuous Lower Cretaceous cover, the maximum present thickness being about 200 feet. Part of the Mitchell Range appears to have been a topographic high during sedimentation.

The sequence is extensively lateritized and consists of a local, basal quartz sandstone or pebble conglomerate, overlain by siltstone and claystone. Local valley-fill conglomerate in the Mitchell Range is probably of Mesozoic age. No fossils have been found in the Sheet area. Broad post-Mesozoic warping has occurred in the Sheet area.

CAINOZOIC

Laterite: A laterite profile is present over much of the Sheet area, developed to a depth of 50 feet in the Mesozoic siltstone on Gove Peninsula, while lateritization of granite, Wessel and Malay Road Group sediments occur in other areas. The laterite is part of the Tertiary Laterite Plain developed throughout the Northern Territory, but includes some later laterite deposits. A ferruginous zone, mottled zone and pallid zone can be recognised except where the profile is truncated by erosion.

A younger detritus with ferruginous cement - "ferricrete" - is locally deposited along streams and alluvial flats and in parts of the coast as a ferruginous conglomerate.

In the vicinity of Yirrkala the laterite profile is aluminous, and pisolitic bauxite is present in the upper zones.

Soils: Large parts of the Sheet area are covered by alluvium residual soils and sand; they are discussed in Table 1 and Physiography.

STRUCTURE

BASEMENT ROCKS

Archaean: The Bradshaw Granite is a composite body including gneiss and foliated granite which have a paracrystallisation foliation mainly defined by compositional banding. This foliation trends between 300° and 330° and dips range from 15° N.E. to vertical, and it appears to be folded about an axis plunging 35° to 300°. The foliation parallels the axial planes of relic fold cores which occur as tectonic inclusions in the granulites. In the granites and more mobilised gneisses these inclusions tend to a random orientation.

The gneissic foliation is folded by a later deformation expressed as a foliation defined by recrystallisation of biotite. This foliation trends between 270° and 300° and is vertical or dipping steeply south. It has produced retrogression within the gneiss. The gneissic granite of the Mirarrmina Complex exhibit similar structural features.

Proterozoic: The Proterozoic granites are undeformed in outcrop. A belt of strong faulting, effecting Lower Proterozoic and Upper(?) Proterozoic sediments, extends from the Mitchell Range to Flinders Peninsula. The Proterozoic sediments of the Mitchell Range have been strongly faulted and moderately folded. The folding is as a broad syncline, culminating in the centre of the Range, with folds plunging 20°S in the south and 15°N in the north. Here the syncline is modified, with the faulted west limb of the adjoining anticline also exposed.

Faulting is intense, and has almost obliterated bedding in the sandstones. The faults are all steep and fall into 3 groups.

1. N.N.E. trending faults, with apparent large strike-slip movement (up to 8,000 feet observed, but probably much greater movements have occurred). These faults have had considerable vertical movement late in their history, and are bounding faults for the Parsons Range Group, Minarrmina Complex and Mitchell Range Blocks.
2. A conjugate set of faults trending 300° and 330°, which intersect in a steep north plunging axis, and have an orthorhombic movement pattern. This set is a result of compression and is mainly developed in the core of folds.
3. Faults subparallel the fold axial planes, with strike slip and dip slip movement.

Minor cross faults trending south-west and north-west are a late feature associated with this stress field.

This fault system has originated prior to sedimentation and has controlled the trough of deposition of the Ritarango Sandstone. Faulting has continued with similar movements but decreasing intensity until late in the Proterozoic.

The Habgood Group is folded and faulted, folds trending about 015° with a clockwise sense of movement, as with the major faults in the Mitchell Range. The Parsons Range Group is faulted but not strongly folded, probably a result of the competent lithology.

The Roper Group is only gently warped, but is terminated by a major fault in the east.

No deformation has effected the Upper Proterozoic or later rocks, except for minor stresses producing jointing in the sandstones.

FIGURE 2.

