DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/52

PROGRESS REPORT ON THE GEOLOGY OF THE BATHURST ISLAND, MELVILLE ISLAND, COBOURG PENINSULA AND FOG BAY 1:250 000 SHEET AREAS, NORTHERN TERRITORY

by

R.J. Hughes and B.R. Senior

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SUMMARY

This Record summarizes results of the reconnaissance geological mapping of the Bathurst Island, Melville Island, Cobourg Peninsula, and Fog Bay 1:250 000 Sheet areas, Northern Territory.

Basement comprises Lower Proterozoic metamorphic and igneous rocks of the Pine Creek Geosyncline and the Litchfield and Nimbuwah Complexes, overlain unconformably by the Upper Proterozoic, moderately folded Moyle River Formation on the Fog Bay Sheet and by the nearly horizontal Upper Proterozoic Kombolgie Formation on southern Cobourg Peninsula Sheet.

Permian sediments, of possible glacial origin, are restricted in outcrop to the south of the Fog Bay Sheet area.

During the Cretaceous, marine sediments accumulated on a basement surface that sloped gently to the north and west - the Bathurst Terrace. About 1600 m of sand, silt, and clay was deposited to the west of the area mapped (Arco Petrel 1) but thins eastwards over the Van Diemen Rise and onto the Bathurst Terrace, where only 500 - 600 m was deposited. Sedimenation during the late Cretaceous was restricted to the area of the islands and Coburg Pourg Peninsula, the mainland part of the Northern Territory being land at that time. At the end of the Cretaceous or in the early Tertiary, the area was uplifted and the Cretaceous sediments were lateritized.

Slight northwesterly tilting during the Tertiary permitted a marine transgression over the area of Bathurst and Melville Islands and sand was deposited on the weathered and lateritized Upper Cretaceous surface. Further slight uplift then resulted in a second phase of weathering that has continued to the present.

Changes in sea level during Quaternary time resulted in the formation of raised, consolidated beach deposits in several areas.

Several onshore and offshore petroleum exploration wells have been drilled in the area but to date with no success.

Bauxite and aluminous laterite deposits are present at several localities on northern Cobourg Peninsula. However, exploration to date indicates that the grades are low and that tonnages are probably small compared to those at Gove.

Heavy minerals including rutile, ilmenite and zircon are concentrated in the recent beach deposits and it is possible that economic deposits are present along the northern coasts of Bathurst and Melville Islands.

Sub-artesian fresh water is available on Bathurst and Melville Islands from aquifers within the Van Diemen Sandstone. On Croker Island and at Murgenella Forestry settlement Quaternary sands and laterite form aquifers from which domestic and stock water is obtained.

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INTRODUCTION

A reconnaissance geological survey of Bathurst Island, Melville Island, Cobourg Peninsula, and Fog Bay 1:250 000 Sheet areas was carried out between June and October 1972. The Sheets mapped are west, north, and northeast of Darwin (Fig. 1).

B.R. Senior (Party Leader) and R.J. Hughes worked full time on the project, D. Burger part-time, and G.E. Wilford visited the party briefly in July. Bathurst and Melville Islands were mapped from a base camp at the Bathurst Island Mission. Cobourg Peninsula Sheet was mapped in conjunction with the Alligator River Party operating from a base camp on Cooper Creek (Alligator River Sheet area).

The area is sparsely populated and all the inhabitants are centred in mission stations throughout the region. Excellent co-operation was received from the residents in the area. Forestry settlements at Pickertaramoor on Melville Island and at Murgenella on southern Cobourg Peninsula Sheet have small resident staff involved in the preservation of existing forests and the development of Cyprus Pine plantations. The Cobourg Peninsula Flora and Fauna Reserve is managed by a ranger stationed at Black Point, Port Essington. The lighthouse at Cape Don is serviced by a small resident staff.

A Bell 47G-3B-1 helicopter chartered from Rotor Services was used for traverses on all four Sheets (total flying time 127 hours). Fog Bay Sheet was mapped entirely by helicopter. Two boats were chartered to enable distant groups of islands and parts of the coastline inaccessible by helicopter or vehicle to be mapped. MV Bali Hai was used from 19th-22nd June and the second, MV Arandel was chartered for 20 days during late August and early September, for access to the coastline of western Cobourg Peninsula and the Islands lying to the north. Persistent rough seas prevented landings at New Year and Cowlard Islands.

On Bathurst Island access is restricted to a track along the south coast from Bathurst Island Mission to Cape Fourcroy, where there is an automatic lighthouse and meteorological station. A disused, overgrown track runs north from the central southern coast to Interview Point. Graded and formed gravel roads provide good access on the western and central parts of Melville Island, but there is no access by land to the eastern side. Access to Cobourg Peninsula from Darwin is initially by a bitumen road and then by a graded gravel road to Oenpelli. In the peninsula area itself access is along graded and rough ungraded tracks which vary considerably according to the terrain they cross; they are impassable during the monsoon season. Access on Fog Bay is limited to a vehicle track from Finniss River Station to the coast at a point in the central north part of Fog Bay.

The area is completely covered by aerial photography at a scale of 1:85 000, and Melville Island and Cobourg Peninsula are partly covered at 1:8 000 scale. Planimetric maps, compiled from aerial photography by the Division of National Mapping, were used as bases for the geological maps. They were amended to show all water bore positions and cultural features which post-date the photography. Topographic survey maps at 1:100 000 scale, produced by the Royal Australian Survey Corps, give coverage of Cobourg Peninsula, except for the Cape Don Sheet area. Admiralty charts, at various scales, are available for the entire area. However, much of the bathymetric detail is incomplete.

PREVIOUS INVESTIGATIONS

The earliest geological investigation in the region was the visit to the south coast of Melville Island by Brown (1906). He noted the presence of horizontal sediments and collected Cretaceous fossils in the cliff sections exposed near Cape Gambier. In 1908 Brown undertook a geological reconnaissance from Darwin eastwards to McArthur River. During this survey he made several landings in the Cobourg Peninsula Sheet area. Woolnough (1932) made an aerial photographic survey of Bathurst and Melville Islands, so as to delineate broad structural features in order to encourage petroleum exploration there.

Daily (1955) was the first to attempt a regional study of Bathurst and Melville Islands. He described in detail the stratigraphy of cliff sections exposed along the south coasts of both islands and briefly discussed the inland occurrences of Cretaceous and Tertiary sediments. Brunnschweiler (1956) carried out further geological work along the south coast and Apsley Strait and confirmed Daily's findings.

Wright (1963) examined the molluscan fauna collected by Daily (1955) and published systematic descriptions of 16 species of ammonites collected from the Bathurst Island cliff sections. Skwarko (1966) discussed the outcrops of Cretaceous strata on Bathurst Island and listed the macrofossils known to occur. A palynological examination of samples from Bathurst Island has been made by Burger & Norvick (in prep.).

In 1960-1961 Alliance Oil Development N.L. drilled two unsubsidized exploration wells, Bathurst Island 1 and 2, on Bathurst Island. The Cretaceous sediments beneath the cover of Tertiary sands on central Bathurst Island were auger sampled by R. Hare and Associates (1962). Flinders Petroleum & Pexa Oil drilled Tinganoo Bay 1 on Melville Island during 1971 (Pemberton, 1971).

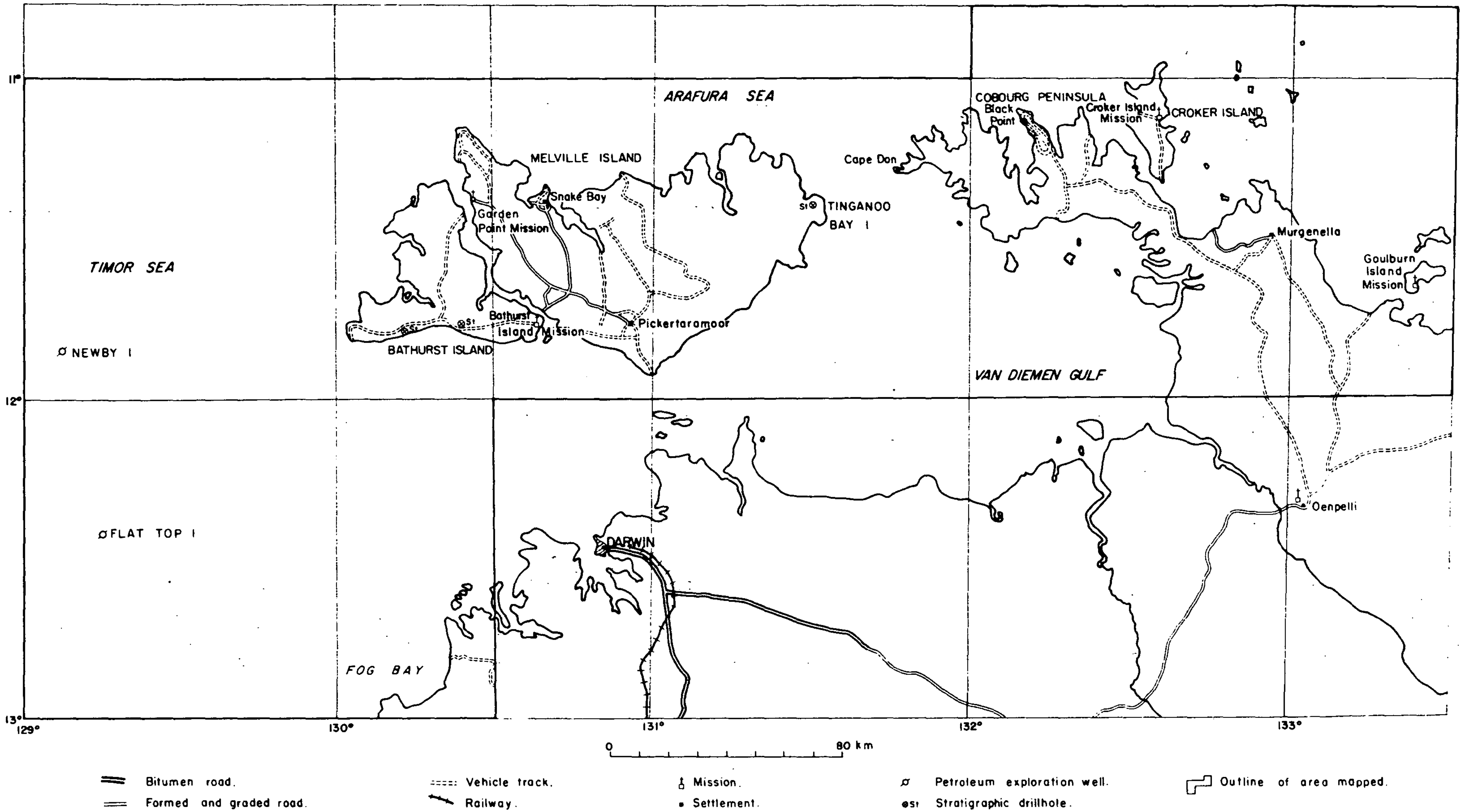

Figure 1 LOCALITY DIAGRAM

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Two petroleum exploration wells have been drilled offshore. Newby 1 was drilled in 1969 by Australian Aquitaine in the southwest corner of the Bathurst Island Sheet and in 1970 Australian Aquitaine drilled Flat Top 1 in the central west part of Fog Bay Sheet.

Geologists of the Water Resources Branch Darwin have examined the Tertiary sediments in connection with the development of a water supply for Bathurst Island Mission (Dunn, 1962; Barclay, 1964; Laws, 1967; Lau, 1971).

The reported occurrence of heavy mineral beach sands along the coasts of Bathurst Island, Melville Island, and Cobourg Peninsula has been investigated by the Bureau of Mineral Resources and private companies (Mackay, 1956; Ward, 1956, 1961; Murphy, 1970). Owen (1949, 1954) examined areas on Cobourg Peninsula for the presence of bauxite. Several exploration surveys followed (Matheson, 1957; Paterson, 1958; Kidd, 1961; Swiss Aluminium, 1969).

Jongsma (in press) has reported the results of an extensive survey of the Arafura Sea region to the north of the area mapped. His work includes a synthesis of the available geophysical data as well as the results of a shallow seismic survey by the BMR.

Aeromagnetic, gravity, and seismic surveys by the Bureau of Mineral Resources and private companies are summarized in Table 1.

PHYSIOGRAPHY

The mapped area is divided into six physiographic units (Fig. 2).

Estuarine Plains (Fig. 2, unit 1) occupy the lowlands within the zone of tidal activity. The large areas of Estuarine Plains along northern Melville Island, western Bathurst Island, and southwest Cobourg Peninsula developed as a result of regional tilting during the Cainozoic. This permitted the flooding of ancient river valleys along these coastlines and accounts for the phenomenon of underfit streams seen on the islands at the present time. Hays (1967) suggested that Aspley Strait, between Bathurst and Melville Islands, and Dundas Strait, separating Melville Island and Cobourg Peninsula, mark a northward continuation of the Darwin, Adelaide, and Alligator River systems.

TABLE 1: SUMMARY OF GEOPHYSICAL SURVEYS

YEAR	ABBREVIATED TITLE	LOCATION	REFERENCE
Seismic Surveys			
1962	Bathurst Island refraction survey	Onshore Bathurst Island	Tinline & Fife, 1962
1964	Marine seismic survey Flat Top Bank area	Timor Sea, Bathurst Island - Cape Ford	Walton, 1964
1965	Marine seismic survey Dundas Strait	Arafura Sea & Dundas Strait 11°-11°30'S; 131°-131°30'E.	Prastka & Polyniak, 1965
1966	Offshore seismic survey Arafura Sea	Arafura Sea, north of Cobourg Peninsula	Smit, 1966
1967	Lynedoch Bank seismic survey	Lynedoch Bank - Money Shoal, 11°-11°30'S; 130°-130°30'E.	Ley, 1967
1967	Hyland seismic survey	Timor Sea, west of Bathurst Island and Fog Bay	Amberg, 1967
1967	Marine seismograph survey Timor Sea	West of Bathurst Island	Namco 1967
1967	Money shoal sparker survey	North of Melville Island	Shell, 1966
1968	New Year Island seismic survey	Arafura Sea 9°-11°S; 132°-135°E.	CGG, 1968
1969	Timor Sea gravity, magnetic and seismic survey	Timor Sea	Jones, 1969
1969	Marine seismic survey Arafura Sea	Arafura Sea 9°-11°S; 130°-135°E.	Spicher, 1969

YEAR	ABBREVIATED TITLE	LOCATION	REFERENCE
Seismic Surveys (cont.)			
1969	Legendre-Marie marine seismic survey	N.W. shelf from Legendre area to NT/P6 Timor Sea	deJong, 1969
1969	Parry shoal marine seismic survey	Off west coast Bathurst Island 11°-12°S; 129°30'-130°10'E.	United, 1969
Gravity Surveys			
1956	Reconnaissance gravity survey of Bathurst and Melville Islands	South coast Bathurst Island and Apsley Strait	Hare, 1962
1969	Timor Sea gravity, magnetic and seismic survey	Timor Sea	Jones, 1969
Aeromagnetic Survey			
1963	Anson Bay aeromagnetic survey	11°-14°S; 128°30'-130°30'E.	Adastra, 1964
1964	Melville Island aeromagnetic survey	Onshore Melville Island	Faessler, 1964
1965	Arafura Sea air magnetometer survey	North Melville Island, Cobourg Peninsula and offshore to Lat. 9°S.	Prior, 1965
1969	Aeromagnetometric survey Van Diemen Gulf	North Melville Island, Cobourg Peninsula and Dundas Strait	CGG, 1969
1969	Timor Sea gravity, magnetic and seismic survey, 1967	Timor Sea	Jones, 1969
1972	Aeromagnetic survey Cobourg Peninsula 1:250 000 Sheet	Onshore Cobourg Peninsula	Horsfall, Wyatt, & Wilkes, (in prep.)

Alluvium (Fig. 2, unit 2) has been deposited on the active floodplains along the Finniss River, Murgenella Creek, and their larger tributaries. The floodplains are characterized by meandering channels, lagoons, swamp depressions, and cut-off meanders.

Reworking of Proterozoic, Cretaceous, Tertiary, and Quaternary sediments has resulted in extensive sandplains on all four Sheet areas (Fig. 2, unit 3). On Melville and Bathurst Islands and on northern Cobourg Peninsula the sand is generally red to yellow; it was derived by erosion from the ferruginous capping to the Cretaceous and Tertiary sediments. On southern Cobourg Peninsula and Fog Bay, however, the sandplains are built up of yellow, loamy sands, this material being derived from the Proterozoic igneous and metamorphic rocks as well as the Kombolgie Formation and the Moyle River Formation.

Gently dissected plateaux (Fig. 2, unit 5) and undulating lateritic rises (Fig. 2, unit 4) form the areas of higher relief on Melville and Bathurst Islands and northern Cobourg Peninsula. The plateaux and hills generally have a hard ferruginous capping consisting of chemically weathered and, in places, reworked Cretaceous and Tertiary sediments. The southern margins of the plateaux are generally steep and it is here that erosion of the laterite is most intense. Where the laterite has been eroded a surface drainage of very shallow creeks has developed.

The deeply dissected plateaux (Fig. 2, unit 6) are made up of resistant Upper Proterozoic sandstones, which on southern Cobourg Peninsula rise steeply out of the sandplains with near vertical scarps up to 250 m high. The plateaux are deeply dissected by joints and faults along which streams flow through deep, youthful gorges. The hardness of the sandstone and the controlled run-off of surface water has greatly influenced the preservation of these deeply dissected plateaux.

STRATIGRAPHY

BASEMENT

The Lower Proterozoic igneous and metamorphic rocks of the Nimbuwah Complex (Pld, Plz$_{1-3}$) crop out on southern Cobourg Peninsula, the only outcrops of Lower Proterozoic rocks in the mapped area. The deformed metamorphosed sediments and igneous rocks related to the Pine Creek Orogenic Province are thought to underlie the sediments that have accumulated over the Bathurst Terrace.

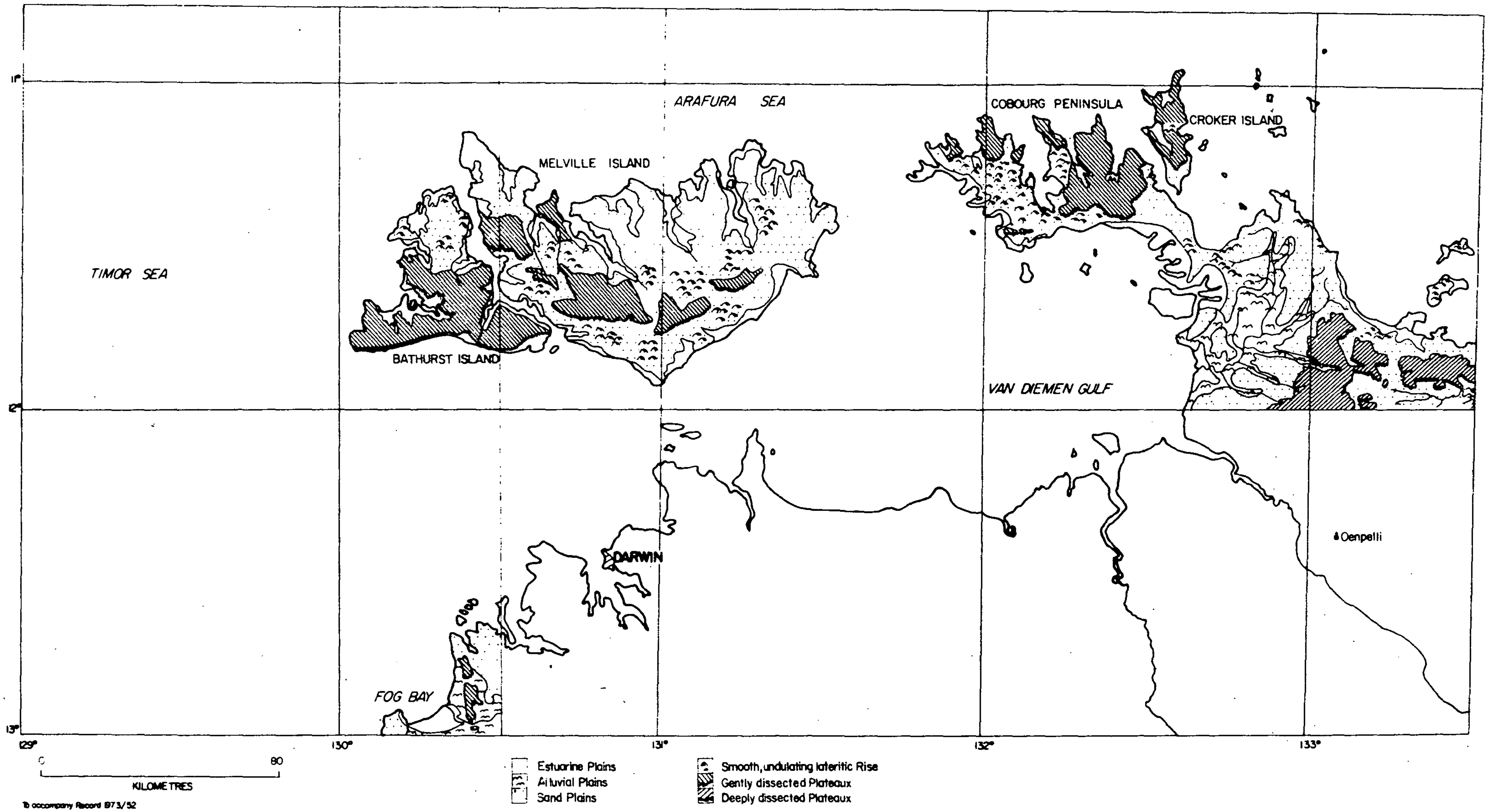

Fig.2 Sketch map showing physiographic units of the Bathurst Island, Melville Island, Cobourg Peninsula & Fog Bay Sheets.

Moyle River Formation (Pfm)

Derivation of Name: The Moyle River Formation was named by Pontifex et al., (1968) after the Moyle River on the Port Keats Sheet area.