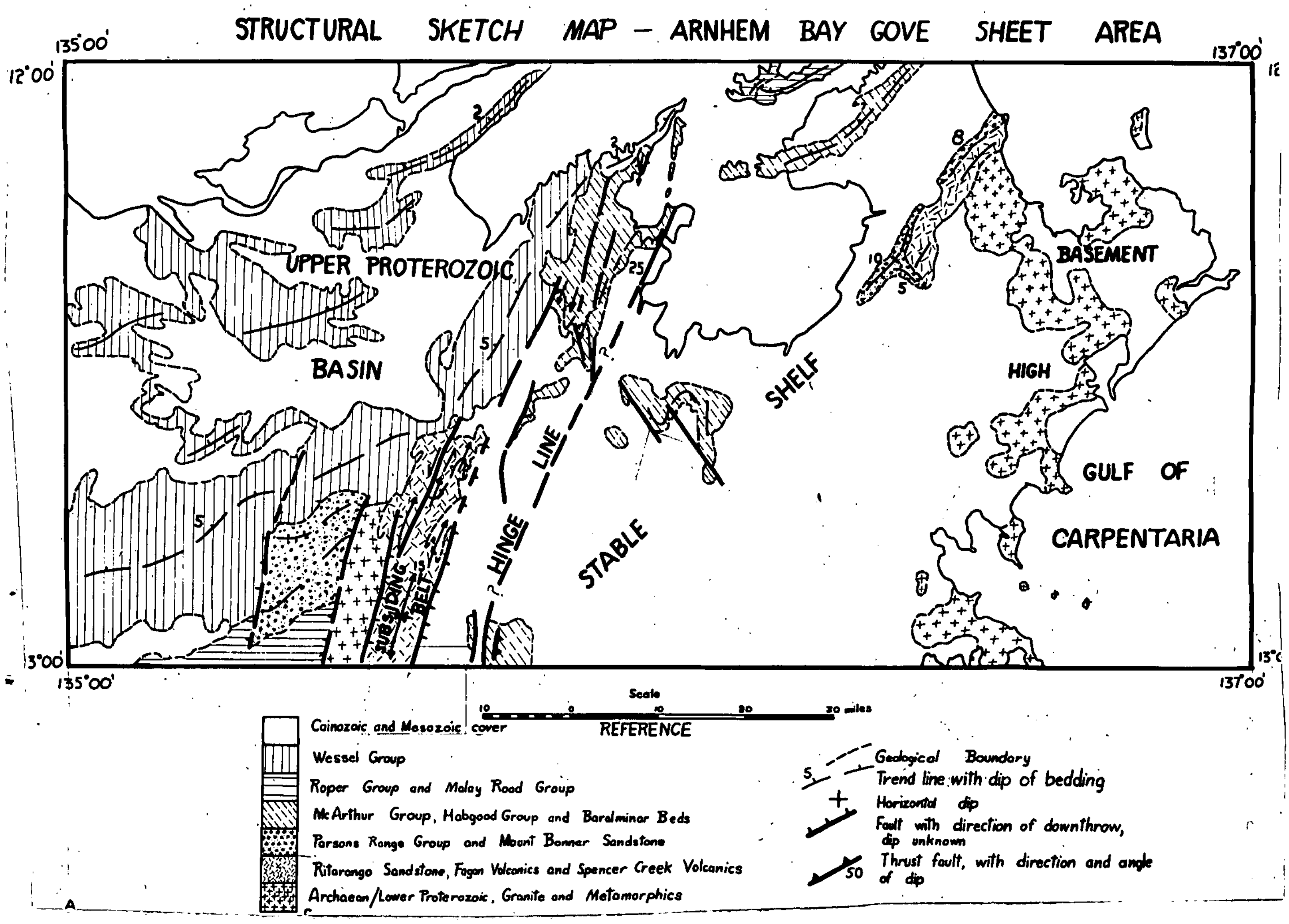


Figure 2: General structure of the Sheet area.

ECONOMIC GEOLOGY

Bauxite:

Bauxite occurs as the upper part of the laterite profile on a plateau, the Gove Bauxite Deposit on Gove Peninsula. The deposit has a surface area of approximately 23 square miles, and an average depth of about 10 feet.

The tonnage of available bauxite reserves at Gove is confidential to companies concerned. During 1963 it was estimated that reserves could range from 100 to 200 million tons assaying approximately 48.7% Al_2O_3. Substantial areas of higher grade bauxite occur within the deposits. Alumina is mostly present as the tryhidrate mineral gibbsite (Dunn, 1963).

During 1963 Duval Holdings Pty.Ltd. commenced a systematic sampling campaign at Gove.

An Australian subsidiary of the Pechiney Company of France holds leases over some of the Deposit and the Swiss Aluminium Company is negotiating (April, 1964) to take over the leases originally held by the British Aluminium Company Ltd.

No production has commenced to date (April, 1964) but consideration is being given to the development of treatment works and port facilities.

The Cato Laterite, of about 30 square miles, is situated 15 miles to the south-west of the Gove deposit. Preliminary sampling (Gardner, 1957) indicates a silica content too high to be economic.

A deposit of bauxite and aluminous laterite was found on Elcho Island, during the 1962 survey, and a single analysis gave 45.7% Al_2O_3 but 25% silica.

Aluminous laterite is scattered throughout the Sheet area, and further sampling and analysis will undoubtedly discover more potentially economic deposits.

Iron:

The extensive laterite through this area has a varying iron oxide content; mostly too low to be economic, and rarely exceeding several feet in thickness.

The only deposits investigated are a cellular sandy hematite and hematite sandstone on Elcho Island. They were mentioned by N.C.Bell in 1922 and Wade in 1924, while they were investigating reports of petroleum on the Island. Rix (1963) sampled the deposits, and found the sandy hematite to be a high grade ore; from 52.7 to 64.2% iron. The calculated reserves are 600,000 tons, but they may be much greater.

Manganese:

Although manganese occurs on Groote Island to the south of this Sheet, only traces have been noted within this Sheet area. Scattered boulders occur in some of the creeks draining the Fredrick Hills, and some isolated manganese bearing rocks were found at Caledon Bay.

Petroleum:

Early reports of bituminous material from Elcho Island were investigated by Bell (1923) and Wade (1924) with no success. One 300 foot drill hole put down on the island was abandoned in 1925. However, the Arafura Basin, although Proterozoic, still remains a potential oil prospect. (Plumb, 1963).

Limestone:

Calcareous deposits occur in the form of sand - and shell - dunes on the north-east coact. The dunes on Bremmer Island and in the vicinity of Port Bradshaw may be utilised in the treatment of bauxite at Gove.

Water:

Surface water is fairly scarce in the area, the main permanent streams being the Goyder, Giddy and Durabudboi Rivers. These rise from springs in the lateritised Mesozoic. Damming of these streams could provide water supplies for industrial development projects.