Distribution: In the area mapped the Moyle River Formation is restricted to the Fog Bay 1:250 000 Sheet. It crops out as a tightly folded syncline extending from latitude 13°44'S southwards to Peaked Hill. There is a small outcrop at Hatter Hill in the southeastern corner of the Sheet.

Lithology: The Moyle River Formation is a medium to coarse quartzose sandstone with a few interbeds of micaceous siltstone and conglomerate containing rounded quartzite, vein quartz, and schist pebbles. Graded bedding was noted in several of the sandstone beds. Strong shearing is common and quartz veining is present in places.

Thickness: Unknown in the Fog Bay Sheet area.

Contacts and Relationships: According to Morgan (1972) the Moyle River Formation is the basal formation of the Fitzmaurice Group, outcropping on the Port Keats Sheet. On the Fog Bay Sheet it is the only formation of this group present and is unconformably overlain by Quaternary sediments. The Moyle River Formation unconformably overlies the biotite granites of the Litchfield Complex.

Structure: The Moyle River Formation is moderately folded and crops out as a north-trending syncline with steeply dipping limbs. The rocks are generally strongly sheared and, in places, an axial plane cleavage has developed with a dominant orientation of 80°-90°/350°. The presence of numerous quartz veins trending between 330° and 010° suggests the extension into this area of the northerly trending system of faults which greatly influenced the deposition of the Fitzmaurice Group to the south.

Age: The Moyle River Formation unconformably overlies the Litchfield Complex, which has been dated by the Rb/Sr whole rock isochron method at 1760 m.y. (Walpole et al., 1968). Consequently, the Moyle River Formation is thought to be Carpentarian or Adelaidean in age.

Kombolgie Formation (Puk)

Nomenclature: The name Kombolgie Formation was introduced by Walpole (1958) for the upper unit of the Upper Proterozoic Katherine River Group. The type locality is the Katherine Gorge 20 km east of Katherine.

The lithology of the Kombolgie Formation is essentially one of medium to coarse quartzose sandstone, and it would be in keeping with the Australian Code of Stratigraphic Nomenclature (1964) to revise its name to Kombolgie Sandstone.

Distribution: The Kombolgie Formation crops out extensively over southern Cobourg Peninsula Sheet. It forms steep-sided hills which are outposts of the Arnhem Land Plateau. (Photo 1) Outcrops were also found offshore at Sims Island and at Anyiminali Point on South Goulburn Island.

Lithology: Mainly medium to coarse quartzose sandstone with bands of quartz pebble conglomerate (Photo 2). Bedding is thick and the sediments are commonly ripple-marked and cross-bedded.

Thickness: No accurate measurement has been made, but a maximum thickness of 160 m is estimated in the southern Cobourg Peninsula Sheet area.

Contacts and Relationships: On the southern Cobourg Peninsula Sheet the formation rests unconformably on the Lower Proterozoic igneous and metamorphic rocks of the Nimbuwah Complex.

Structure: The formation is strongly jointed and, in some areas, faulted. Shallow dips associated with tilting along small faults were recorded, but the formation is generally horizontal.

Age: On the Mount Evelyn 1:250 000 Sheet the Kombolgie Formation conformably and disconformably overlies the Edith River Volcanics, which have been dated at 1760 m.y. (Leggo, in Walpole et al., 1960). The formation is considered to be Carpentarian to Adelaidean in age.

Permian (Pl)

Probable Permian sediments occur in the southwest of Fog Bay and consist of sandstone, siltstone, and diamictite. In the Docherty Hills to the south (Cape Scott 1:250 000 Sheet) the basal Permian is represented by poorly stratified diamictites and a correlation with this unit is probable.

These deposits are probably of glacial origin although positive evidence is lacking.

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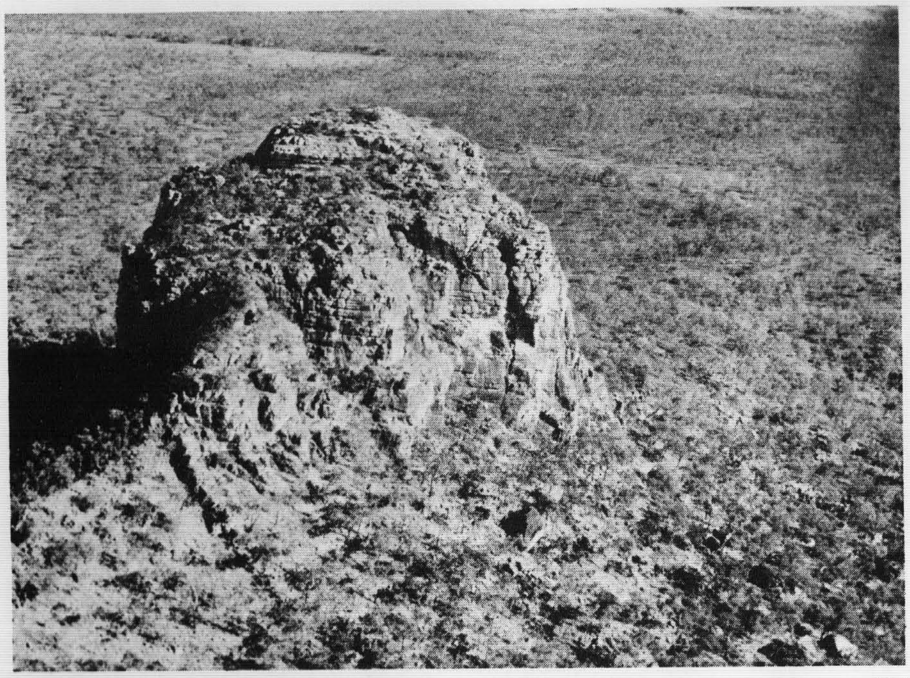

Photo 1: Outline of Kombolgie Formation, Tor Rock, Cobourg Peninsula. The unconformity between this unit and the underlying migmatites of the Nimbuwah Complex is marked by the break in slope at the base of the scarp. BMR Neg. No. GA/7895

Photo 2: Conglomerate bed near the base of the Kombolgie Formation showing well rounded pebbles and boulders of vein quartz and quartzite. The overlying coarse-grained sandstone exhibits large scale, cross bedding. BMR Neg. No. GA/7885

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CRETACEOUS

Tinganoo Bay Beds (Klt)

Derivation: Tinganoo Bay, Lat. 11°23'S, Long. 131°28'E, Melville Island 1:250 000 Sheet.

Distribution: The Tinganoo Bay Beds are known only from Flinders-Pexa Tinganoo Bay 1, where they occur between 569 and 583 m (T.D. for well).

Lithology: Coarse quartzose sandstone and conglomerate containing angular to rounded pebbles of quartz and quartzite grading down into a fine micaceous sandstone with a few shale laminae.

Thickness: The total thickness is unknown. Assuming little change in regional dip, and by extrapolation from the Dundas Strait seismic survey (Prasta & Polyniak, 1965) there is probably 100 m of sediment between the base of the Bathurst Island Formation and Proterozoic basement at Tinganoo Bay.

Contacts and relationships: In Flinders-Pexa Tinganoo Bay 1 the Tinganoo Bay Beds are unconformably overlain by the Bathurst Island Formation. The Mullaman Beds also unconformably underlie the Bathurst Island Formation, but the two units are lithologically distinct. The Mullaman Beds consist of fine-grained sandstone, radiolarian chert, porcellanite, and minor conglomerate. In contrast the Tinganoo Bay Beds are composed primarily of coarse clastics.

Bathurst Island Formation (Kb)

Derivation and type section: Bathurst Island, 60 km northwest of Darwin, Bathurst Island 1:250 000 Sheet. Arco originally reserved the name Bathurst Island Formation with the register of stratigraphic names, Canberra.

The type section is defined as the interval between 412 and 1329 m in Arco Petrel 1 petroleum exploration well (Arco, 1969a). Arco Petrel 1 was drilled on the southeastern edge of the Bonaparte Depression (Veevers & Van Andel, 1967) at latitude 12°49'S, longitude 128°28'E. Sidewall cores, conventional cores, and cuttings from the Bathurst Island Formation are available for examination at the BMR Core and Cutting Laboratory, Fyshwick, A.C.T.

Distribution: The Bathurst Island Formation extends across the Bathurst Terrace (Figure 7) and is represented in outcrop on Bathurst Island, Melville Island, and Cobourg Peninsula by three members. The formation thickens northward over the terrace and probably extends into the Money Shoal Basin (Williams et al., 1973).

The results of the Hyland and Parry Shoals seismic surveys (Amberg 1967; United Geophysical, 1969) indicate that the Bathurst Island Formation is widely distributed along the eastern margin of the Bonaparte Gulf Basin and that it onlaps across the Van Diemen Rise. (Veevers & Van Andel, 1967).

The section intersected by Arco Lacrosse 1 petroleum exploration well (Arco, 1969b) indicates that the Bathurst Island Formation does not extend into the southern part of the Bonaparte Gulf Basin.

Lithology: Between 412 and 543 m the section in Arco Petrel 1 is mainly sandstone with thin beds of shale and limestone. Below 543 m the amount of shale increases and the section consists of interbedded silty shale and sandstone to 975 m, below which the section is mainly shale except for a basal sandstone from 1299 to 1329 m.

Thickness: At the type section 917 m. The formation thins gradually towards the eastern edge of the Bonaparte Gulf Basin, where a thickness of 700 m is indicated by seismic data. The formation thins further over the Van Diemen Rise and eastwards across the Bathurst Terrace. In Flinders-Pexa Tinganoo Bay 1 well (Pemberton, 1971) on northeast Melville Island the Bathurst Island Formation is 569 m thick.

Contacts and relationships: In Arco Petrel 1 the Bathurst Island Formation is overlain unconformably by upper Palaeocene sediments and is underlain unconformably by a quartzose coarse-grained sandstone of Neocomian age. The Van Diemen Sandstone unconformably overlies the Bathurst Island Formation on Bathurst and Melville Islands. Elsewhere on the Bathurst Terrace it is succeeded by a thin cover of Quaternary sediments. Lower Cretaceous Mullaman Beds and Tinganoo Bay Beds underlie the Bathurst Island Formation on the Bathurst Terrace.

Three members are recognized in the onshore sequence of the Bathurst Island Formation. They are laterally equivalent and represent facies changes across the terrace from deeper, open marine conditions in the north (Wangarlu Mudstone Member), through a deltaic environment (Moonkinu Member), to a littoral, marginal marine environment (Marligur Member), in the south (Fig. 3).

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Structure: The Bathurst Island Formation forms a slightly tilted sequence with a regional dip of less than 10° to the northwest. Shallow folding and compaction faults with small throws are common in the outcropping sediments of the Bathurst Island Formation. Onshore mapping failed to establish any large-scale folding except for a very shallow syncline trending from central southern Cobourg Peninsula north to Malay Bay. Offshore geophysical surveys have not revealed evidence for large-scale folding or faulting within the formation.

Fossils and age: Palaeontological and palynological evidence suggests that the interval between 412 and 132 m in Arco Petrel 1 ranges in age from Aptian to Cenomanian or possibly Turonian.

The age of the members of the Bathurst Island Formation and their faunas are discussed below.

Wangarlu Mudstone Member (Kuw)

Derivation and type section: Wangarlu Bay, Lat. 11°22'S, Long. 132°20'E Cobourg Peninsula 1:250 000 Sheet area. The type locality is in cliffs on the northwest side of Wangarlu Bay.

Distribution: The Wangarlu Mudstone Member crops out in cliff sections along the southern coast along part of Cobourg Peninsula between Wangarlu and Wurgurlu Bays and at Guialung Point along the west part of Mountnorris Bay. Inland the outcrop is restricted to a few lateritic rises. Similar sediments correlated with this unit occur in cliffs along the south coast of Bathurst Island 5 km east of Lubra Point.

Lithology: Mudstone with lesser siltstone and a few thin beds and laminae of fine-grained sublabile sandstone. The mudstone contains disseminated pyrite which on oxidation leaves sulphurous encrustations. Scattered dark grey, indurated, pyritic nodules are common in the Bathurst Island outcrop, and a few were observed at Wangarlu Bay on Cobourg Peninsula. The mudstone is soft, and shrinks on drying to crumbly blocky fragments.

Calcareous concretions are present in the cliffs at Guialung Point, where very fine sublabile sandstone is dominant over siltstone. This outcrop is possibly transitional to the coarser grained, well bedded sediments of the Moonkinu Member, which crops out 20 km to the southeast in southern Mountnorris Bay.

Thickness: At Wangarlu Bay 14 m, and at Guialung Point 4 m. The Member is not well enough exposed for top and bottom to be observed and an estimate of thickness is somewhat conjectural. However, its interpreted outcrop width suggests a thickness of the order of 100 m.

Contacts and relationships: The Wangarlu Mudstone Member is overlain by Quaternary superficial sediments. To the northwest of the type section the sediments mapped as undifferentiated Cretaceous may belong to the Member, but they are so chemically weathered that parent rock textures have disappeared and correlation on the basis of lithology is difficult. To the southeast the Member grades laterally into the Moonkinu Member. The Wangarlu Mudstone Member is underlain by the Tinganoo Bay Beds in Flinders-Pexa Tinganoo Bay 1.

Structure: The unit has a slight regional tilt of about 1° to the northwest. Photo-interpreted lineaments may be the surface expression of small compaction faults or a joint system.

Fossils and age: Macrofossils are rare, and most are Mytilus sp. One mudstone sample from Wangarlu Bay had an abundant Cenomanian microflora and microplankton fauna.

Diagnostic features: The Wangarlu Mudstone Member is an essentially massive mudstone sequence with lesser siltstone and fine sublabile sandstone beds.

Moonkinu Member (Kum)

Derivation and type section: Moonkinu Beach 20 km southwest of Bathurst Island Mission, Lat. 11°50'S, Long. 130°28'E, Bathurst Island 1:250 000 Sheet. The type section is in the cliffs adjacent to Moonkinu Beach.

Distribution: The Moonkinu Member crops out in the cliff sections exposed along the southern coasts of both Melville and Bathurst Islands (Photo 3). Inland, on both islands, outcrop is poor and is generally restricted to low cliffs adjacent to streams that have eroded through the Cainozoic cover. In the Notch Peak region, Melville Island, sediments of the Moonkinu Member are exposed below the lateritic cap outcropping on the plateau surface.

On Cobourg Peninsula the Moonkinu Member occurs as discontinuous outcrops of highly weathered sediments in the central portion of the peninsula. Three small areas of unweathered outcrop were found (southern Mountnorris Bay, Copeland Island (photos 4 & 11), and Cowlard Island).

Photo 3: Moonkinu Member outcropping in coastal cliffs along the southern coast of Bathurst Island. Photograph illustrates the regular bedding characteristic of the Moonkinu Member and the laterite developed in the upper part of the Moonkinu Member. An extensive accumulation of dune sands (QC) is

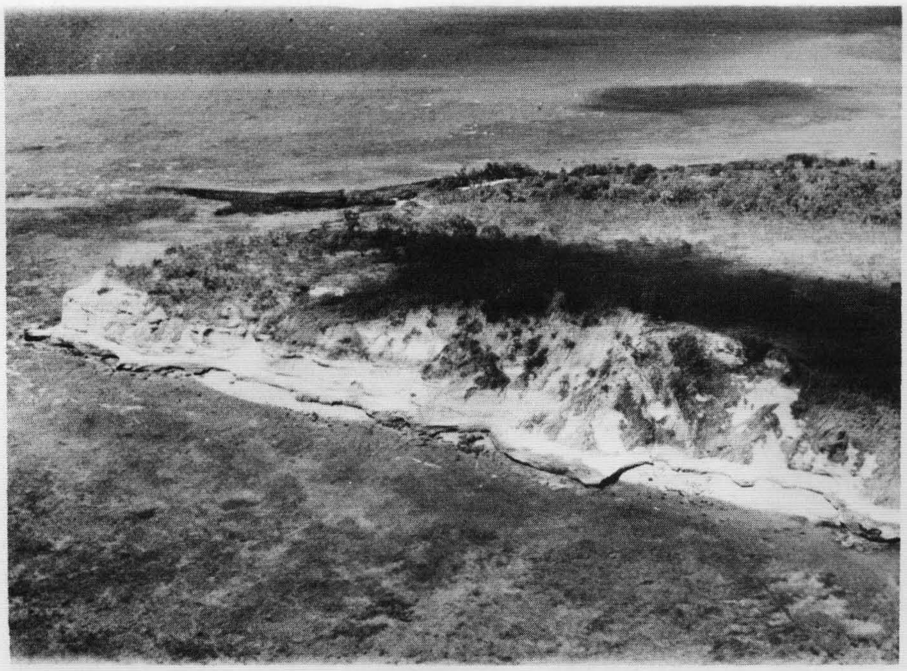

Photo 4: Moonkinu Member outcropping on Copeland Island, Cobourg Peninsula. BMR Neg. No. GA/7894

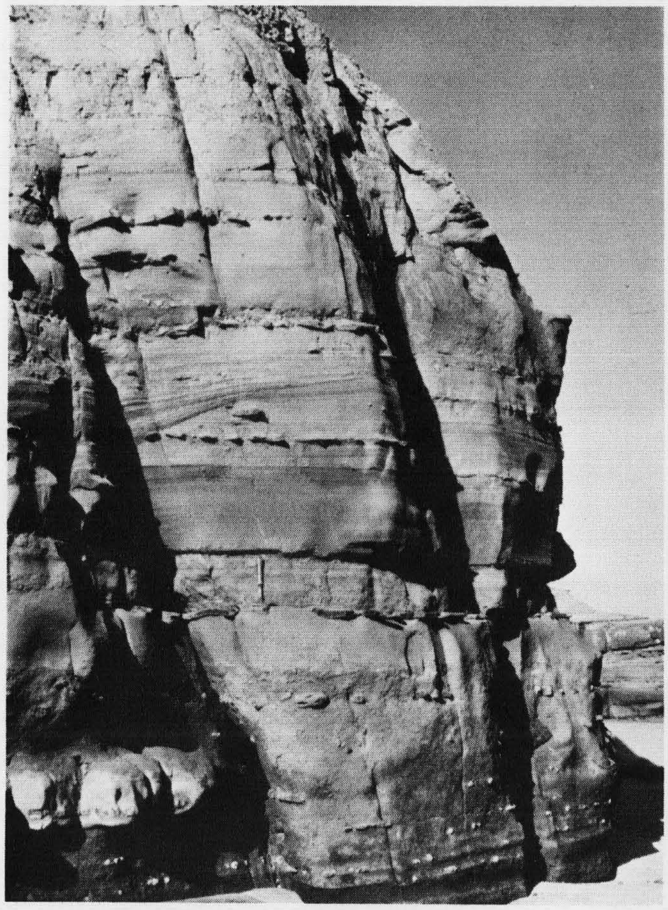

Photo 5: Part of the type section of the Moonkinu Member illustrating the regular nature of the bedding; low angle cross bedding and irregular ferruginous and calcareous concretions aligned parallel to bedding. BMR Neg. No. GA/7890

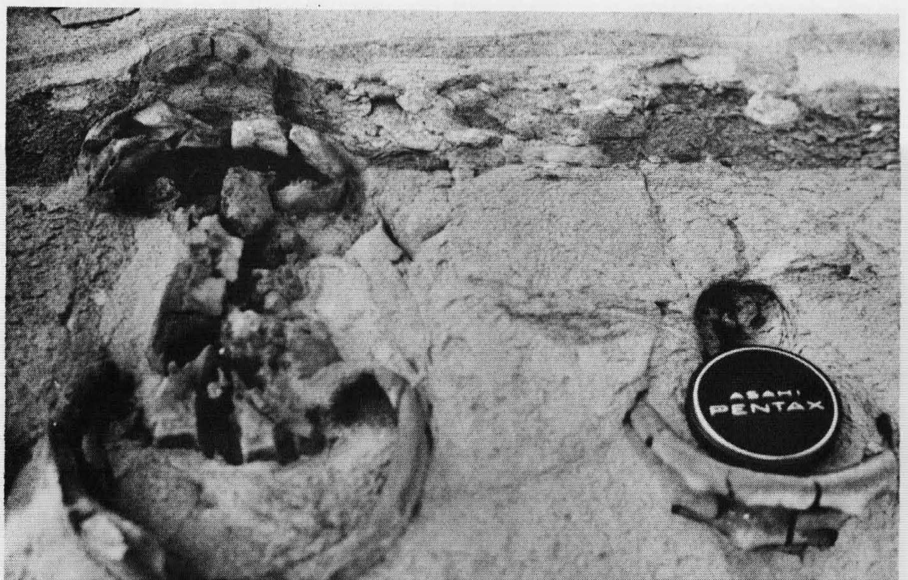

Photo 6: Ammonites within the Moonkinu Member, preserved at right angles to bedding. Attitude of preservation indicates quiet conditions of deposition.
BMR Neg. No. GA/7889

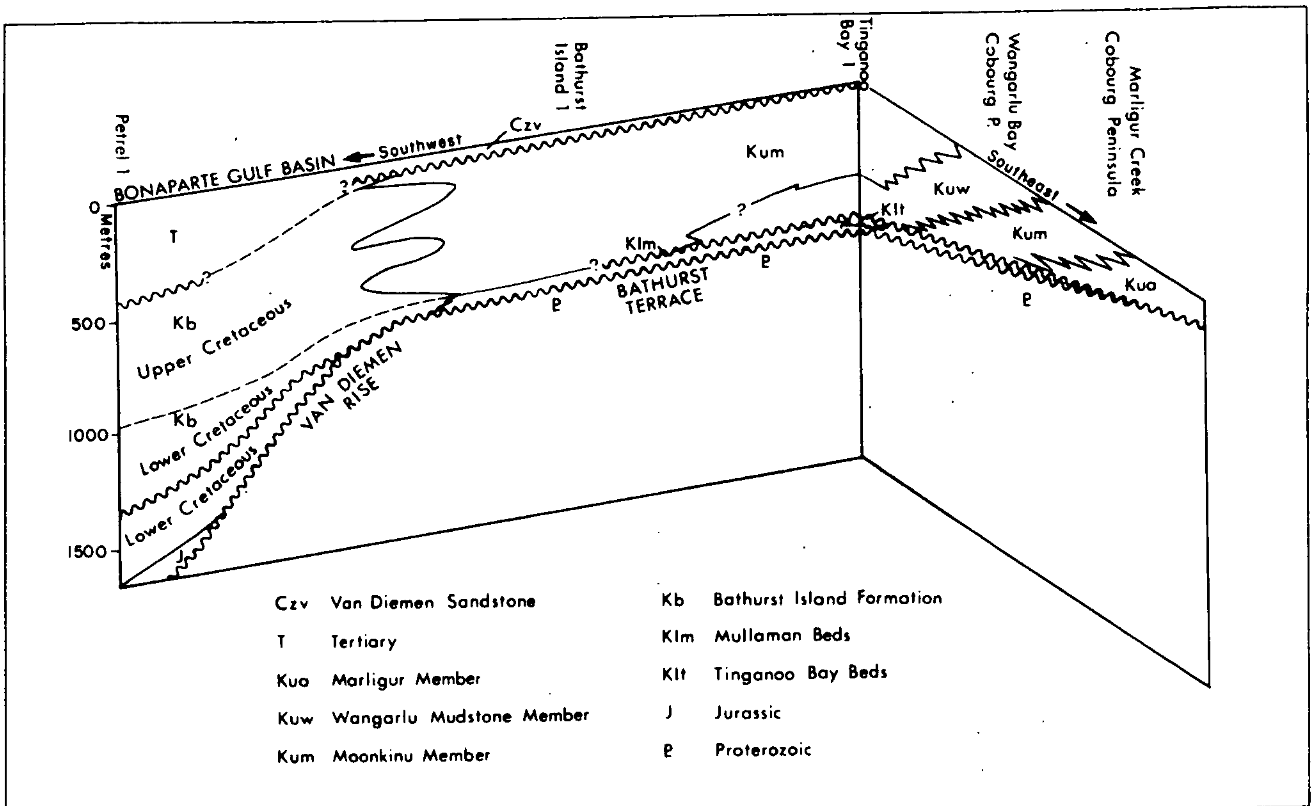

FIG.3 Interpreted stratigraphic relationships of proposed units from Bonaparte Gulf Basin across the Bathurst Terrace

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Lithology: Fine to very fine-grained sub-labile sandstone interbedded with dark to light grey mudstone. The sandstone is dark green or grey to yellow, generally well sorted, and composed of angular to subangular quartz grains, opaque minerals, and weathered feldspar, with minor amounts of muscovite, glauconite, tourmaline, and zircon. Clasts and lenses of mudstone occur at irregular intervals in the sandstone beds. The mudstone is finely laminated, lignitic, soft, and friable where weathered. Fine-grained sandstone lenses and partings are common.