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TABLE 1

STRATIGRAPHIC TABLE - ARNHEM BAY-GOVE SHEET AREA

ERA	AGE	ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER PROTEROZOIC	Ritarango Beds (Blr)	10,000	Massive to blocky fine-to coarse-grained clean quartz sandstone and feldspathic quartz sandstone, grits, arkose, pebble conglomerate.	Crops out as fault bounded ridges up to 600 feet high.	Western part of the Sheet area in the central Mitchell Range.	Thickness, bedding and stratigraphy obscured by faulting. Intruded by dolerite dykes.
		UNCONFORMITY					
		Giddy Granite (Bgg)		Massive, pink, slightly porphyritic granite, mineralogically and texturally resembling Caledon Granite. Biotite-hornblende granite.	Poor outcrop scattered tors and rocky rounded hills.	In the headwaters of the Giddy River on Gove Peninsula.	Appear to intrude the Bradshaw Granite.
		Caledon Granite (Bgc)		Massive, medium to coarse, even grained biotite (hornblende) - 2 feldspar granite. Distinctive pink colour. Fluorite common. Olivine biotite granite.	Crops out well along the coast between Caledon and Trial Bays as scattered tors and cliff exposures.	Between Caledon and Trial Bays.	Intrudes Bradshaw Granite. Fayalite noted in one specimen.
		Younger Mirarrmina Complex (AlBn)		Gabbro, micro-gabbro, diorite and tonalite, Quartz feldspar porphyry, dolerite dykes and hybrid rocks.	Very poor outcrop low relief, scattered tors and low rounded hills.	To the west of the Mitchell Range near the headwaters of Mirarrmina Creek.	Gabbro intrudes older granite/gneiss, and is intruded by quartz-feldspar porphyry. Dolerite dykes late.
		UNCONFORMITY?					
	ARCHAEAN (?)	Older Mirarrmina Complex (A/Bn)		Porphyritic, garnetiferous, microcline, oligoclase granite gneiss, and gneissic granite. Some low grade metamorphics. (retrogression?)	Very poor outcrop scattered tors and individual boulders.	To west of Mitchell Range in N.E. trending belt 15 miles long and 5 miles wide.	Similar to Bradshaw Granite, but no high grade metamorphics.
		Bradshaw Granite (Agb)		Porphyritic microcline garnet granite and gneiss. Foliated biotite granite, amphibolite and granulite grade metamorphics.	Scattered outcrops along coast and as isolated rounded tors. Small rocky islands.	From Caledon Bay to Bremmer Island along the N.E. coast, and outcrop up to 20 miles inland.	Oldest rocks exposed in the Sheet area. Some pegmatite veins.

ERA	AGE		ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER PROTEROZOIC	PARSONS RANGE GROUP	Fleming Sandstone (Bpf)	500 approx.	Pink to white, medium- to coarse-grained blocky to massive and flaggy quartz sandstone.	Resistant sandstone striked ridges with strong jointing and tendency to produce "Castles".	Exposed directly west of Minarrmina Complex.	Conformably overlies Marura Siltstone and is conformably overlain by Koolatong Siltstone.
			Marura Siltstone (Bpm)	1,500 approx.	Flaggy to fissile fine-grained sandstone and siltstone, purple and green dolomitic siltstone, shale, cherty siltstone, fine quartz sandstone, sandy dolomite.	Less resistant than overlying and underlying strata. Sand filled valleys with minor hills.	Exposed west of Mirarrmina Complex in the western part of the Sheet area.	Poor outcrop in this Sheet area. Better exposure in the Blue Mud Bay-Port Langdon Sheet area. Conformably overlies Badalngarrmirri Formation.
			Badalngarrmirri Formation (Bpb)	Top 4,000 feet exposed on this Sheet area. Up to 7,500 feet on Blue Mud Bay Sheet area.	Blocky to flaggy, red quartz sandstone, fine micaceous sandstone, purple ferruginous and feldspathic sandstone, silts, minor algal chert, dolomite and dolomitic siltstone.	Strike ridges of sandstone with interbedded siltstone poorly cropping out in valleys.	Exposed west of Mirarrmina Complex in western part of Sheet area.	Alternating lithology gives distinctive pattern. Base not exposed in this area. Conformably overlies Matta Murta Sandstone to the south.
			UNCONFORMITY					
			Spencer Creek Volcanics (Els)	Greater than 500	Pink, fine-grained rhyolite and and dacite, with interbedded flaggy to blocky quartz sandstone.	Low relief, poor outcrop in valleys and scarps under Mount Bonner Sandstone.	North-east trending belt between Arnhem Bay and Melville Bay.	Unconformably overlies pink Giddy Granite. Unconformably overlain by Mount Bonner Sandstone.
			Fagan Volcanics (Elg)	2,000	Coarse, red porphyritic rhyolite and dacite, ash-flow tuff (?), purple feldspathic ash-stone, red shale, feldspathic sandstone.	Small, rounded rugged hills in volcanics. Sandstones tend to strike ridges. Ash and shale low relief.	At northern and southern extremities of Mitchell Range in western part of Sheet area.	Unconformably overlies Ritarange Beds. Unconformably overlain by Matta Murta Sandstone and Sheridan Formation.

ERA	AGE		ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER PROTEROZOIC		Wilberforce Beds (Bwi)	Exceeds 5,000	Fissile black shale, probably dolomitic. Flaggy micaceous siltstone and fine-grained sandstone.	Very poor outcrop, only top 200 feet exposed. Mainly sand and alluvium covered plains.	Occurring in a north-east trending belt, east of Mallison Island.	Conformably(?) overlies Mount Bonner Sandstone. Unconformably overlain by Mallison Sandstone.
		McARTHUR GROUP	Bath Range Formation (Bme)	500+	Pelletal chert and dolomite, massive white siltstone, laminated dolomitic siltstone, laminated chert, flaggy to fine chert sandstone.	Scarp capping, dissected plateau surface, rubble covered hills.	In vicinity of Baiguridji River. Wide distribution on Blue Mud Bay - Port Langdon Sheet area.	Pelletal chert and white siltstone are characteristic.
			Baiguridji Formation (Bmi)	800 approx.	Flaggy grey-green and purple fine dolomitic sandstone and siltstone, flaggy dolomitic siltstone, micaceous sandstone.	Poor outcrop. Occurs as valley between resistant units.	Poorly exposed in vicinity of Baiguridji River.	Conformably overlies Yarrawirrie Formation and conformably overlain by Bath Range Formation.
			Yarrawirrie Formation (Bmy)	800 approx.	Blocky, coarse-grained chert sandstone, quartz sandstone, flaggy and dolomitic siltstone, algal, laminated and nodular chert.	Resistant rounded rubble covered hills and strike ridges.	To the east of Maidjunga River. Widely distributed on Blue Mud Bay Sheet area.	Conformably overlies Zamia Creek Siltstone, which is not exposed in this Sheet area.
			Strawbridge Breccia (Bms)	200 approx.	Massive chert breccia composed of angular fragments of chert, and occasional fine sandstone.	Resistant; outcrops as rounded hillocks and irregular mounds.	In the vicinity of the Maidjunga River.	Conformably overlies the Koolatong Siltstone. Good marker unit.
			Koolatong Siltstone (Bmk)	Up to 4,000 feet on Blue Mud Bay - Port Langdon Sheet area. Less than 1,000 feet exposed.	Flaggy, brown, green and grey siltstone. dolomitic siltstone, dolomite. Fine-grained sandstone, minor chert, algal chert, chert breccia and cherty siltstone.	Outcrops poorly low rubble covered hills and in creeks.	Scattered outcrop to west of Mitchell Range and along middle reaches of Maidjunga River.	Pyrite and magnesite noted. Unit conformably overlies Fleming Sandstone.
			Mount Bonner Sandstone (Bb)		Massive and blocky medium- and coarse-grained quartz sandstone. Cobble conglomerate.	Resistant strike ridges with good jointing locally forming "Castles".	Exposed in a north-east trending belt between Arnhem Bay and Melville Bay, and south of Arnhem Bay.	Appears equivalent to part or all of the Parsons Range Group. Unconformably overlies Spencer Creek Volcanics.

ERA	AGE		ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	LOWER (?) PROTEROZOIC	HABGOOD GROUP	Gwakura Formation (Eng)	2,000	Cherty siltstone, fine-to medium-grained quartz sandstone. Chert, pebble conglomerate, leached dolomitic siltstone.	More resistant than Ulunourwi Formation, flat rubble covered hills and strike ridges.	Exposed in Darwarunga River District and north to Gwakura Island.	Conformably overlies Ulunourwi Formation. Top not exposed.
			Ulunourwi Formation (Enu)	3,400	Flaggy, purple, leached dolomitic siltstone, cherty siltstone, dolomitic shale, fine cherty and dolomitic purple to grey flaggy algal chert.	Poorly resistant, giving low soft topography.	Exposed in a north trending belt from Darwarunga River to Flinders Peninsula.	Leached intensely near base, probably conformably overlain by Gwakura Formation.
			Darwarunga Sandstone (End)	1,000	Fine-to medium-grained quartz sandstone. Cherty quartz sandstone. Thinly bedded, crossbedded, ripple marked.	Relatively resistant strike ridges.	West of Arnhem Bay in headwaters of Darwarunga River and in north trending ridges along Flinders Peninsula.	Conformably overlain by Ulunourwi Formation.
			Yarawoi Formation (Eny)	3,250	Dolomitic siltstone and shale, fine-grained dolomite, dolomite, siltstone and shale algal chert.	Less resistant than overlying Darwarunga Sandstone. Low rounded hills.	Exposed in anticline west of Arnhem Bay.	Conformably overlies Slippery Creek siltstone.
			Slippery Creek Siltstone (Ens)	2,000	Flaggy purple to white banded siltstone, very fine-grained sandstone and shale.	Dendritic drainage uniformly resistant to erosion, steep sided, but rounded hills. Relief to 400 feet.	Exposed in Kurala River district.	Conformably overlies Kurala Sandstone.
			Kurala Sandstone (Enk)	1,100	Flaggy to blocky medium - to fine-grained white quartz sandstone. Cross bedded.	Resistant sandstone ridges, subdued by unconformably overlying Buckingham Bay Sandstone.	Exposed only in headwaters of the Kurala River south of Flinders Peninsula.	Base not exposed. Conformably overlain by Slippery Creek Siltstone.
			Badalminar Beds (Er)	Unknown	Massive to blocky quartz sandstone alternating with micaceous fine sandstone and siltstone	Discontinuous outcrop in creeks. Occasional sandstone ridges.	Exposed south of Arnhem Bay around the Badalminar and Habgood Rivers.	Stratigraphic relationship unknown.

ERA	AGE		ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
PRECAMBRIAN	UPPER PROTEROZOIC	WESSEL GROUP	Raiwalla Shale (Ber)	1800	Fissile, grey shale; fissile to flaggy fine-grained sandstone. Purple brown shale and siltstone.	Poor outcrop in valleys and scarps. Low rounded hills.	Conformably overlying Buckingham Bay Sandstone in north-west of Sheet area.	
			Buckingham Bay Sandstone (Bek)	1500	Blocky to massive, white cross-bedded, medium-grained quartz sandstone. Purple quartz greywacke. Fine-grained quartz greywacke. Minor pebble conglomerate.	Base as rugged, rocky outcrop Upper part scarp forming.	Widely distributed in north-west of Sheet area. Strongly unconformable on older units.	"Pipe-rock" in basal sandstones. Contains mud pellets.
			UNCONFORMITY					
			Dolerite Sills (Bdl)	300	Fine to coarse vesicular and porphyritic dolerite. Chilled at top and bottom of sills.	Scarps and boulder strewn plains.	Inglis Island and south-west corner of Sheet area.	Intrudes Mainoru and Wigram Formations on this Sheet area.
	LOWER (?) PROTEROZOIC	MALAY ROAD GROUP	Pabasso Formation (Bap)	1600	Purple micaceous quartz greywacke, quartz sandstone; flaggy, purple green and white micaceous siltstone. Laminated glauconitic siltstone.	Caps hills on islands with low rounded relief. Occasional small scarp on backslope.	Hills on north-east of Inglis Island. Extends onto Wessel Islands Sheet area.	Resembles upper Mainoru and Crawford Formation on Mount Marumba Sheet area.
			Wigram Formation (Baw)	2000 only top 300 exposed	Purple, green and black shale massive fine-grained quartz sandstone, flaggy green micaceous quartz greywacke.	Exposed in base of scarp on English Company Islands and beneath the Malay Road.	Crops out in cliffs on the back slope of Inglis Island.	Intruded by dolerite sill. Conformably overlain by Pabasso Formation.
			Mallison Sandstone (Bam)	900	Massive quartz sandstone cross-bedded, medium-to fine-grained. Pink to pale brown colour.	Resistant strike ridges, prominent jointing, producing "Castles".	Occurs in a north-east trending ridge from Mallison Island.	Unconformably overlies the Wilberforce Beds.
		ROPER GROUP	Mainoru Formation (Bru)	900	Flaggy to blocky, purple micaceous siltstone and shale, some marl, chert and dolomitic siltstone, fine glauconitic quartz greywacke.	Low rubble covered hills, poor outcrop.	Crops out poorly east of Goyder River in western Sheet area.	Extensive outcrop on Mount Marumba Sheet area. Intruded by dolerite sills.