Calcareous and limonitic concretions are present in both the sandstone and mudstone beds and are aligned and flattened parallel to the bedding. Medium-scale low-angle cross-stratification is common within the sandstone beds. Other sedimentary structures observed include burrow structures, fine parallel lamination, and wavy lamination. (Photos 5 & 6). Figures 4 &5 are detailed stratigraphic sections of the Moonkinu Member.

Thickness: 150 m along the southern coast of Bathurst Island, including 20 m in the type section (Fig. 4). Alliance Bathurst Island Nos 1 and 2 petroleum exploration wells (Hare, 1961, 1962) were completed within the Moonkinu Member (252 m and 312 m T.D. respectively). In Tinganoo Bay 1 the Moonkinu Member is estimated to be 400 m thick (Fig. 6).

Contacts and relationships: The Moonkinu Member is unconformably overlain by Van Diemen Sandstone (Fig. 4). The base is tentatively picked at 400 m depth in Flinders-Pexa Tinganoo Bay 1. At this level there is a change from the regularly bedded fine-grained sandstone and mudstone characteristic of the Moonkinu Member to a more argillaceous sequence with less regular bedding.

On Cobourg Peninsula the Moonkinu Member grades laterally into the Marligur Member towards the southeast and into the Wangarlu Mudstone Member towards the northwest. Along the south coast of Bathurst Island the Moonkinu Member grades westwards into the Wangarlu Mudstone Member.

Structure: The Moonkinu Member is generally horizontal or has very shallow dips towards the northwest. Shallow folding and compaction faults with small throws are common. Next to the larger faults the bedding becomes inclined and near-vertical dips were observed.

Fossils and age: Daily (1955) collected a molluscan fauna from the southern coasts of Bathurst and Melville Islands and Wright (1963) assigned it to the Cenomanian. Skwarko (1966) came to the same conclusion after reviewing the palaeontological data.

A fauna of macrofossils including ammonites, bivalves, gastropods, and fish teeth was collected during this survey (Photos 7 & 8). The ammonites, identified by R. Henderson (Appendix 2), include Acanthoceras tapara, Chimbuites mirindowensis, ?Collingnoniceras sp., Euompholoceras londsdalei, Hypoturrilites gravensianus, Inoceramus concentricus, Sciponoceras sp., nov., Sciponoceras sp., and Turrilites (Turrilites) costatus. The fauna is middle Cenomanian in age. Numerous samples of drill core from Alliance Bathurst Island 1 and 2 and Flinders-Pexa Tinganoo Bay 1, as well as several outcrop samples, have been examined palynologically by Burger & Norvick (in prep.). The results confirm the Cenomanian age (Appendix 1).

Diagnostic features: Regularly interbedded fine sublabile sandstone, siltstone, and mudstone with well defined bedding distinguish the Moonkinu Member.

Marligur Member (Kua)

Derivation and type section: The type section is 1 km to the east of Marligur Creek at Lat. 11°50'S and Long. 133°12'E, Cobourg Peninsula Sheet, where the Marligur Member crops out as a low, scrub-covered, flat-topped hill.

Distribution: Numerous but very poorly exposed outcrops occur in the Wellington Range (Cobourg Peninsula Sheet) and extend to the northeast portion of the Alligator River and the western part of the Junction Bay Sheet areas.

Lithology: Thinly interbedded quartzose sandstone, siltstone, and mudstone. The sandstone is poorly sorted, with angular to subangular clasts of fine to coarse sand size. The pelitic interbeds are laminar to very thinly bedded, micaceous, and contain scattered fine to coarse sand clasts. All outcrops visited were weathered. The argillaceous fraction is kaolinitic and slight ferruginous mottling and silicification are common to all rock types.

Thickness: Probably 30 m, as indicated by diamond drilling by uranium exploration companies. At the type section, 5 m of Marligur Member is exposed. Most outcrops reveal less than 2 m of the member.

Contacts and relationships: The Marligur Member is unconformable between Quaternary sand and Kombolgie Formation. In places it rests upon the Nimbuwah Complex or overlies, and abuts against, steep escarpments of the Kombolgie Formation.

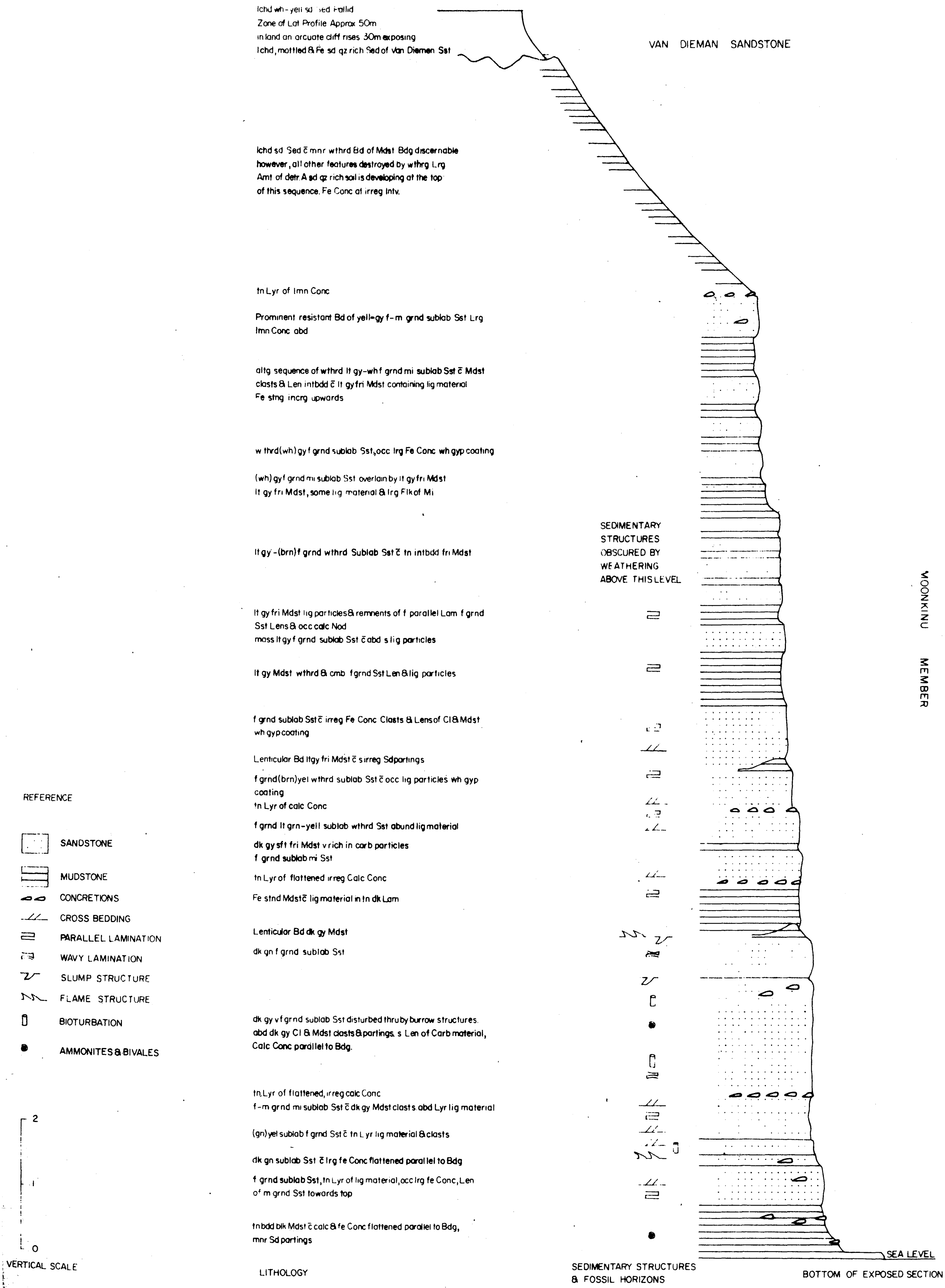

Fig.4 Type section Moonkinu Member, Moonkinu Beach, Bathurst Island.

To accompany Record 1973/52

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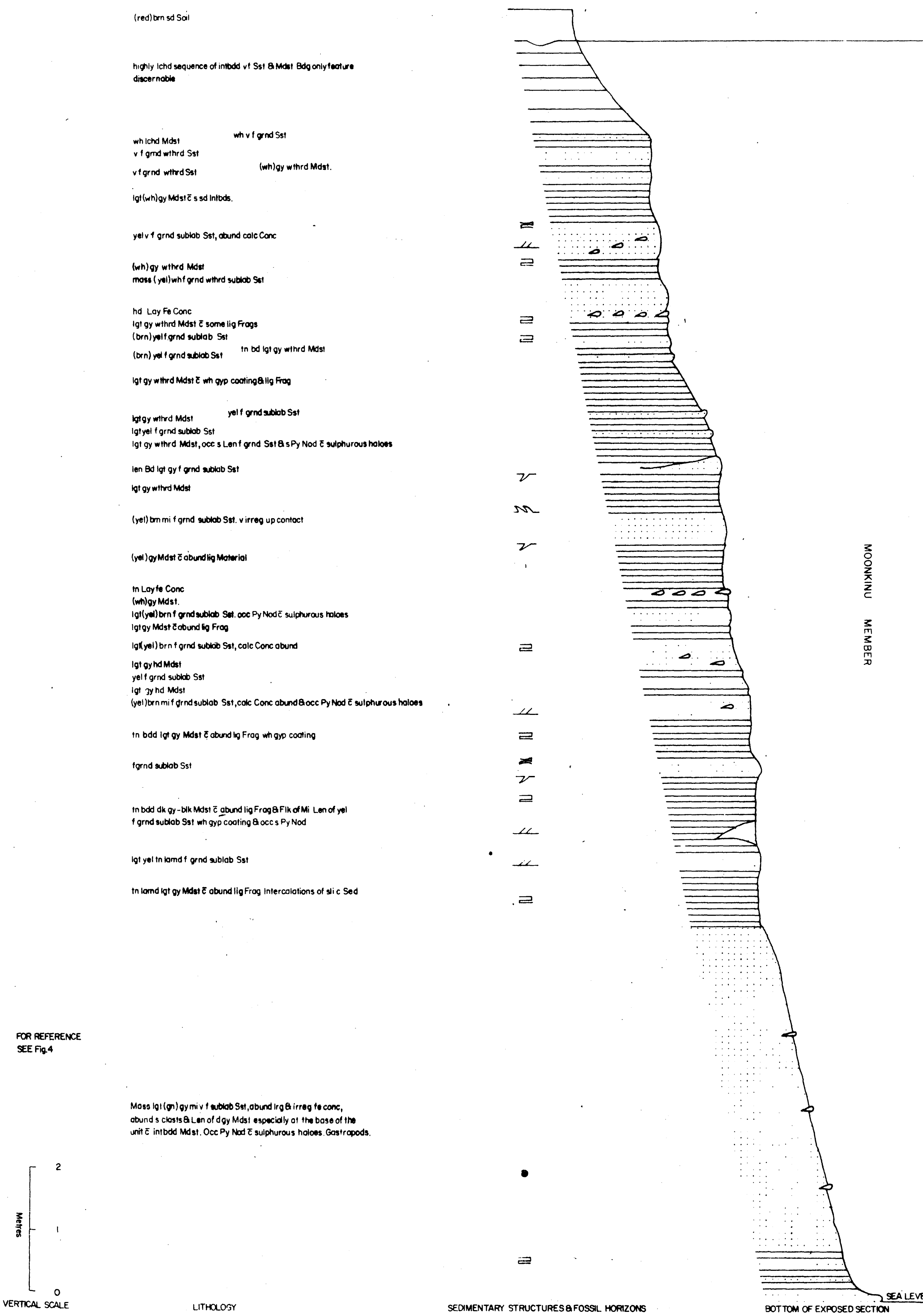

Fig. 5 Measured section Moonkinu Member central south coast Bathurst Island

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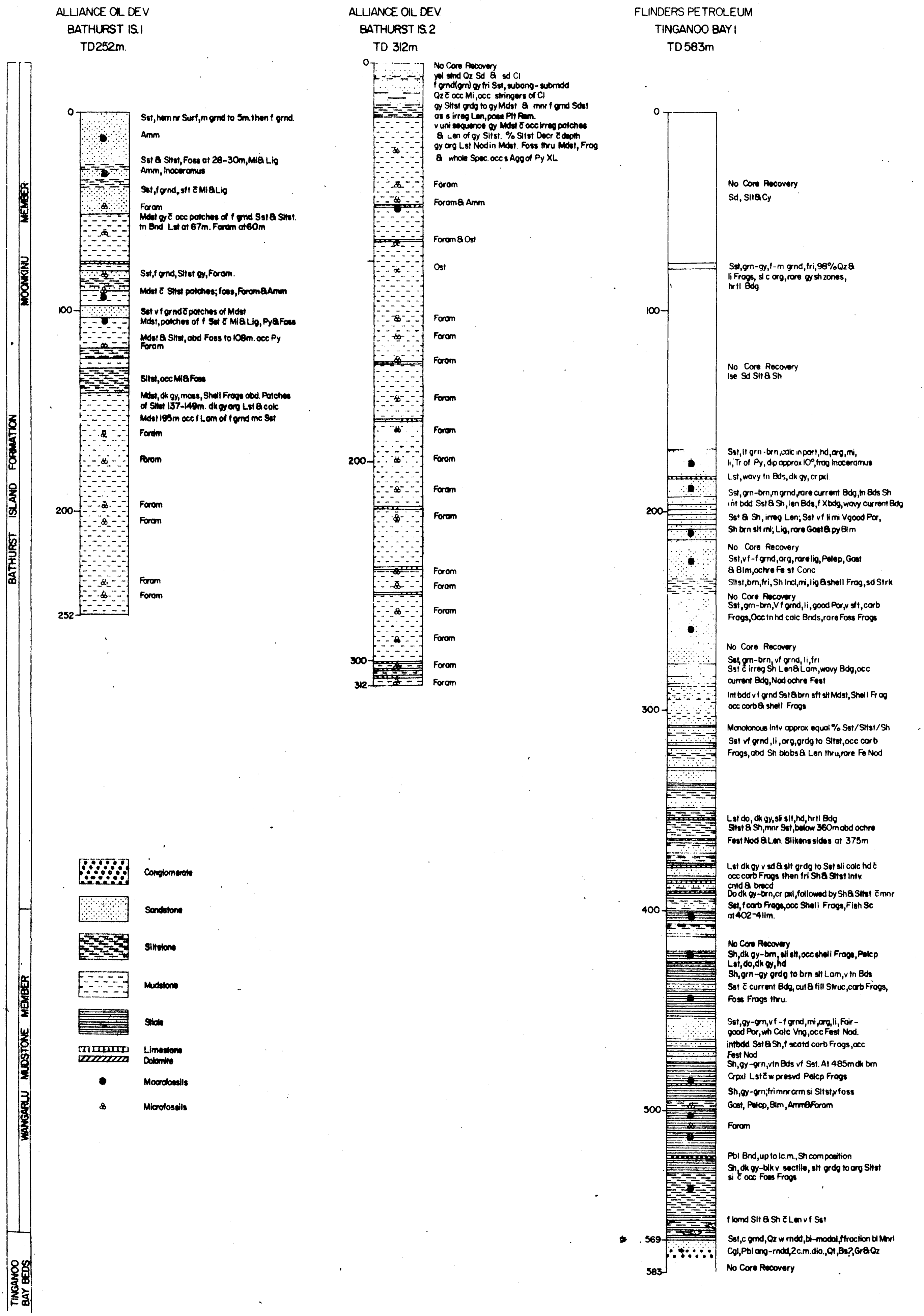

Fig.6 PETROLEUM EXPLORATION HOLES DRILLED ON BATHURST AND MELVILLE ISLANDS.

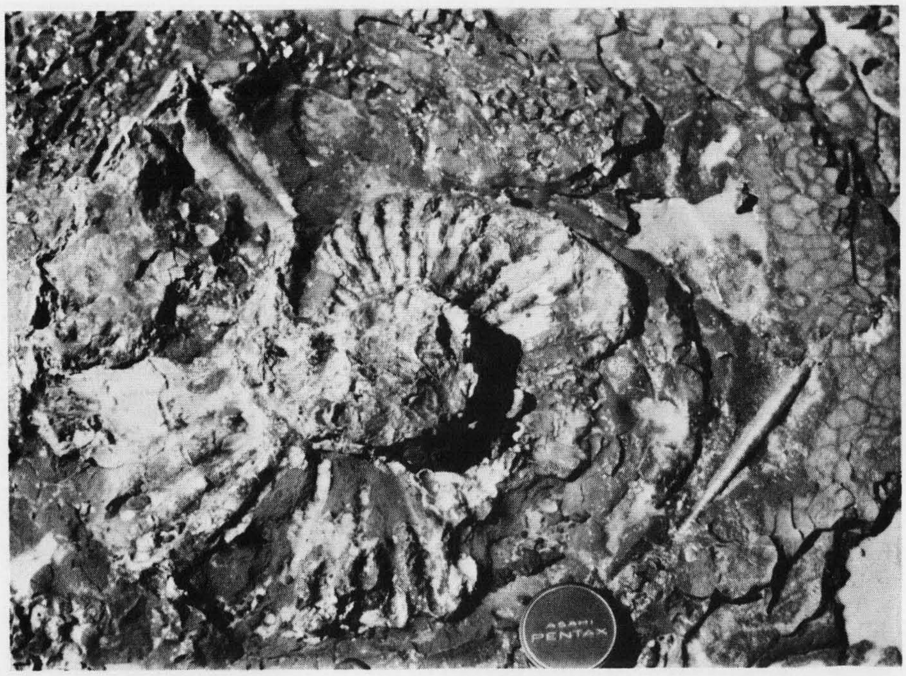

Photo 7: Sciponoceras sp. and an external mould of Acanthoceras tapara exposed on a wave cut platform of mudstone within the Moonkinu Member, Moonkinu Beach, Bathurst Island. BMR Neg. No. GA/7899

Photo 8: Specimens of Acanthoceras tapara and Turrilites costatus from the Moonkinu Member, Moonkinu Beach, Bathurst Island. BMR Neg. No. GA/7898

Structure: Photo-interpreted lineaments probably reflect differential compaction of the sediments across joint systems in the underlying basement.

Fossils and age: Weathering has destroyed most organic material. However, in siliceous, argillaceous beds well preserved fossils are present in places. One heteromorph ammonite, ?Bacculites sp., numerous gastropods, and crinoid ossicles were found in Marligur Member sediments on the Junction Bay Sheet. Worm borings and burrowing is apparent on some bedding surfaces. The member is probably Cenomanian in age.

Diagnostic features: The diagnostic feature is the quartzose nature of the sandstone and the dominance of arenaceous material.

TERTIARY

Van Diemen Sandstone (Czv)

Derivation and type section: Cape Van Diemen, Lat. 11°8'S, Long. 130°23'E, Bathurst Island 1:250 000 Sheet. The proposed type section is in the cliffs exposed on the northeastern headland of Cape Van Diemen (Photo 9).