ERA	AGE		ROCK UNIT AND MAP SYMBOL	MAXIMUM THICKNESS (in feet)	LITHOLOGY	TOPOGRAPHY	DISTRIBUTION	REMARKS
CAINOZOIC	QUATERNARY		Alluvium (Qa)		Alluvium and alluvial soils.	Flood plains, river valleys and swamps.	Widely distributed on major rivers and creeks.	
CAINOZOIC	QUATERNARY		Coastal Alluvium (Qa)		Tidal flats, salt flats, alluvial silts and fine sand deposited by coastal action; evaporites.	Flat plains, often devoid of vegetation.		
CAINOZOIC	UNDIFFERENTIATED		Coastal Sand (Czs)		Sand dunes, quartz sand and cemented calcarenite dunes.		Bordering shorelines throughout area.	Calcarenite dunes and quartz sand dunes, distinct in mode of occurrence.
CAINOZOIC	UNDIFFERENTIATED		Sand (Czs)		Sand and residual soils.		Areas of low relief and on plateau surfaces.	
CAINOZOIC	UNDIFFERENTIATED		"Bauxite" (Czb)		Aluminous laterite, including bauxite. Laterite with light, rough photo pattern.	Thin capping on tablelands of laterite.	To south-west of Yirrkala, Gove Peninsula.	Not all high Alumina. Partly distinguished on photo pattern.
CAINOZOIC	UNDIFFERENTIATED		Laterite (Czl)		Laterite, ferricrete, ferruginous soils.	Scarps, mesas, plateaux, flat rounded hills, ferricrete on coastal and flood plains.	Widespread.	Best developed along eastern and north-eastern coast.
					UNCONFORMITY			
MESOZOIC	LOWER CRETACEOUS		Mullaman Beds (Klm)	200	White and yellow sandy claystone, ferruginous sandstones, grits and clean white quartz sandstone, dolomitic siltstone.	Plateaux and mesas, low hills and open valleys where silt often sand covered.	Widely distributed.	Best exposed along coast where extensively lateritized.
					UNCONFORMITY			
PRECAMBRIAN	UPPER PROTEROZOIC	WESSEL GROUP	Elcho Island Formation (Bee)	500+	Flaggy, micaceous sandstone micaceous glauconitic sandstone. Dolomitic siltstone, chert breccia.	Crops out poorly in cliffs and wave cut platforms.	North-west part of Sheet area.	Slumping in dolomitic rocks. Chert breccia discontinuous. Ferruginous sandstone at base.
PRECAMBRIAN	UPPER PROTEROZOIC	WESSEL GROUP	Marchinbar Sandstone (Bem)	800	Flaggy to blocky thinly bedded quartz sandstone, medium-to fine-grained, cross-bedded and ripple marked. Minor sericitic shale.	Tends to form plateau scarp and strike ridges.	North-west part of Sheet area.	Strongly ripple-marked in lower half of unit. Cross-bedded at top. Shales rarely crop out.

[illegible] 2.

TECTONIC HISTORY - ARNHEM BAY - GOVE SHEET AREA

AGE	EVENT	REMARKS
Tertiary to Recent	Slight epeirogenic uplift with regression of sea.	Continuous erosion of topographic high areas, Eustatic changes in sea level. Alternating erosion and sedimentation on Coastal Plains.
Tertiary (?)	Deposition of coastal deposits. Warping of laterite surface. Laterization.	Peneplain conditions on areas corresponding to present Coastal Plains.
Lower Cretaceous to Tertiary	Epeirogenic uplift and marine regression. Slight erosion.	Peneplain developed on Lower Cretaceous sediments.
Lower Cretaceous	Marine transgression and deposition of fresh and marine sediments on Stable Shelf.	Topographic high areas remained as islands. Fresh water sediments in depressions.
Upper Proterozoic to Lower Cretaceous	Epeirogenic uplift and erosion	Area dissected to produce a topography similar to today.
Upper Proterozoic	Deposition of Wessel Group on Stable Shelf.	
Upper (?) Proterozoic	Orogenic uplift and erosion. Final phase of orogeny in central belt.	Mitchell Range fault blocks uplifted producing folding faulting, and an erosion, a topographic high.
	Deposition of Roper Group and Malay Road Group on a shelf with varying rate of subsidence.	Deposition in two isolated basins either side of the central Mitchell Range belt, in the N.E. and S.W.
	Local orogeny and uplift of central belt. Local erosion of McArthur Group.	
Lower (?) Proterozoic	Deposition of McArthur Group and Habgood Group in central subsiding trough and Wilberforce Beds on subsiding shelf.	Pivotal hinge line appears to define eastern margin of trough, with trough becoming more evident southwards. Sediments considerably thinner on shelf.
Lower Proterozoic	Deposition of Parsons Range Group and thinner sandstones on the shelf (Mount Bonner Sandstone).	Uniform sedimentation over wide area, apparently thinning on to Shelf. Sedimentation keeping pace with subsidence giving thick quartz sandstone sequence.
	Orogenic uplift, folding and faulting in central mobile belt (Mitchell Range).	Lower Proterozoic sediments and volcanics folded and faulted, primarily wrench fault movement.
	Intrusion of dolerite dykes into Minarrmina Complex and Ritarango Sandstone.	
	Acid vulcanism - Fagan Volcanics and Spencer Creek Volcanics	Acid volcanics and quartz-feldspar porphyry may be equivalent (no evidence available).
	Intrusion of quartz -feldspar porphyry into Minarrmina Complex.	
	Emplacement of high level, Giddy and Caledon Granites.	Probably comagmatic with porphyry and acid vulcanism.
	Local deposition of Ritarango Sandstone into narrow trough.	Trough probably bounded by faults, sedimentation keeps pace with subsidence, thick sequence of sandstone.
	Emplacement of gabbro/dolerite in Minarrmina Complex.	
	Orogeny, deformation, retrogression of Bradshaw Granite.	Orogeny produced folding of Lower Proterozoic sediments Blue Mud Bay Sheet area.
Archaean	Major orogeny, metamorphism and granitization of Archaean? sediments, emplacement of granites.	Oldest rocks exposed. Minarrmina Complex and Bradshaw Granites.

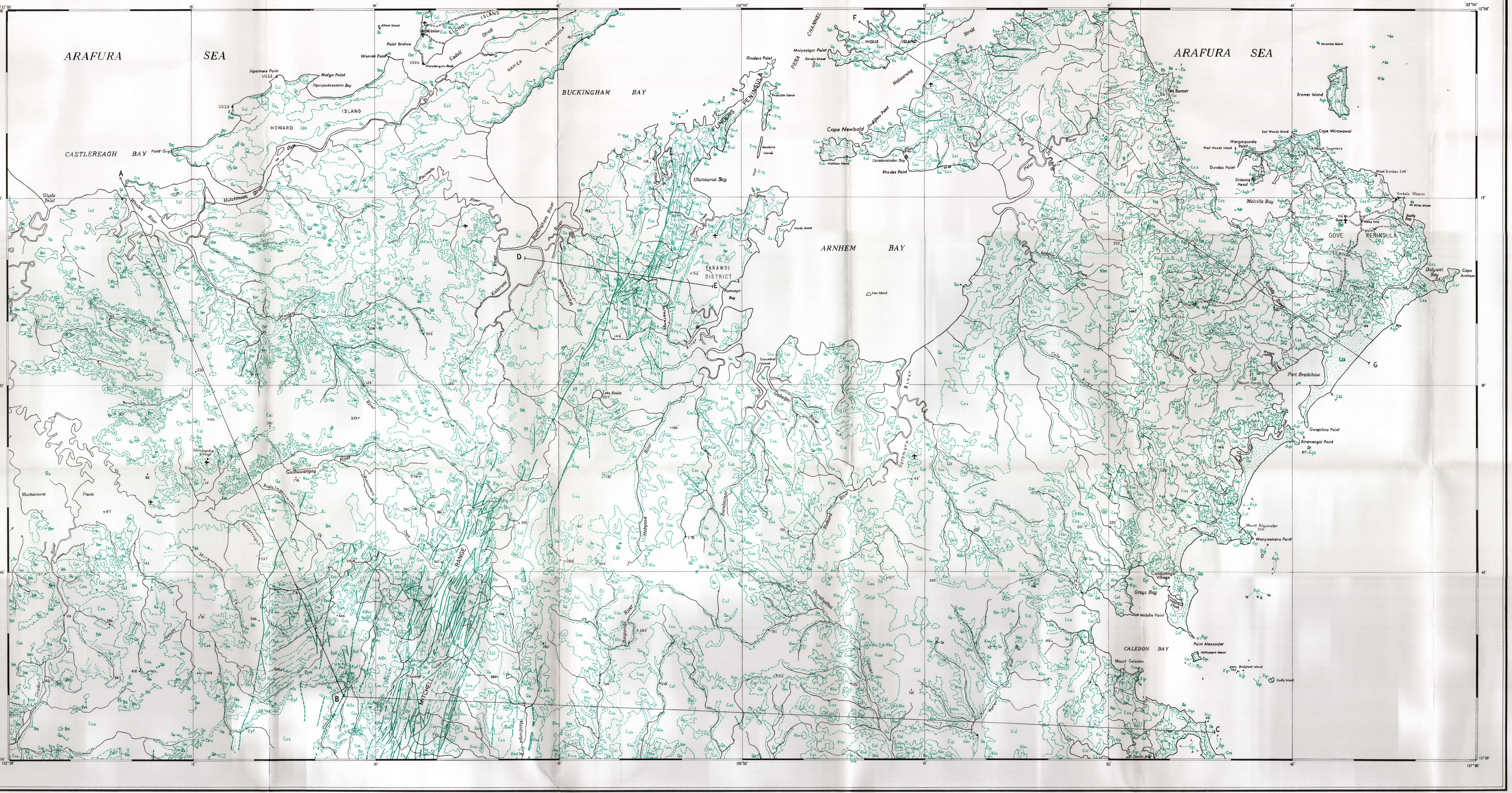
PRELIMINARY EDITION, 1963
SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