Distribution: Discontinuous outcrops of Van Diemen Sandstone occur on both Bathurst and Melville Islands and form low ridges and dissected plateaux.

Lithology: Friable, white to yellow, medium-grained, quartzose sandstone with intercalations of coarse-grained sandstone and minor beds of siltstone and hard calcareous sandstone lenses. The sandstone is poorly sorted and composed predominantly of subangular to rounded quartz with a small percentage of opaque minerals and rare tourmaline grains. There is little matrix in the sandstone, and the grains are closely packed.

The sequence is generally cross-bedded by medium-scale high-angle sets. Small clasts of mudstone and clay are rare. The Van Diemen Sandstone is strongly weathered in outcrop and profusely iron-stained, especially in the upper part (Photo 10).

Thickness: On southern Bathurst Island auger drillholes penetrated up to 60 m of Van Diemen Sandstone (Laws, 1967). The formation thickens gradually northwards. At the type locality on Cape Van Diemen 55 m is exposed, but the base was not seen and the total thickness may be much greater.

Contacts: The Van Diemen Sandstone rests unconformably on the Cenomanian Moonkinu Member at Moonkinu Beach on the south coast of Bathurst Island (Fig. 4) and at Luxmore Head, Melville Island. Offshore, a more conformable sequence of Late Cretaceous and Tertiary sediments may occur within the deeper parts of the Money Shoal Basin. Onshore the Van Diemen Sandstone is overlain by Quaternary sand and soil.

Structure: The Van Diemen Sandstone is essentially horizontal.

Fossils and age: No fossils have been found. The age is Tertiary on rock-stratigraphic position.

Quaternary

The Quaternary sediments are predominantly sand, silt, and mud, with minor gravel. They are generally unconsolidated and modified by soil formation. The six units separated on the basis of lithology and superposition are listed in Table 2.

Table 2: Summary of Quaternary units

Symbol	Lithology	Environment of Deposition
Czm	Coquina, calcarenite, sandy shelly conglomerate	Nearshore and reefs
Qa	Alluvium; silt, fine sand, minor gravel	Fluvial
Qc_1	Beach sand; shell and coralline debris, siliceous dune sands	Estuarine, tidal and littorial
Qc_2 & Qcd	Sand dunes; siliceous dune sands	Aeolian
Qp	Saliferous and organic mud and silt	Tidal flats
Qs	Poorly consolidated sand, silt and sandy soil	Weathering, soil formation

Raised beach and coral reef sediments Czm: Consolidated calcarenite, coquina, and sandy conglomerates rich in organic debris unconformably overlie and abut against laterite on all four Sheets (Photos 13 & 14). They form thin, sheet-like, lenticular bodies adjacent to the present coast,

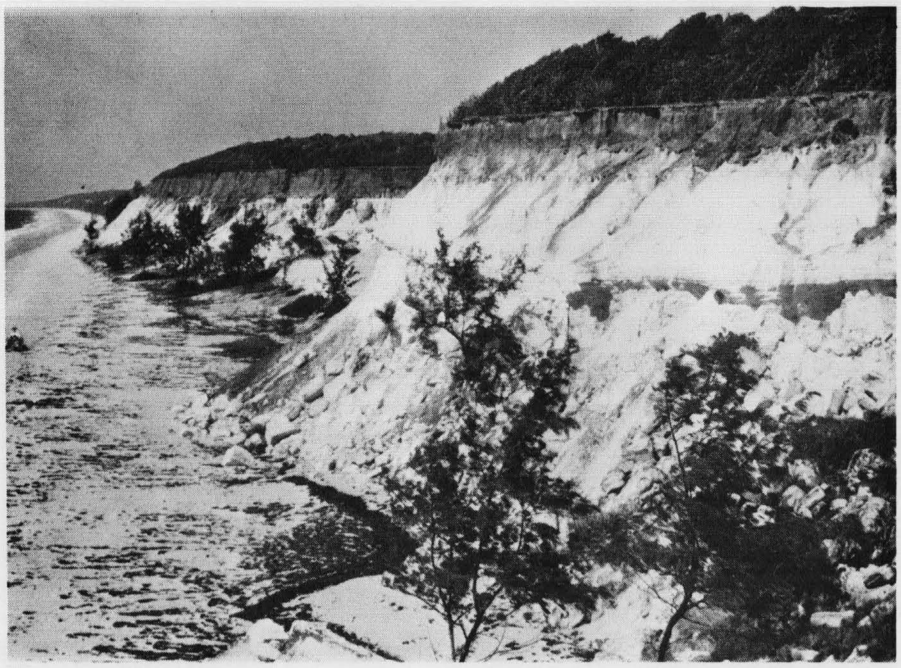

Photo 9: Type section of Van Diemen Sandstone showing development of deep weathering profile within this formation, Cape Van Diemen, Melville Island. BMR Neg. No. GA/7888

Photo 10: 'Organ pipe structure' formed by selective ferruginization within the Van Diemen Sandstone, Snake Bay, Melville Island. BMR Neg No. GA/7883

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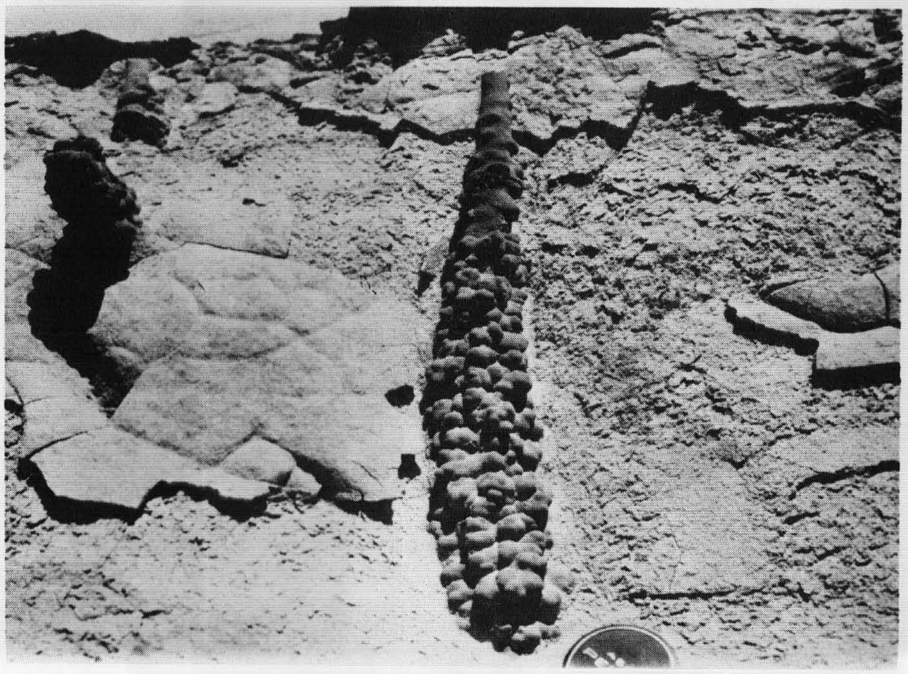

Photo 11: Botryoidal 'ironstone' pipe developed within the zone gradation between the laterite profile and the fresh rock of the Moonkinu Member, Copeland Island. BMR Neg. No. GA/7893

Photo 12: Pisolitic horizon of laterite profile (Al_2O_3 17%) Muranapi Point, Melville Island. BMR Neg. No. GA/7891

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which usually occupy breaks within low laterite cliffs. At the present time they lie several metres above high tide level and as such reflect either eustatic charges in sea level or minor uplift during the Quaternary. The raised beach deposits are considered to be Pleistocene on the basis of their stratigraphic position. The economic potential is discussed below under the title 'Construction materials'.

Alluvium Qa: Superficial alluvium is widespread. Thick and extensive accumulations occur as flood-plain deposits over the coastal lowlands or southern Fog Bay and beneath the Murgenella Plains of southern Cobourg Peninsula. The Finniss River has developed a large black-soil flood-plain across the southern portion of Fog Bay Sheet.

The dark grey argillaceous sediments of the Murgenella Plains are also floodout deposits and relate to the seasonal flooding of Murgenella Creek, the major watercourse in the area (Photo 15). Many are thinly coated by salt.

Elsewhere, fine sand and minor gravel have accumulated along the layer watercourses. Towards the coastal margins the saline and organic muds and silts of the tidal flat areas grade into alluvium.

Coastal Deposits Qc_1: Considerable amounts of quartz-rich sand and organic debris have accumulated as beach and littoral sand deposits along the western and northern coasts of Bathurst Island as well as along the northern coast of Melville Island. Former strand-lines are preserved in some of the larger accumulations as low vegetated ridges. The ridges are generally parallel to each other and the present coast, but several sets of oblique ridges were observed, e.g. Lethbridge Bay and Point Jahleel. Large areas of sand have been deposited offshore from northern Bathurst Island and Cape Van Diemen, Melville Island. These form sand banks and bars which are exposed during low tides. Along the southern coasts of both islands the beach sands are much less extensive, except in the region of Buchanan Island at the southern entrance to Apsley Strait, where large sand banks have built up.

Except in two areas, beach sand deposits on Cobourg Peninsula are small. On the western side of Croker Island beach deposits extend inland from Palm Bay for as much as 5 km. Black silts and saline clays (floodout deposits of Ajamujic Creek) have been deposited along with coastal siliceous sands; so the area has been periodically inundated both by the sea during high tides and by flood waters. A similar situation occurs along the west coast of southern Cobourg Peninsula, where former beach deposits and strand-lines occur several kilometres inland.

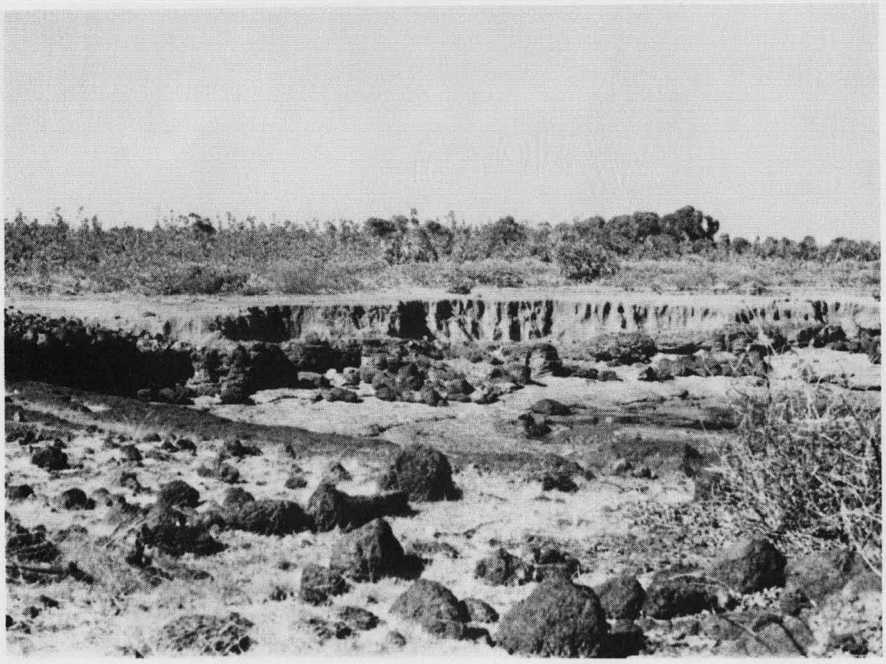


Photo 13: Raised, iron-stained beach sands resting unconformably on strongly ferruginized Van Diemen Sandstone, Point Fawcett, Bathurst Island. BMR Neg. No. GA/7896

Photo 14: Consolidated raised Coquina beach sand deposits (Czm) Point Blaze, Fog Bay. BMR Neg. No. GA/7892

Qc$_2$ & Qcd: Aeolian quartz-rich sands occupy a 20 km coastal strip on southern Bathurst Island (Photo 3). They form sets of dunes oriented northwest which rise locally to more than 60 m above sea level and extend inland up to 1.5 m. The dunes have formed barriers to the short streams draining to the south and lagoonal and fresh to brackish lake deposits commonly occur on the landward side. The dunes are well vegetated and the sand is strongly iron-pigmented in many places.

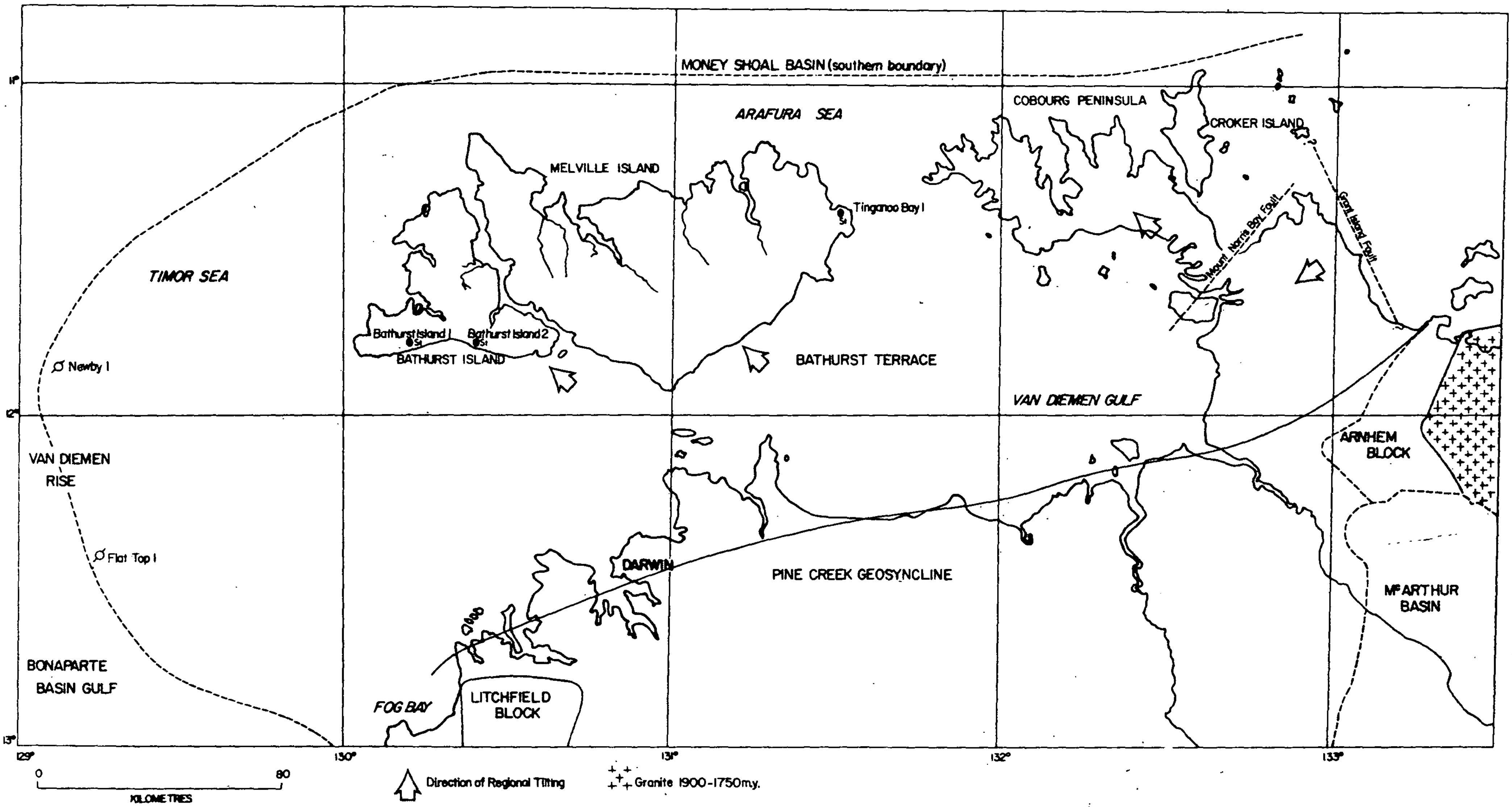
Quartz-rich dune sands are also being laid down at the present time across the peninsula separating Malay Bay from the Arafura Sea (Cobourg Peninsula). The dune sands are being deposited along coastlines facing the southeast trade winds and have accumulated, by aeolian reworking of beach sands, within breaks in the cliffs.

Tidal Flats Qp: The main sediments within the tidal flats are dark grey cracking clays and muds, commonly with calcareous concretions and containing layers of gypsum. They are rich in organic matter and extensively bioturbated. The large areas of tidal flats along the northern coast of Melville Island (Photo 16) and western coast of Bathurst Island formed as a consequence of the northwest tilting of the islands during the Cainozoic.

Soils Qs: The main soils developed on the dissected plateaux and the cliffs along coastal margins are sandy to loamy red and yellow earths. Associated with these, beneath areas of gentler topography, are yellow and red earth sands. Ironstone gravels occur below the dissected ridges and cliffs. The soils are the products of the lateritic deep-weathering mantle which has been active throughout the Cainozoic.

STRUCTURE

A thin cover of Cretaceous and Cainozoic sediments has been deposited on a stable shelf (Bathurst Terrace) lying between sedimentary basins to the north and west and a stable cratonic block to the south (Fig. 7). A thickening of the sedimentary sequence into the Money Shoal Basin delineates the northern boundary of the Bathurst Terrace, and a geophysically determined basement feature, the Van Diemen Rise, forms its western limit. Across this rise sediment thickens markedly into the Bonaparte Gulf Basin.



To accompany Record 1973/52

Fig.7 Tectonic setting of Bathurst Island, Melville Island, Cobourg Peninsula & Fog Bay 1:250000 Sheets (modified after Geol. Soc. Aust, 1971)

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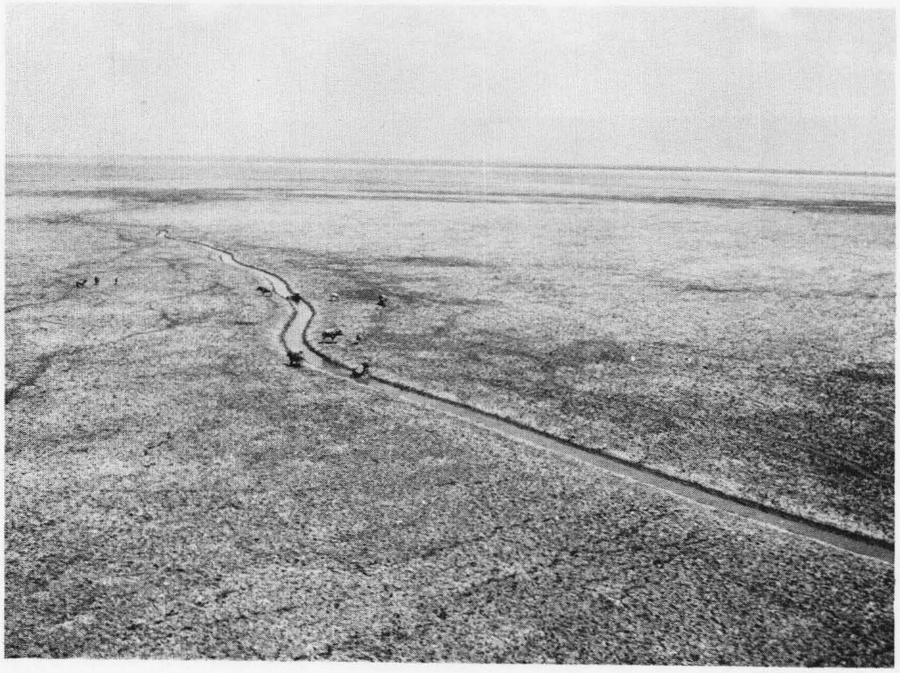

Photo 15: Flood-plain of Murgenella Creek, Cobourg Peninsula illustrating the extensive accumulation of alluvium (Qa). BMR Neg. No. GA/7886

Photo 16: Aerial view south across Melville Island. The island is very flat and there are large areas of tidal flats and mangrove swamps (Qp). BMR Neg. No. GA/7884

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The cover sediments were tilted during the Cainozoic (Fig. 7). Dips of between 2° and 7° to the northwest were measured in the Moonkinu Member on Bathurst and Melville Islands. The seismic data contoured by United Geophysical Corporation (1969) and Jongsma (in press) also indicate a northwest tilting of the cover sediments about a line of uplift parallel to the Mountnorris Fault. The thin Cretaceous and Cainozoic sediments to the south of the Mountnorris Fault have been tilted towards the southeast, probably along a line of uplift parallel to the Grant Island Fault.

A shallow syncline is inferred crossing southern Cobourg Peninsula along the line followed by Murgenella Creek from Malay Bay to Van Diemen Gulf. The only other folds seen in the cover sediments are associated with the Moonkinu Member along the southern coast of Bathurst and Melville Islands. Here shallow, broad undulations of bedding have arisen as a result of differential compaction.

The Upper Proterozoic quartzite and conglomerate of the Moyle River Formation cropping out on the Fog Bay Sheet are tightly folded in a northerly plunging syncline. The sediments are strongly sheared and an axial plane cleavage oriented at 80°-90°/330° has developed. The Kombolgie Formation is extensively and conspicuously vertically jointed. The longer and more deeply dissected set of joints trends approximately north-south, and numerous shorter joints form a second, nearby east-west, set. The joint pattern is thought to be the result of a homogeneous horizontal stress field (Walpole et al., 1968). The faults in the Kombolgie Formation generally have small displacements and show similar trends to the joint system.

GEOLOGICAL HISTORY

Sediments that accumulated in the Pine Creek Geosyncline during the Lower Proterozoic were deformed, metamorphosed and intruded by igneous rocks before cratonization. The age of the deformation and metamorphism has been determined by isotopic methods as between 2200 and 1900 m.y. (GSA, 1971). Age determinations on the Nimbuwah Complex indicate that it formed late in the Pine Creek Orogeny.

During the late Carpentarian or early Adelaidean, deposition of marine sediments led to the accumulation of the Moyle River Formation in Fog Bay Sheet area. The fluviatile Kombolgie Formation outcropping on southern Cobourg Peninsula also accumulated during the Upper

Proterozoic and its deposition was possibly contemporaneous with that of the Moyle River Formation.

Marine deposition took place intermittently throughout the Palaeozoic within the Money Shoal Basin to the north and the Bonaparte Gulf Basin to the west. Onshore the only outcropping sediments of Palaeozoic age are Permian sandstone and diamictite. Offshore, Permian sediments are known to occur to the west of the Van Diemen Rise on the Bathurst Island and Fog Bay Sheets. Similarly, the available seismic data and correlation with Arco Petrel 1 (Arco, 1969a) indicate deposition at various times during the Triassic and Jurassic to the west of the Van Diemen Rise. These sediments wedge out against the Van Diemen Rise.

A marine transgression during the Lower Cretaceous led to widespread deposition across the Bathurst Terrace and to the southeast over much of what is now the northeastern part of the Northern Territory. The sedimentary structures and faunal associations of the Mullaman Beds outcropping on the mainland suggest the existence of a shallow epicontinental sea over this region from Neocomian to Aptian (Skwarko, 1966). However, gradual uplift of the areas to the south of the Bathurst Terrace before the Albian caused a regression of the sea, and sedimentation during the Upper Cretaceous was restricted to the Bathurst Terrace and the adjoining offshore basins.

A shallow sea covered the Bathurst Terrace during the Cenomanian. On southern Cobourg Peninsula, poorly sorted quartzose sands accumulated along beaches and in shallow water. Much of Bathurst and Melville Islands was deltaic, with a more open sea to the north. Regression of the sea continued during the Cenomanian, and by the late Cretaceous or early Tertiary weathering of the emerged sediments had produced on extensive cover of laterite.

The Bathurst Terrace was then tilted and the sea transgressed once more. As a result, the quartzose sands forming the Van Diemen Sandstone were deposited with slight unconformity upon the weathered surface of the Moonkinu Member. A second phase of weathering resulted from further slight uplift and has continued to the present day. Quaternary weathering and erosion has produced a widespread but generally thin cover of red sandy soil and ironstone gravel. In addition, eustatic changes in sea level or minor uplift, during the Quaternary, have resulted in the formation of raised beach sediments adjacent to the present-day coastlines.

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Report No. 194

MINERAL OCCURRENCES

Hydrocarbons

Bathurst Terrace. The only positive evidence of hydrocarbons in the area is the occurrence of bitumen adhering to rocks on eastern Mountnorris Bay on Cobourg Peninsula (Map reference sample No. 17). Analyses of samples collected over a period of several years show identical composition, which discounts the possibility of oil spillage. A northeast-trending fault offshore from the locality suggests that the material could be from a subsea seepage between the mainland and Valencia Island.

The hydrocarbon potential of the sediments which overlie the Bathurst Terrace is dependent on up-dip migration of hydrocarbons from the Bonaparte Gulf Basin to the west and Money Shoal Basin to the north. Drillholes on Bathurst Island, AOD Bathurst Island 1 and 2, and Flinders-Pexa Tinganoo Bay 1 on east Melville Island, partly penetrated the Cretaceous sequence. Wireline logs were not run in these wells. Observations of the recovered drill core indicate that the upper part of the Cretaceous sequence lacks porosity and permeability. However, the layer of sand and conglomerate (Mullaman Beds and Tinganoo Bay Beds) laid down across the Bathurst Terrace during an early Cretaceous transgression may have potential as reservoir rocks. On testing, this interval in Tinganoo Bay 1 flowed saline water to the surface.

Onshore mapping failed to establish any folding except for a possible syncline running from central southern Cobourg Peninsula north to Malay Bay. Structural traps are unlikely in the Cretaceous sequence, as it is only gently warped. Fault traps may be present, although displacements are likely to be small. Stratigraphic traps, on the other hand, can be expected within the sediments deposited on the Bathurst Island.

Northeast Bonaparte Gulf and southern Money Shoal Basins. The thick Palaeozoic, Mesozoic, and Cainozoic sedimentary rocks to the west and north of the Bathurst Terrace in the Bonaparte Gulf and Money Shoal Basins are prospective for petroleum. Geophysical evidence shows a marked change in slope of the basement with increasing thickness of sediments over the Van Diemen Rise.

The Money Shoal Basin is not well known and has been drilled by only one exploration well (Shell Money Shoals 1) to a total depth of 2589 m. According to Balke et al. (1973), the sedimentary sequence is more than 4500 m thick within this basin to the north of the mapped area.

Flat Top 1 and Newby 1 were drilled along the northeast edge of the Bonaparte Gulf Basin in the zone of sediment thinning along the Van Diemen Rise. West of the Van Diemen Rise geophysical evidence indicates up to 3500 m of prospective sediments within the mapped area. Arco Petrel 1, to the west of the mapped area, penetrated 3156 m of sediments. Uneconomic high-pressure gas was met in this well.

Bauxite

According to the available information, bauxite occurs in several places on the northern Cobourg Peninsula; but outcrop is so poor and the surface laterite so ferruginous that the potential of the area could only be assessed after intensive auger drilling.

Bauxite on Cobourg Peninsula was first reported by Brown (1908). Several mineral exploration companies have investigated the occurrence of bauxite on both Cobourg Peninsula and Melville Island but, as yet, no deposits of economical significance have been discovered.

The bauxite is closely associated with laterite formed by the in situ weathering of Cretaceous sublabile sandstone and mudstone. Where bauxite is present two broad zones can generally be recognized, an upper one of pisolitic and nodular bauxite up to 5 m thick overlying a zone of tubular, ferruginous sublabile sandstone and red-brown, sandy clay.

Laterite covers large areas of Cobourg Peninsula, Melville Island, and Bathurst Island, but the pisolitic deposits (both ferruginous and bauxitic) mapped as Czp on the accompanying geological maps are more restricted. On the Cobourg 1:250 000 sheet area of the following six areas containing bauxite have been delineated on the basis of airphoto interpretation, limited sampling during this survey, and compilation of company data.

Croker Island. Croker Island lies northwest of Mountnorris Bay and is separated from Cobourg Peninsula by Bowen Strait. Most of the island is covered by laterite, but bauxite only occurs on the northern extremities. It is pisolitic and overlies a hard, reddish brown, tubular laterite with a sharply defined contact. The tubular laterite grades down into mottled clay. The bauxitic layer has an average thickness of 1.5 m. Company estimates of the grade and reserves of bauxite on Croker Island vary considerably. Matherson (1957) estimated that the available alumina in the pisolitic bauxite was of the order of 40% and that there were reserves of 5 000 000 long tons, whereas according to Kidd (1961) the reserves of greater than 30% available alumina were of the order of 650 000 long tons. Three analyses of the bauxite from northern Croker Island are given in Table 3.

Danger Point. Larsen (1965) noted the presence of pisolitic laterite in a small area approximately 1.5 km south of Danger Point. These deposits proved to be highly ferruginous and to have a high silica content (Table 3).

Smith Point. Pisolitic and nodular bauxite was encountered during a traverse along the narrow peninsula separating Port Essington and Port Bremer. It crops out as small, discontinuous laterite rises as well as in the cliff sections exposed around the coast, and extends from Smith Point southwards for approximately 13 km. The pisolitic layer varies in thickness from 0.5 in the vicinity of Smith Point to 2 m in the cliffs around Berkeley Bay. Both United Uranium and Swiss Aluminium have analysed bauxite samples from this area (see Table 3).

Turtle Point. Low cliffs in the vicinity of Turtle Point expose a weathering profile showing an upper layer of dark red pisolitic laterite, approximately 2 m thick, underlain by tubular and mottled ferruginous sandstone. Chemical analyses of the pisolitic material by United Uranium and BMR are given in Table 3.

Vashon Head. Discontinuous outcrops of pisolitic bauxite on Vashon Head peninsula cover approximately 48 km^2. Cliff sections along the coast and inland reveal thicknesses of 1 to 4.5 m of pisolitic bauxite. The volume of bauxite has not been assessed, but Larsen (1965) considered 50 million tons of bauxite might be present. The results of analytical work on this deposit are summarized in Table 3.

Araru Point. The presence of bauxite at Araru Point has been recorded by both United Uranium and Swiss Aluminium and the results of their analytical work are included in Table 3.

Melville and Bathurst Islands. Bauxite is present in two areas on northern Melville Island. Pisolitic and nodular bauxite crops out as erosion remnants on the peninsula separating Shark Bay and Snake Bay over an

Table 3. Major oxide analyses of bauxites from Cobourg Peninsula Sheet Area

Sample Locality	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	Company or Organization
Peacock Island	7.3	44.7	8.9	2.0	4.4	0.16	0.1	0.25	Bureau Mineral Resources
Cape Croker	7.3	46.3	-	-	-	-	-	-	Reynolds Metals
Cape Croker	11.1	49.0	-	-	-	-	-	-	Reynolds Metals
Danger Point	31.1	33.2	18.7	-	-	-	-	1.6	United Uranium (average of 4 analyses)
Smith Point	30.2	37.3	11.8	-	-	-	-	1.6	Swiss Aluminium (average of 7 analyses)
Smith Point	29.6	36.6	16.7	-	-	-	-	1.6	United Uranium (average of 8 analyses)
Turtle Point	31.2	26.3	28.8	0.1	0.09	0.26	0.1	1.3	Bureau Mineral Resources
Turtle Point	21.3	40.2	18.7	-	-	-	-	1.7	United Uranium (average of 3 analyses)
Midjari Point	15.0	46.3	10.8	-	-	-	-	3.2	Swiss Aluminium (average of 12 analyses)
Midjari Point	17.1	44.9	12.7	-	-	-	-	2.5	United Uranium (average of 4 analyses)
Vashon Head	21.0	39.5	11.5	-	-	-	-	2.2	Swiss Aluminium (average of 2 analyses)
Vashon Head	14.1	46.3	10.3	-	-	-	-	2.6	United Uranium (average of 13 analyses)
Trepang Bay	17.9	40.1	18.8	-	-	-	-	1.6	Swiss Aluminium (average of 10 analyses)
Araru Point	18.1	42.3	17.4	-	-	-	-	3.3	Swiss Aluminium (average of 12 analyses)
Araru Point	12.0	46.5	15.0	-	-	-	-	2.6	United Uranium (average of 4 analyses)

Note: Loss of volatiles on ignition and minor amounts of CaO, MgO, Na_2O and K_2O account for the discrepancies in the total percentages of analyses shown in this table.

area of approximately 15 km^2. The maximum thickness of the pisolitic layer is 6 m and according to Patterson (1958) the available alumina in the deposit ranges up to 35%. Small deposits of aluminous laterite occur as erosional remnants between Shark Bay and Garden Point. Three surface samples had available alumina contents of 14%, 24%, and 16% respectively. The coastal pisolitic laterites (Photo 12) on Bathurst and Melville Islands are also of low alumina content.

The bauxite on Cobourg Peninsula is confined to the northern parts, probably because the peninsula was tilted to the northwest. In the uplifted southern part the laterite profile has been deeply eroded and reworked; on the other hand, to the north the laterite profile has been preserved from extensive planation and has been in a favourable position for the undisturbed concentration of alumina. The tilting also made it possible for dissolved silica and iron to be drained away during seasonal fluctuations of the water table level.

In a sample of bauxite from Croker Island the pisolites are set in a matrix of fine detrital quartz, rock fragments, and opaques. The pisolites are made up of subrounded cryptocrystalline clasts which have developed around nuclei of very fine quartz grains.

Groundwater

Domestic water for Bathurst Island Mission is drawn from three bores (Table 4) which have intersected an aquifer within the Van Diemen Sandstone. Water used to be obtained from 16 wells sunk into a permeable layer of laterite developed in Cretaceous sediments which underlie the mission. No water was intersected within the Cretaceous sequence during the drilling of Bathurst Island 1 & 2 and all water resources investigations in this region have concluded that the Cretaceous sequence has little potential as an aquifer.

Snake Bay Native Settlement obtains its water supply from a system of sand spears at depths of about 8 m into Quaternary clayey sands. New sand spears are proposed to penetrate to greater depths in the hope of obtaining larger yields (Water Resources Branch, N.T., verb. comm.). Two bores (5553 & 5555) drilled through the entire Cainozoic section were dry. Perennial spring-fed streams originating from aquifers within the Van Diemen Sandstone supply both Garden Point Mission and Pickertaramoor Forestry Settlement.

Croker Island Mission derives its domestic and stock water supplies from Quaternary sands. Murgenella Forestry Settlement on Cobourg Peninsula relies on one water bore, pumping water from aquifers within the Quaternary sands and laterite, and a large water-hole to the south of the settlement. Buffaloes seriously pollute the surface water and further groundwater investigations to locate an alternate supply are essential. BMR plans to site a stratigraphic investigation hole at Murgenella in 1973, where a productive aquifer may be present within a basal Cretaceous sandstone overlying basement (Marligur Member).

Ninety-five water bores drilled on Bathurst Island, Melville Island, and Cobourg Peninsula 1:250 000 Sheet are registered with the Water Resources Branch of Northern Territory Administration, Darwin. None have been drilled on Fog Bay 1:250 000 Sheet. Table 4 summarizes the data. Dunn (1962), Barclay (1964), Laws (1967), and Lau (1972) have made water-supply investigations on Bathurst and Melville Islands.

Beach Sands

An analysis of the heavy mineral content of samples of beach sand taken from Bathurst and Melville Islands during this survey indicates that marginally economic deposits do occur in certain areas. However, their extent is still unknown and commercial quantities and grades have yet to be located. Additional reconnaissance sampling of beach sands will be undertaken in 1973.

Several investigations have been made to assess the concentrations of heavy minerals in the beach sands of Bathurst and Melville Islands (Mackay, 1956b, Murphy, 1970). During the 1972 field survey 37 beach-sand samples were collected from Bathurst and Melville Islands. A hand auger was used to collect a column of sand to a depth varying from 0.6 to 0.9 m depending on the depth to the water table. The sand retrieved was mixed and quartered in order to obtain a representative sample. The samples were sent to Amdel, South Australia, for heavy-mineral separation and semi-quantitative mineralogy.

The principal components of the heavy fraction were opaques, zircon, and rutile, with small amounts of tourmaline, kyanite, andalusite, staurolite, garnet, and chlorite. The opaque fraction generally formed the dominant constituent of the samples and was found to consist of ilmenite (in varying stages of alteration), leucoxene, and rutile, with a little hematite, goethite, and maghemite. Traces of chromite were found in two samples. Details of the composition and mineralogy of sands are

Table 4: Summary of water bores

COBOURG PENINSULA

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	Metres^3/hr	Remarks
5086	Black Point Bore	Port Essington	6 m	6.0 m	Laterite (Czl)	0.5	Abandoned
5513	Mission Hill Bore 1	Croker Island	31 m	30.4 m	Qs Sand	0.9	Operating
5540	Ryan's Lookout 5	Croker Island	25 m	24.4 m	Qs Clayey Sand	2.7	Potential domestic supply
5539	Cup o Tea Point 4	Croker Island	27 m	-	-	-	Abandoned
5538	Timor Springs 3	Croker Island	24 m	10.6 m	Qs Sand clay	13.5	Operating
7263	No. 6 Domestic Supply	Croker Island	36 m	32.8 m	Qs Coarse Sand	4.8	Operating
7264	No. 7 Domestic Supply	Croker Island	32 m	19.8 m	Qs medium sand	0.6	Collapsed
7265	No. 7a Domestic Supply	Croker Island	34 m	19.8 m	Qs medium sand	3.0	Operating
7266	Back Jungle 8	Croker Island	41 m	24.3 m 32.0 m 35.0 m	Qs medium sand	4.0	Operating
7267	Palm Bay 9	Croker Island	22 m	10.6 m	Qs silty-sand	0.8	Operating (stock only)
7268	Main Airstrip 10	Croker Island	16 m	9.1 m	Qs sandy-silt	0.9	Operating (stock only)
7269	Four Mile South 11	Croker Island	18 m	15.5 m	Qs medium sand	1.2	Abandoned
7270	The Point 12	Croker Island	24 m	22.8 m	Qs sandy-silt	3.6	Potential domestic supply
7271	Nine Mile South 13	Croker Island	18 m	15.8 m	Qs medium sand	5.5	Potential domestic supply

COBOURG PENINSULA (cont.)

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	$Metres^3/hr$	Remarks
7272	Jap Creek 14	Croker Island	25 m	7.6 m	Qs sandy-silt	-	Abandoned
7633	W.L. 1	Murgenella	20 m	10.4 m 13.7 m	Qs	7.5	Potential domestic supply
7634	W.L. 2	Murgenella	21 m	13.7 m	Qs	8.0	Potential domestic supply
7836	72/1	Croker Island	38 m	32.0 m	Fe Sandstone (Czl)	13.5	Operating
7839	72/2	Croker Island	31 m	15.2 m 16.7 m	Qs gravelly-clay	14.5	Operating
7850	W.L. 4	Murgenella	38 m	2.7 m	Qs	5.5	Operating
7852	W.L. 3	Murgenella	65 m	14.6 m	Qs	-	Abandoned
7853	W.L. 5	Murgenella	38 m	-	-	-	Abandoned
5695	Sand Spear 1	Murgenella	3 m	-	-	-	Abandoned
5696	Sand Spear 2	Murgenella	3 m	-	-	-	Abandoned
5697	Sand Spear 3	Murgenella	3 m	-	-	-	Abandoned

MELVILLE ISLAND

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	Metres^3/hr	Remarks
5064-5073		Snake Bay	15 m	-	-	-	All abandoned, exact location uncertain
5074	Spring Hole 2	Snake Bay	21 m	-	-	-	Abandoned, exact location uncertain
5075-5083		Snake Bay	15 m	-	-	-	All abandoned, exact location uncertain
5553	Snake Bay 1	Snake Bay	43 m	-	-	-	Abandoned
5555	Snake Bay 2	Snake Bay	66 m	-	-	-	Abandoned
5556	Snake Bay 3	Snake Bay	37 m	-	-	-	Abandoned
5563	Snake Bay 4	Snake Bay	29 m	-	-	-	Abandoned
5592	Snake Bay 5	Snake Bay	32 m	-	-	-	Abandoned
5593	Banjo Swamp 1/66	Snake Bay	7 m	6.8 m	Qs Sand	1.3	Abandoned
5594-5597		Snake Bay	15 m	-	-	-	All abandoned
5598	Banjo Swamp 6/66	Snake Bay	12 m	11.5 m	Qs Sand	-	Abandoned
5619	No. 1 Job 324	Garden Point	15 m	7.3 m	Qs clayey sand	-	Abandoned
6072	Sand Spear E2	Snake Bay	9 m	2.1 m	Qs fine sand	8	Potential domestic supply
6193	Sand Spear E1	Snake Bay	4 m	-	-	-	Abandoned
6194	Sand Spear E3	Snake Bay	8 m	7.9 m	Qs fine sand	8	Potential domestic supply

MELVILLE ISLAND (cont.)

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	$Metres^3/hr$	Remarks
6195	Sand Spear E4	Snake Bay	10 m	2.1 m	Qs fine sand	6	Potential domestic supply
6208-6210		Snake Bay	15 m	-	-	-	Abandoned, sand spears
6211	Sand Spear E12	Snake Bay	4 m	3.9 m	Qs gravel & sand	7	Potential domestic supply
6212	Sand Spear E14	Snake Bay	10 m	8.8 m	Qs gravel & sand	3	Potential domestic supply
7111	Bango Swamp 8	Snake Bay	10 m	1.5 m	Qs clayey sand		Operating (10/72) sand spear
7112	Bango Swamp 7	Snake Bay	14 m	1.5 m	Qs clayey sand		" " "
7113	Bango Swamp 6	Snake Bay	8 m	1.5 m	Qs clayey sand		" " "
7114	Bango Swamp 5	Snake Bay	8 m	1.5 m	Qs clayey sand		" " "
7115	Bango Swamp 4	Snake Bay	6 m	1.5 m	Qs clayey sand	8.5	" " "
7116	Bango Swamp 3	Snake Bay	7 m	1.5 m	Qs clayey sand		" " "
7117	Bango Swamp 2	Snake Bay	8 m	1.5 m	Qs clayey sand		" " "
7118	Bango Swamp 1	Snake Bay	8 m	1.5 m	Qs clayey sand		" " "
7121	Observation Hole 5	Snake Bay	9 m	1.5 m	Qs clayey sand		Observation
7607	Paru 1	Paru Village	36 m	-	-	-	Abandoned
7608	Paru 2	Paru Village	20 m	-	-	-	Abandoned
7609	Paru 3	Paru Village	23 m	-	-	-	Abandoned
7610	Paru 4	Paru Village	15 m	-	-	-	Abandoned
7611	Paru 5	Paru Village	46 m	-	-	-	Abandoned

BATHURST ISLAND

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	Metres^3/hr	Remarks
5875	Bathurst Is. 1	5 km west of mission	32 m	-	-	-	Abandoned
5885	Bathurst Is. 2	10 km west of mission	49 m	47.2 m	Qs clayey sand	28	Potential domestic supply
5886	Bathurst Is. 3	20 km west of mission	35 m	-	-	-	Abandoned
5887	Bathurst Is. 4	24 km west of mission	55 m	-	-	-	Abandoned
5902	Bathurst Is. 5	37 km west of mission	30 m	-	-	-	Abandoned
5903	Bathurst Is. 6	32 km west of mission	8 m	-	-	-	Abandoned
5904	Bathurst Is. 7	10 km west of mission	55 m	27.4 m	Qs sandy clay	45	Potential stock or irrigation supply
5936	Observation Bore 8	10 km west of mission	30 m	27.4 m	Qs sand	20	Observation
6920	Bathurst Is. 69/2	10 km west of mission	50 m	43.0 m	Lateritic Sandstone (Czv)	5	Potential domestic
6921	Bathurst Is. 69/3	10 km west of mission	32 m	21.3 m	Qs fine sand	5	Potential domestic supply
6922	Bathurst Is. 69/1	10 km west of mission	50 m	45.0 m	Fine sandstone (Czv)	5	Potential domestic supply
7416	Bathurst Is. 70/2	13 km west of mission	70 m	20.4 m	Qs silty clay	-	Abandoned
7466	Bathurst Is. 70/3	13 km west of mission	53 m	45.7 m	Lateritic Sandstone (Czv)	23	Operating (10/72)

BATHURST ISLAND (cont.)