ARNHEM BAY–GOVE

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SD 53-3,4

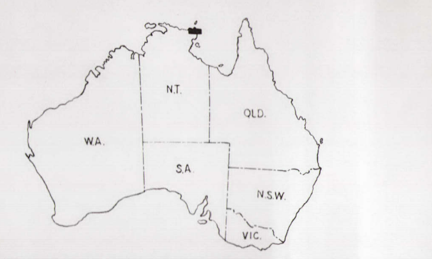


Reference

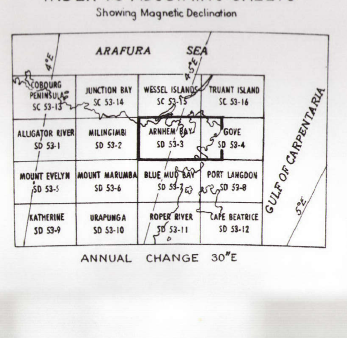
CAINOZOIC	QUATERNARY		Qa	Coastal silt, fine sand, and evaporite deposits
			Qa	Alluvium
	UNDIFFERENTIATED		Czs	Sand dunes (calcareous in places)
			Czs	Sand, residual soil
			Czb	Aluminous laterite; bauxite
			Czl	Laterite, lateritic soil, ferruginous cemented detritus (ferricrete), bauxite
MESOZOIC	LOWER CRETACEOUS	Mullaman Beds	Klm	White and yellow sandy claystone, quartz sandstone, ferruginous sandstone
PRECAMBRIAN	UPPER PROTEROZOIC	Wessel Group: Elcho Island Formation	Pee	Flaggy micaceous sandstone, micaceous glauconitic sandstone, ferruginous sandstone, dolomitic siltstone, chert, breccia
		Wessel Group: Marchinbar Sandstone	Pem	Flaggy to massive thin-bedded quartz sandstone
		Wessel Group: Raiwalla Shale	Per	Interbedded fissile grey shale and fine-grained sandstone; quartz sandstone; purple-brown shale; siltstone
		Wessel Group: Buckingham Bay Sandstone	Pek	Blocky to massive medium-grained quartz sandstone and quartz greywacke; fine-grained quartz greywacke, minor pebble conglomerate
	UPPER (?) PROTEROZOIC		Pdl	Fine to coarse dolerite; porphyritic and vesicular dolerite
		Malay Road Group: Pobassoo Formation	Pap	Flaggy purple, green and white micaceous siltstone, quartz greywacke, quartz sandstone, laminated glauconitic sandstone
		Malay Road Group: Wigram Formation	Paw	Flaggy black, green and purple shale, massive grey, fine sandstone, micaceous siltstone, quartz greywacke
		Malay Road Group: Mallison Sandstone	Pam	Massive pink to pale brown medium-grained quartz sandstone
		Roper Group: Mainoru Formation	Pru	Flaggy purple micaceous siltstone and shale, laminated cherty siltstone and dolomitic siltstone; fine glauconitic quartz greywacke
	LOWER (?) PROTEROZOIC	Habgood Group: Gwakura Formation	Png	Cherty siltstone, fine to medium quartz sandstone, chert pebble conglomerate, dolomitic siltstone
		Habgood Group: Ulunourwi Formation	Pnu	Flaggy purple dolomitic siltstone, dolomitic shale, flaggy purple to grey dolomite, fine-grained dolomitic sandstone
		Habgood Group: Darwarunga Sandstone	Pnd	Fine to medium quartz sandstone; cherty quartz sandstone
		Habgood Group: Yarawoi Formation	Pny	Dolomitic siltstone and shale, quartz sandstone, dolomite, siltstone, shale
		Habgood Group: Slippery Creek Siltstone	Pns	Flaggy, banded purple-white siltstone; minor very fine sandstone, shale
		Habgood Group: Kurala Sandstone	Pnk	Flaggy to blocky, fine to medium white quartz sandstone
		Baralminar Beds	Pr	Massive to blocky medium quartz sandstone; fine micaceous sandstone and siltstone
		Wilberforce Beds	Pwi	Fissile black shale, flaggy micaceous siltstone and fine sandstone
		McArthur Group: Bath Range Formation	Pme	Pelletal chert, massive white siltstone, laminated dolomitic siltstone, flaggy fine sandstone, chert sandstone, chert breccia, laminated chert, pelletal dolomite
		McArthur Group: Baiguridji Formation	Pmi	Flaggy grey, green and purple dolomitic fine sandstone and siltstone; micaceous sandstone and siltstone
		McArthur Group: Yarrawirrie Formation	Pmy	Blocky chert sandstone and quartz sandstone, flaggy chert and dolomitic siltstone; algal chert, laminated and nodular cherty siltstone
		McArthur Group: Strawbridge Breccia	Pms	Massive chert breccia
		McArthur Group: Koolatong Siltstone	Pmk	Flaggy brown, green and grey siltstone; dolomitic siltstone and silty dolomite; dolomite, fine-grained sandstone; minor chert, chert breccia and cherty siltstone
		Undifferentiated	P?	Quartz sandstone, chert chert breccia
	LOWER PROTEROZOIC	Mount Bonner Sandstone	Pb	Massive and blocky medium to coarse quartz sandstone, cobble conglomerate
		Parsons Range Group: Fleming Sandstone	Ppf	Flaggy to massive, pink to white, medium to coarse quartz sandstone
		Parsons Range Group: Marura Siltstone	Ppm	Flaggy and fissile siltstone, shale and dolomitic siltstone, fine sandstone, sandy dolomite
		Parsons Range Group: Badalngarrmirri Formation	Ppb	Blocky to flaggy medium quartz sandstone, fine micaceous sandstone; ferruginous and feldspathic sandstone; siltstone, minor dolomitic siltstone
		Spencer Creek Volcanics	Pls	Pink porphyritic acid to intermediate volcanics, flaggy to blocky quartz sandstone
		Fagan Volcanics	Plg	Coarse red porphyritic acid volcanics, purple feldspathic ashstone, feldspathic sandstone, red shale
		Ritarango Beds	Plr	Blocky and massive fine to coarse quartz sandstone, feldspathic sandstone, arkose
		Giddy Granite	Pgg	Pink massive porphyritic granite; massive biotite-hornblende granite
		Caledon Granite	Pgc	Massive pink even grained biotite-hornblende granite and olivine-biotite granite
	LOWER PROTEROZOIC AND ARCHAEAN	Mirarrmina Complex	A/Pn	Undifferentiated granite, gabbro, porphyry, metamorphics
				Massive quartz-feldspar porphyry
				Massive dolerite gabbro and diorite,
				Foliated and massive porphyritic garnetiferous microcline granite; with schistose inclusions; garnetiferous gneiss
	ARCHAEAN	Bradshaw Granite	Agb	Foliated garnetiferous granite and garnetiferous gneiss with abundant metamorphic inclusions; granulite

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

Geology, 1962, by: D. Dunnet, H.G. Roberts, P.R. Dunn, K.A. Plumb, R. Ruker, P. Rix.
Compilation by: D. Dunnet, K.A. Plumb, H.G. Roberts, A. Mikolajczak
Drawn by: F.J. Peneguel, W.W. Webb; R.J. Pennington

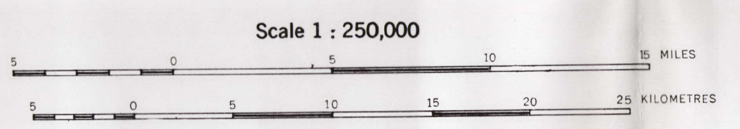


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

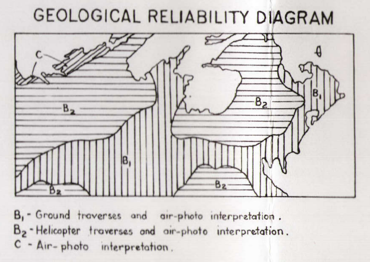


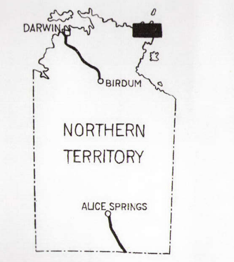
ANNUAL CHANGE

Scale 1:250,000



GEOLOGICAL RELIABILITY DIAGRAM

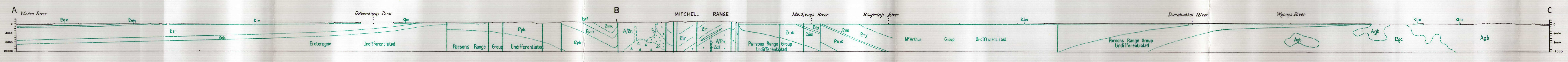


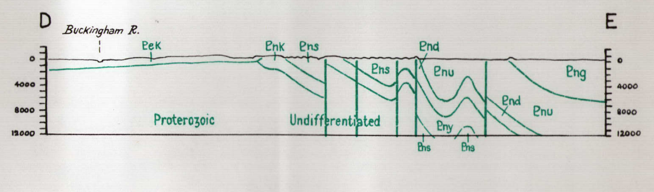


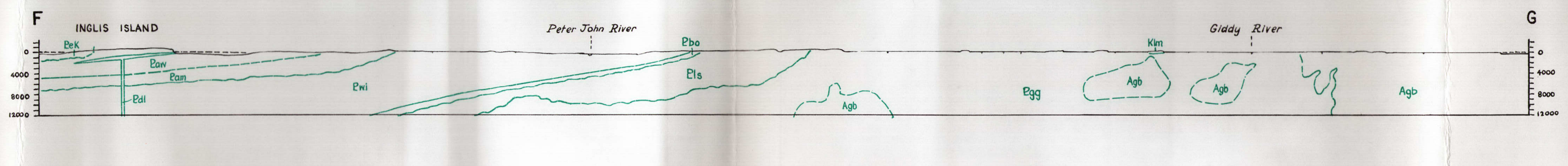
- Geological boundary
- Fault
  Where location of boundaries, faults and folds is approximate, line is broken, where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes
- Strike and dip of strata
- Vertical strata
- Horizontal strata
- Dip < 15° } air-photo interpretation
- Trend lines } air-photo interpretation
- Joint pattern } air-photo interpretation
- Age determination locality and reference number (Prefix A - Arnhem Bay sheet, G - Gove)
- Dyke: p = porphyry, dl = dolerite
- Unexploited bauxite deposit
- Spring
- Waterhole
- Swamp
- Sand dunes
- Road
- Vehicle track
- "York" Homestead
- Landing ground
- Astronomical station
- Trigonometrical station
- ·750 Height in feet

Sections

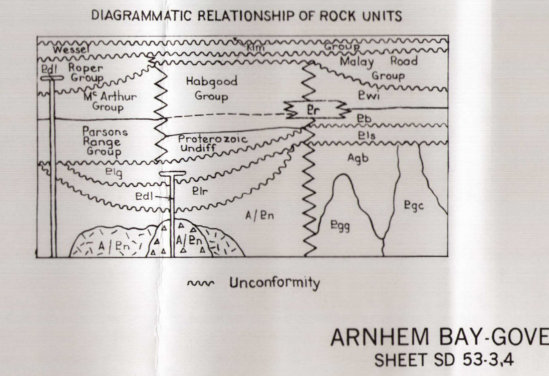
Scale $\frac{V}{H} = 1$
(Cainozoic omitted from sections)







DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



ARNHEM BAY-GOVE
SHEET SD 53-3,4