Reg'd No.*	Name	Location	Depth	Water Level	Aquifer	$Metres^3/hr$	Remarks
7467	Bathurst Is. 70/1	13 km west of mission	48 m	47.2 m	Lateritic Sandstone (Czv)	23	Operating (10/72)
7612	Bathurst Is. 70/5	10 km west of mission	46 m	45.7 m	Lateritic Sandstone (Czv)	20	Operating (10/72)

* Bore registration number of Northern Territory Administration, Darwin.

given in Appendices 3 & 4. Analysis of these results will be done in conjunction with those available from work in 1973, but results to date indicate a zircon-shale provence to which climate plays a minor economic role.

Nine of the 37 samples analysed contained greater than 2% by weight heavy minerals. Areas of high concentration include Cape Van Diemen (Melville Island), Boradi Bay (Melville Island), Cape Fourcroy (Bathurst Island), and Murrow Point (Bathurst Island).

The results suggest the presence of marginally economic heavy mineral deposits in certain areas and indicate the need for more detailed sampling, especially of the extensive offshore sand deposits, ancient beach strand-lines, and tidal flats.

Construction Material

Limestone. Coquina and calcareous sandstone form linear bodies adjacent to the present-day coastlines in the Cobourg Peninsula and Fog Bay Sheet areas, but they are probably too small to be considered as an economic source of lime for Darwin.

Up to 5 m of consolidated coquina beach sand disconformably overlies laterite along South West Bay, South Goulburn Island, and about 4 m of raised beach sandstone and coquina limestone crop out on McCluer Island. Other outcrops on Cobourg Peninsula Sheet occur on North Goulburn Island, Grant Island, Oxley Island, and Lawson Island. On Fog Bay Sheet cliffs of calcareous sandstone and coquina limestone, up to 5 m high, were noted in the vicinity of Point Blaze and to the north of Fog Bay itself (Photo 14).

Laterite. Bricks hewn from the ferruginous capping of the laterite were used in the construction of early settlements (Fort Dundas, Melville Island; Raffles Bay, Cobourg Peninsula; Victoria, Port Essington, Cobourg Peninsula). The blocks were cemented together with mortar using lime made from shell and coralline debris. Victoria was abandoned in 1849, but the walls of many of the buildings are still standing and are in good condition (Photos 17 & 18).

Clay. Rix (1964) investigated the pottery clay resources on northern Melville Island, taking samples from Goolumbini Creek, 11 km east of Garden Point Mission, and Piper Head. The samples were tested by CSIRO Division of Building Research and were found to be useless for

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any kind of ceramics because of the high sand content and low plasticity. Initial testing of small samples of the kaolinitic clays from Piper Head suggested that it was satisfactory for moulding, and could be burnt at 900°C to 1100°C. The product was white, free from cracks or deformation, and showed shrinkage of about 4%. It also took a transparent commercial glaze well. However, a larger sample (50 lb) representative of the three main clay lenses at Piper Head was later tested by the Division of Building Research. The results showed the clay to have a low plasticity and to be mechanically weak. The maximum temperature in the firing range tested (800°-1050°C) was not sufficient to give it the mechanical strength necessary for a ceramic industry or small pottery items.

The results of analyses of clays from Piper Head indicate that as a whole the deposits are not suitable for pottery making and would not support a large industry, but small selective samples within the layers of clay, were of higher quality clay which could possibly support a small-scale local industry. A pottery industry to provide employment of aboriginals is planned at Bathurst Island Mission.

Phosphate

Phosphate nodules occur as irregular layers within the Moonkinu Member along the south coast of Bathurst Island. The nodules are elliptical and are up to 1 m long. Analyses by Parker (1966) indicated P_2O_5 contents of between 10 and 20%. Phosphatic nodules and pellets were intersected in Bathurst Island 1 & 2. In Bathurst Island 1 samples were taken between 188 and 200 m with grades in the range of 2-3% P_2O_5. Samples from Bathurst Island 2, between 43 and 305 m, ranged up to 12% P_2O_5. However, in the light of present knowledge there is neither the concentration nor the grade of P_2O_5 for the nodules to be of commercial interest.

Photo 17. BMR Neg. No. GA/7900

Photos 17 & 18: Victoria (1838-49) Port Essington, Cobourg Peninsula. Ruins of the married officer quarters (17) and bakery (18). Bricks used for the construction were hewn from nearby outcrops of ferruginous laterite.

Photo 18. BMR Neg. No. GA/7897

BIBLIOGRAPHY

* Unpublished reports submitted in accordance with the requirements of the Petroleum Search Subsidy Acts; available for study at the Bureau of Mineral Resources, Canberra.

\+ Unpublished reports available on open file at the Mines Department, Darwin.

*ADASTRA [HUNTING GEOPHYSICS], 1965 - Anson Bay aeromagnetic survey for Mines Administration Pty Ltd (unpubl.).

*AMBERG, R., 1967 - Hyland seismic survey, NT/P17. Australian Aquitaine Petroleum Pty Ltd, (unpubl.).

*ARCO, 1969a - Petrel 1 Well completion report NT/P3. Arco Ltd - Australian Aquitaine Petroleum Pty Ltd, (unpubl.).

*ARCO, 1969b - Lacrosse 1 Well completion report W.A./19-P. Arco Ltd., (unpubl.).

BALKE, B., PAGE, C., HARRISON, R., & ROUSSOPOVLOS, G., 1973 - Exploration in the Arafura Sea. APEA J., 13(1), 9-12.

BARCLAY, J., 1964 - Geological notes on water supplies at Bathurst Inland Mission, Garden Point and Paru missions on Melville Island. Bur. Miner. Resour. Aust. Rec. 1964/98 (unpubl.).

BOUTAKOFF, H., 1963 - Geology of the offshore areas of northwest Australia. APEA J., 3, 10-18.

BROWN, H.Y.L., 1905 - Melville and Bathurst Islands. S. Aust. parl. Pap. 1905, 22-24.

BROWN, H.Y.L., 1906 - The Cretaceous fossils of Maclear Creek, Cape Gambier, Melville Island. Supplement S. Aust. parl. Pap. 55 of 1906, 18-19.

BROWN, H.Y.L., 1908 - Report on geological reconnaissance of the eastern coast from Van Diemen Gulf to the McArthur River etc., 1907. S. Aust. parl. Pap. 25, 3-10.

+BRUNNSCHWEILER, R.O., 1956 - A geological reconnaissance of Bathurst and Melville Islands, Northern Territory. Geosurveys of Aust. Ltd (unpubl.).

BURGER, D., & NORVICK, M.S., In prep. - Stratigraphic palynology of the Cenomanian, Bathurst Island, Northern Territory. Bur. Miner. Resour. Aust. Bull.

*CGG [COMPAGNIE GENERALE DE GEOPHYSIQUE], 1968 - New Year Island seismic survey NT/OP 156. Australian Aquitaine Petroleum Pty Ltd (unpubl.).

*CGG, 1969 - Aeromagnetometric survey Van Diemen Gulf NT/OP 167 Northern Territory. Flinders Petroleum N.L. (unpubl.).

DAILY, B., 1955 - Geological observations on Melville and Bathurst Islands, Northern Territory. Adelaide Univ. (unpubl.).

*DEJONG, A., 1969 - Final report Legendre - Marie marine seismic survey 1969, north-west Australia NT/P6. Burmah Oil Company of Australia Ltd (unpubl.).

DUNN, P.G., 1962 - Water supply: Bathurst Island mission. Bur. Miner. Resour. Aust. Rec. 1962/21 (unpubl.).

DUNN, P.R., 1962 - Alligator River, N.T. - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes D/53-1.

*FAESSLER, C.W., 1964 - Melville Island aeromagnetic survey. Alliance Oil Development (Australia) N.Z. (unpubl.).

GSA [GEOLOGICAL SOCIETY OF AUSTRALIA], 1971 - Tectonic map of Australia and New Guinea. 1:5,000,000. Geol. Soc. Aust., Sydney.

+HARE & ASSOCIATES, 1961 - Bathurst Island 1 Well completion report NT/P8 Alliance Oil Development (unpubl.).

+HARE & ASSOCIATES, 1962 - Bathurst Island 2, Well completion report NT/P8. Alliance Oil Development (unpubl.).

HAY, J., 1967 - Land surface and laterites in the north of the Northern Territory. In LANDFORM STUDIES FROM AUSTRALIA AND NEW GUINEA. Australian National University Press.

+HOLTZE, N., 1911 - Report on Goulburn and other Islands (unpubl.).

HORSFALL, K., WYATT, B., & WILKES, P., in prep. - Aeromagnetic survey Cobourg Peninsula 1:250 000 Sheet. Bur. Miner. Resour. Aust. Rec. (unpubl.).

HUGHES, R.J., in prep. - Heavy mineral beach sand investigations, Bathurst Island and Melville Island, Northern Territory. Bur. Miner. Resour. Aust. Rec. (unpubl.).

HUGHES, R.J., & SENIOR, B.R., in prep. - New stratigraphic names for Cretaceous and Cainozoic units of Bathurst and Melville Islands and Cobourg Peninsula, Northern Territory.

+HUNTER, R., 1964 - Report on fieldwork in O.P. 36, N.T. October-November 1964. (unpubl.).

ISBELL, R.F., WEBB, A.A., & MURTHA, G.G., 1968 - ATLAS OF AUSTRALIAN SOILS Vol. 8. Northern Territory, with explanatory data. CSIRO and Melbourne University Press. Melbourne.

JONES, B.F., 1969 - Timor Sea gravity, magnetic and seismic survey, 1967. Bur. Miner. Resour. Aust. Rec. 1969/40 (unpubl.).

JONGSMA, D., 1970 - Texture of sediments of the Arafura Sea. Bur. Miner. Resour. Aust. Rec. 1970/59 (unpubl.).

JONGSMA, D., in press - Marine geology of the Arafura Sea. Bur. Miner. Resour. Aust. Bull.

KEMEZYS, K.J., 1968 - Cretaceous phosphorites of the Darwin region. Bur. Miner. Resour. Aust. Rec. 1968/52 (unpubl.).

+KIDD, B., 1961 - Bauxite exploration of permits to enter Nos. 57 and 69. Reynolds Metals Co. (unpubl.).

+LARSEN, E., 1965 - Preliminary report on the bauxite investigations of A.P. 1157 and 1158. United Uranium N.L. (unpubl.).

LAU, J.E., 1972 - Paru village water supply investigation, Melville Island. N.Terr. Mines Br. Rec. 271 (unpubl.).

LAWS, A.T., 1967 - Bathurst Island water supply, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1967/125 (unpubl.).

*LEY, J.R., 1967 - Final report Arafura Sea, offshore Northern Territory O.P. 127, O.P. 128, O.P. 140 marine seismic survey. Shell Development (Australia) Pty Ltd. (unpubl.).

McANDREW, J., 1961 - Laterite from Bathurst Island, Northern Territory. CSIRO mineragr. Invest. Rep. 830.

MACKAY, N.J., 1956a - Summary of activities of resident geologists in the Northern Territory for 1955. Bur. Miner. Resour. Aust. Rec. 1956/30 (unpubl.).

MACKAY, N.J., 1956b - Occurrence of black sands on the north coast of Melville Island, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1956/21 (unpubl.).

McQUEEN, W.F., 1958 - Report on search for phosphate deposits in the Northern Territory. Bur. Miner. Resour. Aust. Rec. 1958/77 (unpubl.).

MALONE, E.J., 1962 - Darwin, N.T. - 1:250,000 geological series. Bur. Miner. Resour. Aust. explan. Notes D/5 2-4.

+MATHESON, R.S., 1957 - Bauxite investigations Arnhem Land, Northern Territory. Rio Tinto Australia Exploration Pty Ltd (unpubl.).

MORGAN, C.M., 1972 - Port Keats, N.T. - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SD/52-11.

+MURPHY, T.D., 1970 - Report on heavy beach sand deposits on Bathurst Island, Northern Territory. Placer Prospecting (Aust.) Pty Ltd, (unpubl.).

*NAMCO [GEOPHYSICAL COMPANY], 1967 - Final report marine seismograph survey Timor Sea - Permit O.L. 2. Canadian Superior Oil (Australia) Pty Ltd (unpubl.).

OWEN, H.B., 1949 - Examination of a supposed bauxite bearing area on Cobourg Peninsula, Northern Territory of Australia. Bur. Miner. Resour. Aust. Rec. 1949/21 (unpubl.).

OWEN, H.B., 1954 - Bauxite in Australia. Bur. Miner. Resour. Aust. Bull. 24.

+PARKER, B., 1966 - Report on prospecting activities Bathurst and Melville Islands, N.T. Homestake Iron Ore Co. Aust. (unpubl.).

61

+PATTERSON, G.W., 1958 - Report on bauxite investigations of Bathurst and Melville Islands, N.T. Australian Mining & Smelting Co. Ltd, (unpubl.).

+PEMBERTON, R.L., 1971 - Tinganoo Bay 1 Well completion report NT/P.167. Flinders Petroleum & Pexa Oil N.L. (unpubl.).

PONTIFEX, I.R., MORGAN, C.M., SWEET, I.P., & REID, A.G., 1968 - The geology of the Auvergne 1:250,000 Sheet area, Victoria River Basin, N.T. Bur. Miner. Resour. Aust. Rec, 1968/117 (unpubl.).

*PRASTKA, R.L., & POLYNIAK, H.P., 1965 - Marine seismic survey Dundas Strait, Northern Territory, Australia. NT/P 21. Anacapa Corp. (unpubl.).

*PRIOR, W., 1965 - Report on airborne magnetometer survey over the Arafura Sea, Northern Australia. Hunting Geology & Geophysics Ltd (unpubl.).

RIX, P., 1964 - Investigation of pottery clay resources, Darwin area, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1964/94 (unpubl.).

*SHELL, 1966 - Money Shoal sparker survey, NT/P.19, 20 & 21. Shell Development (Australia) Pty Ltd, (unpubl.).

SKWARKO, S.K., 1960 - Mesozoic strata and fossils of Northern Territory. Bur. Miner. Resour. Aust. Rec. 1960/29 (unpubl.).

SKWARKO, S.K., 1962 - A new ophiuroid from Upper Cretaceous strata of Bathurst Island, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1962/20 (unpubl.).

SKWARKO, S.K., 1966 - Cretaceous stratigraphy and palaeontology of the Northern Territory. Bur. Miner. Resour. Aust. Bull. 73.

SKWARKO, S.K., 1967 - Mesozoic of the Northern Territory. Bur. Miner. Resour. Aust. Rec. 1967/134 (unpubl.).

SKWARKO, S.K., 1969 - A correlation chart of the Cretaceous system in Australia. Bur. Miner. Resour. Aust. Bull. 126, 55-63.

*SMIT, A.W., 1966 - Final report offshore seismic survey Arafura Sea Northern Territory. NT/P.20. Shell Development (Australia) Pty Ltd., (unpubl.).

*SPICHER, J.P., 1969 - Final report Arafura D.2 marine seismic survey Northern Territory exploration permits for petroleum Nos. NT/P.19, 20 and 21. Shell Development (Australia) Pty Ltd., (unpubl.).

+SWISS ALUMINIUM [MINING AUSTRALIA PTY LTD], 1969 - Final report on authority to prospect No. 2246 Cobourg Peninsula, Northern Territory (unpubl.).

*TINLINE, R.J., & FIFE, J.S., 1962 - Final report Bathurst Island refraction survey. Oil Development N.L. (unpubl.).

*UNITED [GEOPHYSICAL CORPORATION], 1969 - Final report Parry Shoal marine seismic Licence No. 2. Northern Territory. Longreach Oil Ltd (unpubl.).

VEEVERS, J.J., 1967 - The Phanerozoic geologic history of northwest Australia. J. geol. Soc. Aust., 14(2), 253-71.

VEEVERS, J.J., & VAN ANDEL, Tj.H., 1967 - Morphology and basement of Sahul Shelf. Marine Geol., 5, 293-8.

WALPOLE, B.P., 1958 - The Maranboy tinfield, Northern Territory. Bur. Miner. Resour. Aust. Bull. 37.

WALPOLE, B.P., DUNN, P.R., & RANDAL, M.A., 1968 - Geology of the Katherine-Darwin Region, Northern Territory. Bur. Miner. Resour. Aust. Bull. 82.

*WALTON, R.C., 1964 - Final report Flat Top Bank area, NT/O.P. 83 Northern Territory, marine seismic survey. Australian Aquitaine Petroleum Ltd (unpubl.).

WARD, J., 1961 - Sample of heavy mineral beach sand from east Kilu-Impini beach, Melville Island, N.T. Bur. Miner. Resour. Aust. Rec. 1961/115 (unpubl.).

WILLIAMS, L.W., FORMAN, D.J., HAWKINS, R.B., 1973 - Sedimentary basins of the Sahul Shelf. Bur. Miner. Resour. Aust. Rec. 1973/74.

*WOOLNOUGH, W.G., 1932 - Report on aerial survey operations in Australia during 1932 Chapter 5 Melville and Bathurst Islands, Northern Territory (unpubl.).

WRIGHT, C.W., 1963 - Cretaceous ammonites from Bathurst Island, Northern Territory. Palaeontology, 6(4), 597-614.

APPENDIX 1

PALYNOLOGICAL EXAMINATION OF OUTCROP SAMPLES FROM BATHURST AND MELVILLE ISLANDS, AND COBOURG PENINSULA SHEET AREAS

by D. Burger

Outcrop samples collected during 1972 from Bathurst and Melville Islands and Cobourg Peninsula were palynologically examined. Most of the 26 samples contained sufficient spores, pollen, and microplankton for age determination. The results of the examination are listed in Table 1. Dating of the microfloras is based on detailed palynological investigation of two wells, Bathurst Island No. 1 and 2, which penetrated Cenomanian strata on the south coast of Bathurst Island (Burger & Norvick, in prep.).

Species on which dating of the samples is based are:

Classopollis sp. nov. (BMR 337)

Asteropollis asteroides Hedlund & Norris (BMR 1157)

Camarozonosporites sp. nov. (BMR 1128)

Gleicheniidites cf. G. *trijugatus* (Pierce) (BMR 1139)

Liliacidites sp. (BMR 1121)

Outcrop Locality	Latitude/ Longitude	Map. Ref. No.	BMR No. (MFP)	Stratigraphic unit	Suggested Age
	11°49'S, 130°28'E	4	5900	Moonkinu Member	Cenomanian
	11°49'S, 130°28'E	4	5931	Moonkinu Member	Cenomanian
	11°49'S, 130°28'E	4	5932	Moonkinu Member	Cenomanian
	11°46'S, 130°20'E	3	5901	Moonkinu Member	Cenomanian

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Outcrop Locality	Latitude/ Longitude	Map. Ref. No.	BMR No. (MFP)	Stratigraphic unit	Suggested Age
BATHURST ISLAND	11°46'S, 130°20'E	3	5902	Moonkinu Member	Cenomanian
	11°47'S, 130°18'E	2	5840	Moonkinu Member	Albian/ Cenomanian
	11°47°S, 130°15'E	1	5841	Wangarlu Mudstone Member	Cenomanian
	11°50'S, 130°30'E	5	5903	Moonkinu Member	Cenomanian?
	11°50'S, 130°31'E	6	5842	Moonkinu Member	Cenomanian
	11°50'S, 130°30'E	5	5843	Moonkinu Member	Cenomanian
MELVILLE ISLAND	11°53'S, 130°52'E	7	5904	Moonkinu Member	Cenomanian
	11°47'S 130°11'E	8	5845	Moonkinu Member	Cenomanian
COBOURG PENINSULA	11°29'S, 132°19'E	9	5850	Wangarlu Mudstone Member	Cenomanian

REFERENCE

BURGER, D., & NORVICK, M.S., in prep. - Stratigraphic palynology of the Cenomanian, Bathurst Island, Northern Territory. Bur. Miner. Resour. Aust. Bull.

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APPENDIX 2

REPORT ON COLLECTIONS OF MACROFOSSILS FROM BATHURST AND MELVILLE ISLANDS

by

R.A. Henderson*

The fauna collected by the Bureau of Mineral Resources during the 1972 field season is similar to that described by Wright (1963). There is one species which does not appear in Wright's lists - a new species of Sciponoceras.

The fauna from Moonkinu Beach, Bathurst Island (Map Reference No. 3), is certainly of middle Cenomanian age and part of a cosmopolitan fauna which existed throughout the globe at that time. All the genera are shared with Europe and two of the species are common European forms. The other localities I would take to be of equivalent age. The Inoceramus from M939 (Map Reference No. 5) appear to be identical with Inoceramus concentricus (sensu lato) which is itself a reliable Cenomanian indication. The following table gives a complete list of the macrofossils collected at each locality.

REFERENCE

WRIGHT, C.W., 1963 - Cretaceous ammonites from Bathurst Island, Northern Territory. Palaeontology. 6, (4), 597-614.

Outcrop Locality	Map Ref. No.	Field Book No.	Fauna
	1	B820	Unidentified gastropods
	2	B815	Unidentified gastropods
	3	B807	Sciponoceras glaessneri Wright Sciponoceras sp. nov. Hypoturrilites gravesianus (d'Orbigny) Chimbuites mirindowensis Wright

* James Cook University of North Queensland

Outcrop Locality	Map Ref. No.	Field Book No.	Fauna
Bathurst Island			Acanthoceras mirialampiense Wright Turrilites (Turrilites) Costatus Lamarck Euomphaloceras lonsdalei (Adkins) ?Collingnoniceras sp. Inoceramus concentricus Parkinson Trigonia sp. Teredo? bored wood Unidentified myoid bivalve Unidentified scaphopod Unidentified gastropods
	4	B869	Sciponoceras glaessneri Wright Acanthoceras mirialampiense Wright ?Chimbuites sp. Inoceramus concentricus Parkinson
	5	M897	Acanthoceras tapara Wright Acanthoceras mirialampiense Wright Sciponoceras glaessneri Wright ?Inoceramus concentricus Parkinson
	6	M939	Sciponoceras glaessneri Wright Sciponoceras sp. nov. Inoceramus concentricus Parkinson Unidentified gastropod

Outcrop Locality	Map Ref. No.	Field Book No.	Fauna
	7	M868	Sciponoceras glaessneri Wright
	8	M810	Sciponoceras glaessneri Wright
	9	M867	Sciponoceras glaessneri Wright
	10	M814	Worm borings
			Teeth
	11	M831	Euomphaloceras londsdalei (Adkins)
			Acanthoceras sp. indet.
			Inoceramus cf concentricus Parkinson
Melville Island			Unidentified gastropods
	12	M850	Euomphaloceras londsdalei (Adkins)
			Acanthoceras sp. indet.
			Sciponoceras sp. nov.
			Spatangoid echinoid indet.
			Inoceramus concentricus Parkinson
	15	M854	Unidentified bivalve
			Sciponoceras sp.
			Acanthoceras sp. indet.
	14	M842	Unidentified gastropod
	15	M861	Acanthoceras sp. indet.
	16	M901	Acanthoceras sp. indet.

APPENDIX 3

THIN SECTIONING, HEAVY MINERAL SEPARATION AND SEMI-QUANTITATIVE MINERALOGY OF FORTY-THREE UNCONSOLIDATED SAND SAMPLES

by M.J.W. Larrett*

INTRODUCTION

Forty-three samples of unconsolidated material (beach sands) were submitted to Amdel by the Bureau of Mineral Resources, Canberra, for:

1. Preparation of one thin section from each of the unconsolidated samples.
2. Separation of the heavy mineral constituents by heavy liquid separation.
3. Semi-quantitative mineralogical analysis of the heavy mineral fractions.

It was agreed that the work should proceed as follows:

1. Thin sectioning according to Amdel scheme MN 1.2
2. Heavy mineral separation according to Amdel scheme MH 2.1.2
3. Semi-quantitative mineralogical analysis according to Amdel scheme MH 7.1

PROCEDURES

The 43 wet unconsolidated sand samples were quartered, oven-dried, and riffled to obtain a representative subsample for thin sectioning. The remaining oven-dried sands were then weighed, sieved at 14 mesh B.S.S. to remove the varying amounts of oversize material present, and the -14 mesh material reweighed and subsequently subjected to static heavy mineral separations using tetrabromoethane (S.G. 2.96) as the separating medium.

*Amdel, Adelaide, South Australia

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TABLE 1: MINERALOGICAL COMPOSITION OF THE HEAVY MINERAL FRACTIONS AS DETERMINED BY VISUAL ESTIMATION (MH 7.1)

Sample No.	+14 Mesh Material Wt %	-14 Mesh Material Wt %	S.G>2.96 H.Minerals Wt % -14 Mesh	Undifferentiated Opaques	Zircon %	Rutile %	Tourmaline %	Kyanite %	Andalusite %	Staurolite %	Amphibole %	Pyroxene %	Green Spinel %	Monazite %	Garnet %	Epidote %	Chlorite %	Map Ref No.
72050034	0.1	99.9	0.84	35-45	40-50	1-2	1-2	Tr	Tr	-	-	-	-	Tr	-	-	-	H.D.24
35	0.1	99.9	22.24	50-60	30-35	<1	<1	Tr	Tr	Tr	-	-	-	Tr	-	-	-	H.D. 3
36	-	100.0	0.13	40-50	40-45	4-6	<1	-	-	Tr	-	-	-	-	-	-	-	H.D.19
37	0.4	99.6	0.44	70-80	20-25	2-4	<1	Tr	Tr	Tr	-	-	-	-	Tr	-	-	H.D.29
38	21.5	78.5	0.63	70-80	15-20	Tr	1-2	Tr	-	Tr	-	-	-	-	-	-	-	H.D.26
39	-	100.0	2.13	10-20	30-40	30-40	<1	Tr	-	<1	-	-	-	-	Tr	-	-	H.D. 9
72050040	16.1	83.9	0.14	20-25	15-20	1-2	Tr	Tr	Tr	Tr	-	-	-	-	Tr	-	50-60	H.D. 1
41	-	100.0	0.32	20-30	30-40	2-5	<1	Tr	Tr	-	-	-	Tr	-	-	-	30-40	H.D. 7
42	7.5	92.5	1.57	90-95	1-5	-	1-2	-	-	-	-	-	-	-	Tr	-	-	H.D.31
43	2.3	97.7	1.24	80-90	5-10	<1	<1	-	Tr	-	-	-	-	-	Tr	-	-	H.D.14
44	-	100.0	11.66	30-40	30-40	10-20	<1	Tr	Tr	Tr	-	-	-	-	-	-	-	H.D. 7
45	0.5	99.5	1.12	<100	Tr	Tr	Tr	-	Tr	-	-	-	-	-	-	-	-	H.D.12
46	0.8	99.2	1.78	40-50	35-45	2-5	<1	Tr	-	Tr	-	-	-	-	-	-	-	H.D.13
47	0.5	99.5	15.76	60-70	Tr	<1	4-8	10-15	1-2	5-10	-	-	-	-	-	-	-	H.D. 4
48	0.1	99.9	96.46	20-30	60-70	5-7	-	-	-	-	-	-	-	-	-	-	-	H.D.16
49	0.1	99.9	17.79	30-40	50-60	2-4	<1	Tr	Tr	Tr	-	-	-	-	Tr	-	-	H.D.17
72050050	5.4	94.6	0.55	97-100	1-2	<1	Tr	Tr	-	-	-	-	-	-	-	-	-	H.D.20
51	2.4	97.6	0.26	70-80	3-5	<1	5-10	1-2	Tr	1-2	-	-	-	-	-	-	-	H.D. 2
52	0.1	99.9	0.39	80-90	10-15	1-2	Tr	-	-	-	Tr	-	-	-	-	-	-	H.D.23
53	0.1	99.9	77.02	98-100	1-2	Tr	-	-	--	-	-	-	-	-	-	-	-	H.D.33
54	-	100.0	1.00	70-80	15-20	1-2	2-4	Tr	Tr	Tr	-	-	-	-	-	-	-	H.D. 3
55	-	100.0	3.08	70-80	15-20	2-4	1-2	-	-	Tr	-	-	-	-	-	-	-	H.D.18
56	3.3	96.7	0.27	80-90	8-10	1-2	Tr	Tr	-	-	-	Tr	-	-	-	-	-	H.D.21
57	19.1	80.9	1.34	80-90	5-10	<2	<1	Tr	-	-	Tr	-	-	-	-	Tr	-	H.D.27
58	0.4	99.6	0.92	80-90	5-10	1-2	2-4	Tr	Tr	-	-	-	-	-	-	-	-	P.B.32
59	5.9	94.1	2.26	96-98	1-2	Tr	Tr	-	1-2	-	-	-	-	-	-	-	-	P.B.28

(Continued)

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Table 1: Continued

Sample No.	+14 Mesh Material	-14 Mesh Material	S.G.>2.96 H.Minerals Wt % -14 Mesh	Undifferentiated Opaques	Zircon %	Rutile %	Tourmaline %	Kyanite %	Andalusite %	Staurolite %	Amphibole %	Pyroxene %	Green Spinel %	Monazite %	Garnet %	Epidote %	Chlorite %	Map Ref No.
72050060	0.6	99.4	1.72	90-95	1-2	Tr	2-4	Tr	2-4	-	Tr	-	-	-	-	-	-	F.B.26
61	3.1	96.9	1.83	90-95	1-2	Tr	2-3	Tr	1-2	-	Tr	-	-	-	-	-	-	F.B.27
62	6.6	93.4	0.27	90-95	2-3	Tr	1-2	-	Tr	-	Tr	-	-	-	-	-	-	F.B.33
63	0.1	99.9	0.14	20-30	40-50	5-10	1-2	Tr	Tr	1-2	Tr	-	-	-	-	-	-	H.D.10
64	0.1	99.9	5.41	50-60	20-30	4-6	1-2	Tr	Tr	1-2	-	-	-	-	-	-	-	H.D. 2
65	11.6	88.4	0.05	50-60	20-30	3-5	1-2	Tr	-	Tr	-	-	-	-	-	-	-	H.D. 6
66	0.1	99.9	0.35	80-85	8-10	2-3	Tr	Tr	-	<1	Tr	-	-	-	-	-	-	H.D.32
67	1.6	98.4	0.56	70-80	20-30	Tr	<1	Tr	<1	-	-	-	-	-	-	-	-	H.D.11
68	1.2	98.8	0.68	40-50	45-55	2-4	<2	Tr	Tr	Tr	Tr	-	-	-	-	-	-	H.D. 8
69	1.3	98.7	1.06	98-99	1-2	Tr	Tr	-	Tr	-	Tr	-	-	-	-	-	-	H.D.22
72050070	36.9	63.1	4.30	80-90	5-10	1-2	Tr	Tr	Tr	Tr	Tr	-	-	-	-	-	-	H.D.30
71	15.1	84.9	0.19	60-70	30-40	1-2	Tr	Tr	Tr	Tr	-	-	-	-	-	-	-	H.D. 5
72	-	100.0	0.37	85-95	5-10	<1	Tr	Tr	Tr	-	Tr	-	-	-	-	-	-	H.D.15
73	0.2	99.8	0.18	50-60	-	-	20-25	5-10	4-6	Tr	Tr	-	-	-	-	-	-	H.D. 4
74	0.4	99.6	0.23	70-80	10-20	-	2-5	Tr	-	Tr	-	-	-	-	-	-	-	H.D.25
75	2.0	98.0	0.92	30-40	50-60	3-5	1-2	Tr	Tr	-	Tr	-	-	-	-	-	-	H.D.28
76	5.5	94.5	2.09	80-90	2-4	-	8-10	-	1-2	-	-	-	-	-	-	-	-	F.B.29

The resultant heavy mineral fractions were examined optically through stereo-binocular and polarizing microscopes to identify the constituents. Standard oil-mounts were used in conjunction with the polarizing microscope (under transmitted light conditions) to enable visual estimations of abundances of the constituent heavy minerals to be made (Table 1).

Thin sections were prepared by conventional methods appropriate to the unconsolidated nature of the samples.

RESULTS

Table 1 shows the mineralogical composition (semi-quantitatively), of the 43 heavy mineral fractions as determined by visual estimation (Amdel scheme MH 7.1), together with weight percentages of +14 and -14 mesh material, and weight percentages of heavy minerals expressed as a percentage of the -14 mesh material. One thin section of each of the original unconsolidated samples has been prepared.

COMMENTS

The abundant and often dominant opaque minerals can only be identified by preparation and examination of a polished briquette; but in many cases the proximity of a hand magnet evokes strong response from numerous opaque grains, suggesting the presence of varying amounts of magnetite.

It can be seen from Table 1 that certain samples containing moderate to high concentrations of heavy minerals also contain significant amounts of zircon and rutile (and possibly ?ilmenite in the undifferentiated opaques), and in fact this is also true of many samples with low heavy-mineral contents. Therefore, if this suite represents one particular deposit (as suggested by the mineralogy), it seems likely that the deposit may contain economic quantities of zircon, rutile, and perhaps ilmenite.

In the light of these factors it might prove worthwhile to carry out a quantitative mineralogical assessment of these heavy mineral fractions to provide data for calculations of grade, reserves, etc., and to give an indication of possible mineral concentrates obtainable and their suitability to meet marketing specifications.

APPENDIX 4

OPAQUE MINERALS IN 8 HEAVY MINERAL SANDS

by S. Whitehead*

INTRODUCTION & PROCEDURE

Eight samples of heavy mineral sands were submitted for the identification of opaque minerals with particular reference to ilmenite and chromite.

The samples were mounted without further treatment, polished, and examined in incident light.

GENERAL SUMMARY

The most abundant opaque minerals in these samples are completely altered ilmenite grains composed of porous, apparently amorphous iron-titanium oxide, rutile, and, in three samples, grains composed of fine-grained supergene iron oxides including hematite, goethite, and maghemite. Leucoxene occurs in subordinate to minor amounts and two samples contain some fresh and partly altered ilmenite. Traces of chromite were found in only two samples - those containing the fresh and partly altered ilmenite.

Most of the ilmenite, altered ilmenite, leucoxene, and rutile grains are well sorted and rounded to subangular and between 0.1 and 0.3 mm.

Most of the supergene iron oxide grains are well rounded (larger) and some show textures suggesting that this iron oxide has cemented and/or replaced earlier sediments. The presence of maghemite accounts for most if not all of the magnetic grains in the respective samples.

The eight samples can be divided into three groups.

Samples 7205-0035, 0039, 0044, 0047, and 0064 contain completely altered ilmenite, leucoxene, and rutile. No fresh ilmenite and chromite were found, and only trace amounts of goethite and other ferric oxides.

*Amdel, Adelaide, South Australia.

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Sample 7205-0048 and 0049 contain some fresh, partly altered, and completely altered ilmenite, unlike leucoxene, and a trace of chromite. They also contain abundant large grains of supergene ferric oxides.

Sample 7205-0070 differs from all others in that it is composed almost entirely of well rounded grains composed of goethite, hematite, and some maghemite.

Textures in many of these grains suggest that they were derived from an earlier sediment which had been cemented and/or partly replaced by the supergene iron oxides.

Non-opaque minerals are predominantly zircon with lesser amounts of tourmaline, kyanite and staurolite.

DESCRIPTION OF SAMPLES

Sample 72050035, PS 20031 (Map Ref. No. HD3)

Well sorted grey sand containing up to 50% of colourless transparent grains. There are extremely few magnetic grains.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Altered ilmenite	30-35
Leucoxene	10-15
Rutile	5-10
Goethite	Trace
Non-opaque	40-50

Neither chromite nor fresh ilmenite were found in the section.

The altered ilmenite grains are 0.1-0.2 mm in size, many are elongate and they vary from subrounded to well rounded. A few are subangular. They are slightly porous and are composed of apparently amorphous iron-titanium oxide. Some of the grains show relict textures mak ng former basal parting planes

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of the original ilmenite but no remnants of fresh ilmenite were found.

The leucoxene grains are similar to the altered ilmenite grains but a higher proportion are well rounded. They are pale grey to yellowish with internal reflections. Iron oxide, which is present in the altered ilmenite has been largely leached from the leucoxene grains and the remaining titanium oxide has recrystallized.

Rutile grains are semi-translucent, dark reddish brown and are generally subangular. A few show twinning.

The sample contains a few grains of porous, fine grained goethite.

The non-opaque grains are mainly zircon with a few of tourmaline and some quartz and very rare kyanite.

Sample 72050039, PS 20032 (Map Ref. No. HD9)

The sample contains heavy mineral grains mixed with an abundance of pale coloured clay.

Polished Section:

A visual estimate of the minerals present, disregarding the clay is as follows:

	%
Altered ilmenite	10-15
Leucoxene	3-5
Rutile	25-30
Goethite	Trace
Non-opaque	50-60

The altered ilmenite and leucoxene grains are similar to those in Sample 72050035 described above. Most of these are porous and subrounded to well rounded and between 0.1 and 0.3 mm in size.

The rutile grains are generally more angular and fractured but some are well rounded.

The non-opaque grains are predominantly zircon but also include minor kyanite, staurolite and tourmaline.

Some of the grains are surrounded by an adhering layer of clay containing some very fine grained quartz.

Sample 72050044, PS 20033 (Map Ref. No. HD7)

A well sorted, generally dark sand containing dark opaque grains, yellowish leucoxene, dark red rutile and colourless zircon.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Completely altered ilmenite	30-35
Leucoxene	5-10
Rutile	20-25
Non-opaque	30-35
Goethite	Trace

No fresh ilmenite or chromite were found.

The grains are generally well sorted and between 0.1 and 0.3 mm in size. Many of the rutile, zircon and altered ilmenite grains are elongate.

The individual minerals are essentially very similar to those described in sample 72050035 and they vary from subangular to well rounded.

The non-opaque grains are predominantly zircon with traces of tourmaline, kyanite and staurolite.

Sample 72050047, PS 20034 (Map Ref. No. HD4)

Dark, heavy mineral sand containing colourless transparent grains, dark opaque grains and translucent reddish brown grains.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Completely altered ilmenite	50-55
Leucoxene	5-10
Rutile	3-4
Goethite	Trace
Hematite (martite)	Trace
Non-opaque	30-40

The mineral grains are not as well sorted as in some of the other specimens and vary in size from 0.1 to 0.5 mm. The opaque grains are however essentially similar to those in other samples. The only trace of fresh ilmenite found is as a small inclusion in a non-opaque grain.

Chromite was not found.

The non-opaque heavy minerals are predominantly tourmaline, kyanite and staurolite with very few zircons.

Sample 72050048, PS 20035 (Map Ref. No. HD16)

Very dark heavy mineral sand containing grains of different sizes. Many of the grains are attracted to a magnet.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Fresh ilmenite	15-20
Partly altered ilmenite	2-3
Completely altered ilmenite	5-7
Leucoxene	Trace

Rutile	10-15
Titaniferous magnetite?	Trace
Chromite (partly altered)	Trace
Supergene ferric oxides including maghemite	30-40
Non-opaque	30-40
Sulphide (inclusions in ilmenite)	Minute trace

The ilmenite grains are well sorted (0.1-0.2 mm) and generally subrounded. A few have cavities from which an undetermined mineral inclusion has been leached.

The partly altered grains show all stages of replacement by porous, amorphous iron-titanium oxide beginning at the surface and extending into the grain along some small fractures and basal parting planes.

The completely altered ilmenite, leucoxene and rutile grains are similar to these in other samples and are of similar grain size to the ilmenite.

A significant proportion of this sample is composed of rounded and subrounded grains of porous, very fine grained ferric oxides including hematite, maghemite and minor goethite. These grains are larger than the other heavy mineral grains and average 0.2-0.4 mm with a few up to 0.5 mm long. Some show fine, colloform textures and many have small cavities from which a silicate? mineral has been leached.

Because of the presence of maghemite, many of these grains are probably magnetic and this accounts for the very numerous magnetic grains in the sample.

The non-opaque grains are all zircon.

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Sample 72050049, PS 20036 (Map Ref. No. HD17)

Dark, heavy mineral sand containing a small proportion of magnetic grains and abundant reddish brown grains.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Ilmenite	5-10
Altered ilmenite	20-25
Leucoxene	5
Rutile	10-15
Titaniferous magnetite(?)	Trace
Chromite	Minute trace
Supergene ferric oxides (hematite, maghemite & goethite)	25-30
Non-opaque	20-25

The ilmenite grains are subrounded to subangular and show all gradations from only very slightly altered to completely altered. Those grains showing minor alteration are listed as ilmenite and those showing extensive and complete alteration are listed as altered ilmenite.

Supergene iron oxide grains are similar to those in Sample 72050048 and those containing maghemite probably account for most of the magnetic grains in the sample. This sample contains a greater percentage of very porous reddish grains composed of ochreous and extremely fine grained hematite and goethite. These oxides may have replaced some fine grained rock.

A few of the heavy mineral grains show an adhering layer of supergene iron oxide suggesting that some may have been derived from an earlier deposit which was at least partly cemented by supergene iron oxide. These grains were rounded before being coated or cemented by iron oxide.

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The few chromite grains present are 0.05-0.1 mm, subangular and show a thin zone of alteration around the margin.

Two zircon grains were found with inclusions of ilmenite containing exsolved lamellae of hematite. A few ilmenite and zircon grains contain minute inclusions of yellow sulphide.

The non-opaque grains are predominantly zircon with minor tourmaline and quartz.

Sample 72050064, PS 20037 (Map Ref. No. HD 2)

Dark heavy mineral sand without magnetic grains.

Polished Section:

A visual estimate of the minerals present is as follows:

	%
Completely altered ilmenite	60-65
Leucoxene	5-10
Rutile	10-15
Goethite	1-2
Non-opaque	20-25

No fresh ilmenite or chromite were found.

The grains are well sorted and most of them are between 0.1 and 0.3 mm. The altered ilmenite and leucoxene grains are well rounded to subrounded and most of the rutile grains subangular to subrounded but some show evidence of recent fracturing of rounded grains.

The supergene iron oxides are very porous, fine grained hematite and goethite. One rounded grain of altered ilmenite was found surrounded by similar fine grained goethite.

Non-opaque minerals are predominantly kyanite, tourmaline and staurolite with a trace of zircon and amphibole. Many tourmaline grains are very well rounded.

Sample 72050070, PS 20038 (Map Ref. No. HD30)

Dark brown, poorly sorted sand with a small percentage of magnetic grains.

Polished Section:

The sample is composed predominantly of well rounded, porous grains 0.5 to over 2 mm in size composed of supergene ferric oxides mainly goethite and hematite but with a few containing maghemite. Many of these grains contain small inclusions or remnants of unleached silicate and/or quartz grains and the textures shown by some grains suggest that small, angular silicate and/or quartz grains have been cemented by the iron oxide. It is possible that some iron oxide has replaced clay.

One fragment of a large, rounded grain shows evidence of layering in the sediment which has been cemented and partly replaced by goethite. Another contains remnants of mica flakes replaced partly by goethite and another shows a relict fine granular texture typical of siltstone or fine grained sandstone.

A trace of fresh ilmenite occurs as very small (0.05 mm) grains included in a few of the large iron oxide grains.

Most of the heavy mineral grains in this sample were derived from an older sediment which had been cemented and partly replaced by ferric oxides predominantly goethite and hematite but with maghemite locally developed.

APPENDIX 5

CHEMICAL ANALYSES

Fifteen rock samples were sent to Amdel, Adelaide South Australia for major oxide analysis (Table 1).

Table 1: Major oxide analyses of weathered rock from Bathurst Island, Melville Island and Cobourg Peninsula.

Rock Type	Map Ref. No.	Sample No. 7205	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	MnO	TiO_2	P_2O_5	Cr_2O_3	V_2O_5	LOI	Total
Pisolitic Ironstone	BI. 9	0077	27.0	15.5	45.4	<0.1	0.21	0.15	<0.1	<0.02	0.72	0.15	<0.1	<0.05	10.5	99.6
Lateritic Sandstone	BI. 4	0078	45.1	25.4	13.5	<0.1	0.15	0.11	<0.1	<0.02	1.7	0.08	<0.1	<0.05	13.6	99.6
Pisolitic Ironstone	CP. 10	0079	31.2	26.3	28.8	<0.1	0.09	0.26	<0.1	<0.02	1.3	0.11	<0.1	<0.05	11.7	99.8
Pisolitic Ironstone	CP. 11	0080	36.3	29.7	20.0	<0.1	0.04	0.03	<0.1	<0.02	1.2	0.11	<0.1	<0.05	12.0	99.4
Pisolitic Laterite	BI. 3	0081	44.9	32.4	7.4	<0.1	0.03	0.03	<0.1	<0.02	1.8	0.08	<0.1	<0.05	12.9	99.5
Bauxite	CP. 12	0082	26.3	34.1	21.7	<0.1	0.06	0.26	<0.1	<0.02	1.6	0.11	<0.1	<0.05	15.3	99.4
Pisolitic Ironstone	BI. 5	0083	24.8	19.9	41.5	<0.1	0.11	0.16	<0.1	0.05	1.0	0.18	<0.1	<0.05	11.7	99.4
Bauxite	CP. 13	0084	7.3	44.7	8.9	2.0	4.4	0.16	<0.1	<0.02	2.5	0.25	<0.1	<0.05	29.3	99.5
Laterite	MI. 8	0085	27.1	7.1	55.2	<0.1	0.11	<0.03	<0.1	0.08	0.4	0.50	<0.1	<0.05	9.0	99.5
Pisolitic Laterite	CP. 14	0086	28.0	23.2	35.6	<0.1	0.21	0.37	<0.1	<0.02	0.95	0.08	<0.1	<0.05	11.1	99.5
Mottled Sandstone	CP. 15	0087	41.8	36.3	5.4	<0.1	0.06	0.03	<0.1	<0.02	2.1	0.08	<0.1	<0.05	14.0	99.8
Pisolitic Ironstone	MI. 7	0088	30.0	17.4	40.5	<0.1	0.10	0.09	<0.1	<0.02	0.65	0.25	<0.1	<0.05	10.7	99.7
Ferruginous Sandstone	BI. 1	0089	34.2	22.8	30.7	<0.1	0.09	0.03	<0.1	<0.02	1.35	0.11	<0.1	<0.05	10.1	99.4
Mottled Sandstone	BI. 2	0090	40.5	22.0	24.6	<0.1	0.09	0.17	<0.1	<0.02	1.1	0.11	<0.1	<0.05	11.0	99.5
Ferruginous Sandstone	CP. 16	0091	56.3	1.3	35.2	<0.1	0.05	0.10	<0.1	0.06	0.16	0.43	<0.1	<0.05	5.7	99.3

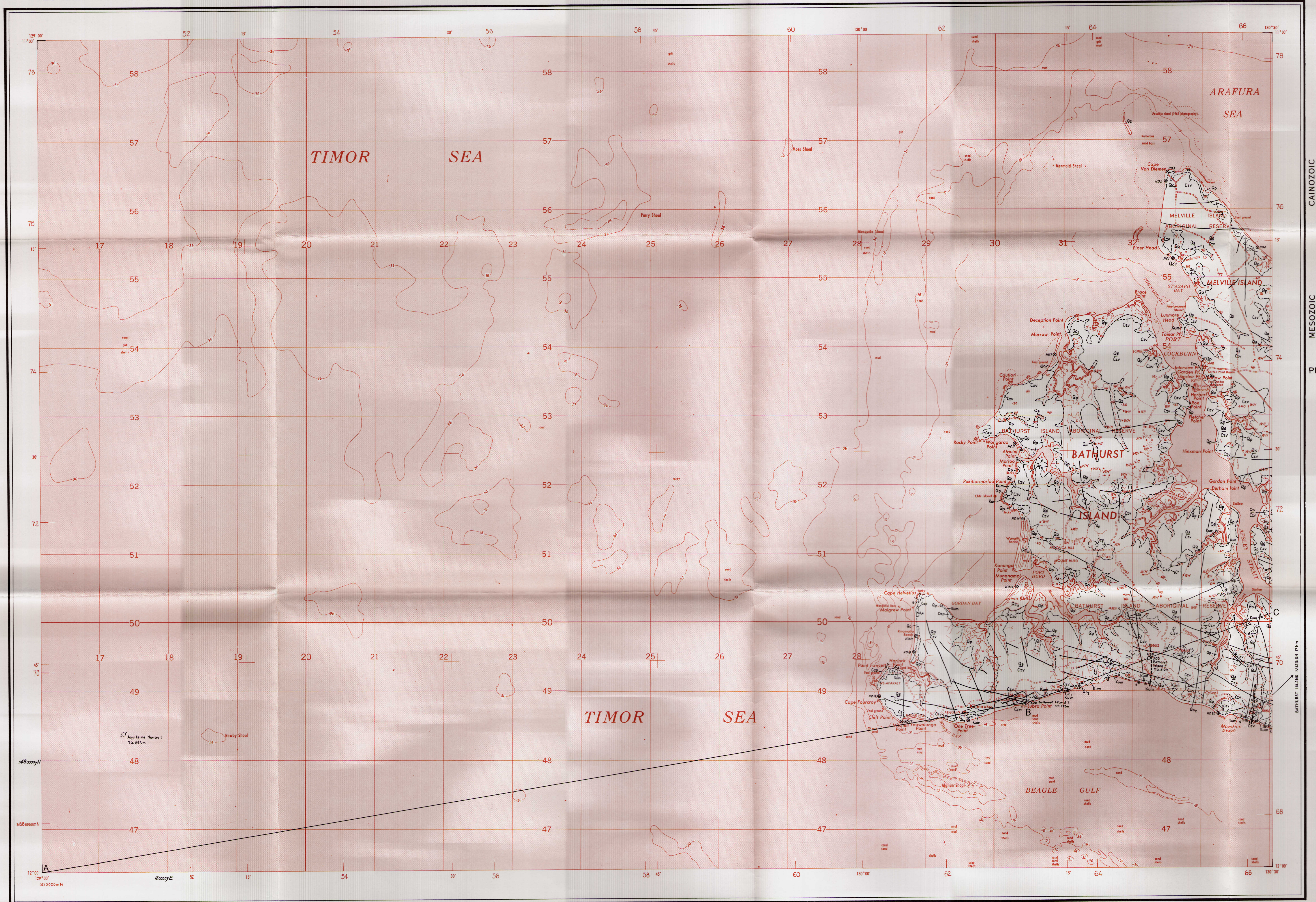
B.I. Bathurst Island Sheet. C.P. Cobourg Peninsula Sheet. M.I. Melville Island Sheet.

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

BATHURST ISLAND

NORTHERN TERRITORY

SHEET SC 52-15



Reference

Era	Period	Unit	Symbol	Description
CAINOZOIC	QUATERNARY		Qa	Silt, fine sand, minor gravel: alluvium
			Qc_2	Quartzose sand, shell and coralline debris
			Qc_1	Quartzose dune sand
			Qp	Saliferous, organic mud and silt
			Qs	Quartzose sandstone, poorly consolidated sand and silt, sandy soil
			Czm	Coquina, calcarenite, conglomerate
			Czp	Ferruginous to bauxitic, pisolitic laterite
		Van Diemen Sandstone	Czv	Poorly sorted quartzose sandstone, minor siltstone and calcareous lenses, crossbedded in part, strongly weathered in outcrop, iron-stained in upper part
				Chemically altered sediments (kaolinized, mottled and ferruginous zones of laterite profile)
MESOZOIC	LOWER TO UPPER CRETACEOUS	Bathurst Island Formation	Kb	Sublabile sandstone, siltstone and mudstone, glauconitic and calcareous in part. Section only
		Moonkinu Member	Kum	Sublabile sandstone, lignitic mudstone, calcareous in part; calcareous and limonitic concretions, crossbedded in part, fossiliferous
		Wangarlu Mudstone Member	Kuw	Mudstone, siltstone, minor sublabile sandstone, scattered nodular pyrite, fossiliferous
	LOWER CRETACEOUS	Mullaman Beds	Klm	Sublabile sandstone, siltstone and mudstone (Section only)
PROTEROZOIC			P	Igneous and metamorphic basement (Section only)

Geological boundary

Fault (D,U indicates relative movement down, up)

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

Lineament, airphoto interpretation

Strike and dip of strata

Macrofossil locality } with reference number
Microfossil locality
Specimen locality
Type section

HD1 Hand auger drill hole, with reference number

Petroleum exploration well, dry, abandoned

Abandoned bore

5619 Bore registration number of Northern Territory Administration records

WH Waterhole

Swamp

Mangrove

Rocks submerged

Coral reef

18 Bathymetric contour, depth in metres, approximate

Cliff

Former strand line

Road

Vehicle track

Landing ground

Building

Lighthouse

Astronomical station

85 Elevation in metres, approximate

NOTE ON GRID COORDINATES

Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10,000 yard grid, Zone 4 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered ticks (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 52 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

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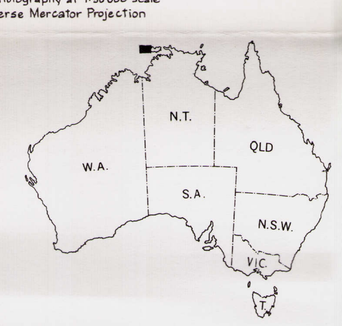
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50 000 scale
Transverse Mercator Projection



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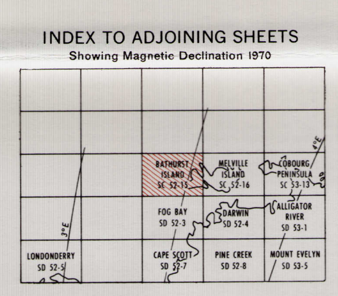


Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

Section

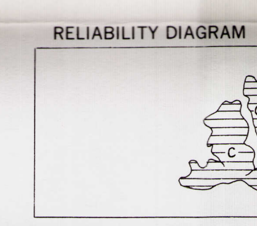
Scale: $\frac{V}{H} = 4$

Depth in metres

Superficial Cainozoic deposits omitted

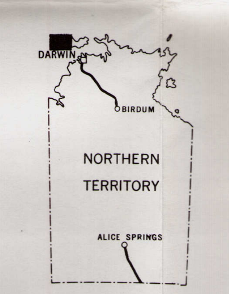
Section based on Hyland Seismic Survey 1967 for Australian Aquitane Petroleum Pty Ltd and Parry Shoals Seismic Survey 1969 for Longreach Oil Ltd

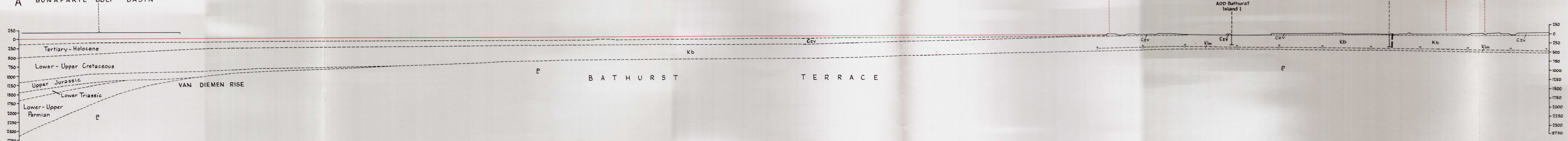
RELIABILITY DIAGRAM



Geology C General reconnaissance: many traverses, and airphoto interpretation

Geology 1972 by R.J. Hughes, B.R. Senior
Photogeology 1972 by C.J. Simpson
Compiled 1972-73 by R.J. Hughes, D.M. Pillinger
Cartography by Geological Branch, BMR
Drawn 1972 by I.D. Johnston
Printed by Mercury-Walch Pty Ltd, Hobart, Australia





PRELIMINARY EDITION 1973
SUBJECT TO AMENDMENT

BATHURST ISLAND

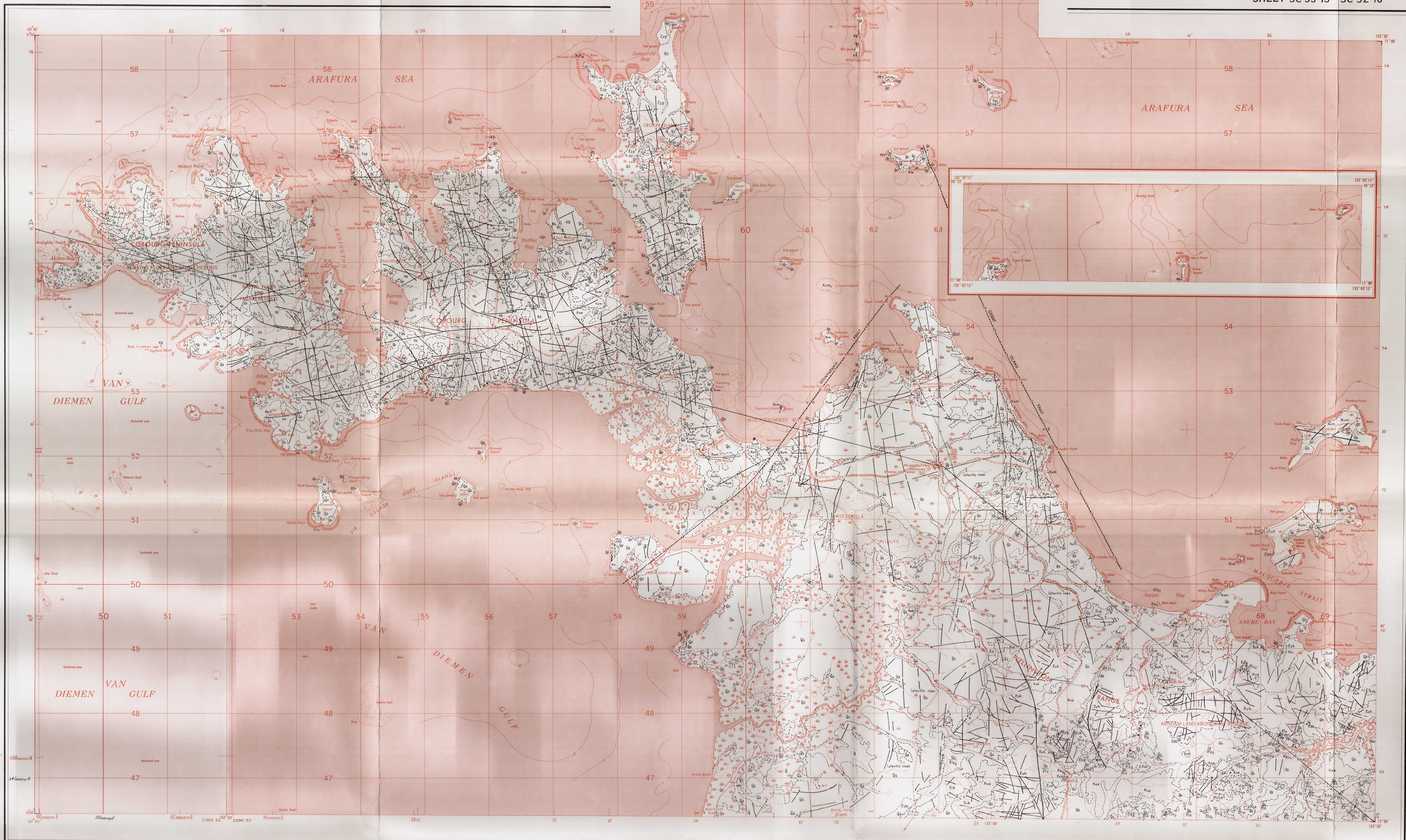
SHEET SC 52-15

COBOURG PENINSULA – MELVILLE ISLAND

NORTHERN TERRITORY

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

SHEET SC 53-13 SC 52-16



Reference

Era	Period	Unit	Symbol	Description
CAINOZOIC	QUATERNARY		Q	Sand, silt, soil, minor gravel
			Qa	Silt, fine sand, mud, minor gravel : alluvium
			Qs	Quartz-rich, red-brown, sandy soil
			Qc	Sand, silt and mud; with sand-shell coralline debris in beach ridges : coastal alluvium
			Qcd	Quartzose dune sand
			Qp	Saliferous organic silt and mud in mangrove swamps and tidal flats
			Czp	Ferruginous to bauxitic pisolitic laterite
			Czm	Coquina, calcarenite, minor conglomerate
				Ferruginous laterite (ferruginous zone) tubular, concretionery and vesicular in part; Ferruginous laterite capping, as shown in section
				Kaolinized sedimentary rocks (leached and mottled zones of laterite profile)
MESOZOIC	UPPER CRETACEOUS	Bathurst Island Formation	Kb	Mainly sublabile sandstone, siltstone and mudstone calcareous in part (lateritized in outcrop)
		Wangarlu Mudstone Member	Kuw	Mudstone, siltstone, minor sublabile sandstone, scattered nodular pyrite, fossiliferous
		Moonkinu Member	Kum	Sublabile sandstone, carbonaceous siltstone and mudstone, calcareous and limonitic concretions, crossbedded in part, fossiliferous
		Marligur Member	Kua	Quartzose sandstone, siltstone and mudstone, micaceous and sparsely fossiliferous
PROTEROZOIC	CARPENTARIAN	*Kombolgie Formation	Puk	Crossbedded quartzose sandstone, medium to very coarse grained and siliceous; conglomerate of quartzite and vein quartz clasts
	LOWER PROTEROZOIC	*Oenpelli Dolerite	Pdo	Dolerite
		Nimbuwah Complex	Plz	Granite, migmatite, gneiss and schist
			Plz_1	Homogeneous to foliated migmatitic granitoid rocks
			Plz_2	Migmatitic and minor homogeneous to foliated granitoid rock and schist
			Plz_3	Lit-par-lit gneiss, augen gneiss, schist

* Name not yet approved

Geological boundary
Syncline
Fault (D, U indicate relative movement down, up)

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

Strike and dip of strata
Strike and dip of foliation
Strike and dip of foliation, unmeasured
Dip less than 5° } air-photo interpretation
Joints } air-photo interpretation
Lineament } air-photo interpretation

Macrofossil locality
Microfossil locality
X15 Specimen locality and reference number

Prospect, U uranium

Abandoned bore
Subartesian bore
5695 Bore registration number of Northern Territory Administration records
Waterhole
Swamp
Mangroves
Mud
Rock ledges, coral reef
Submerged rocks
Rocks, bare or awash
Bathymetric contour, depth in metres, approximate

Former strand lines
Coastal cliffs
Road
Vehicle track
Landing ground
Building
Trigonometrical station
Astronomical station
·25 Elevation in metres, approximate
** Name not yet approved

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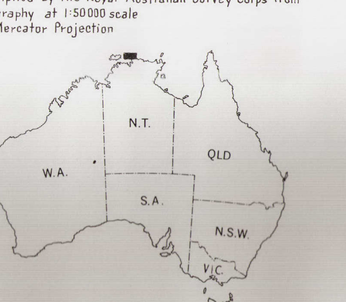
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50000 scale
Transverse Mercator Projection



NOTE ON GRID COORDINATES
Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10,000 yard grid, Zone 4 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection
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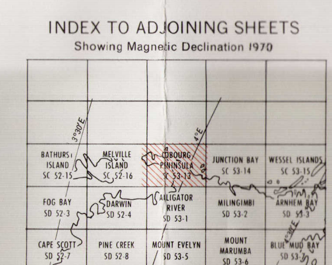


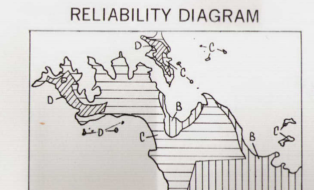
Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

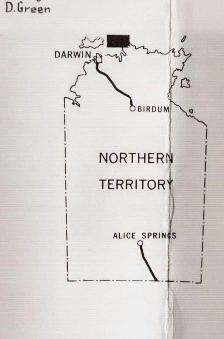
Section
Scale $\frac{V}{H} = 4$
Depth in metres
Quaternary sediments omitted

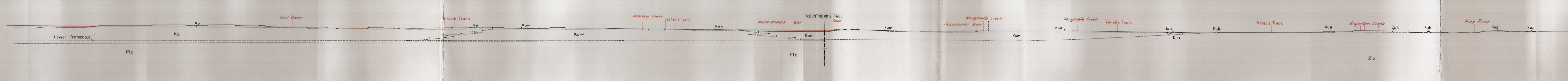
RELIABILITY DIAGRAM



Geology
B Detailed reconnaissance and airphoto interpretation
C General reconnaissance: many traverses, mainly airphoto interpretation
D Airphoto interpretation

Geology 1972 Mesozoic, Cainozoic by B.R. Senior, R.J. Hughes
Geology 1972 Pre-Mesozoic by A. Watchman, P. Smart
Photogeology 1972 by C.J. Simpson
Compiled 1972-73 by B.R. Senior
Cartography by Geological Branch BMR
Drawn 1973 by D. Green





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COBOURG PENINSULA – MELVILLE ISLAND
SHEET SC53-13 SC52-16

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

FOG BAY
NORTHERN TERRITORY

SHEET SD 52-3

Reference

Era	Period	Formation	Symbol	Description
CAINOZOIC	QUATERNARY		Qa	Alluvium; silt, fine sand, minor gravel
			Qs	Quartzose sandstone, poorly consolidated sand and silt
			Qp	Saliferous organic mud and silt
			Czm	Coquina, calcarenite, sandy shelly conglomerate
			Czr	Coralline limestone?, section only
			Czl	Chemically altered rocks (kaolinized, mottled and ferruginous zones of a laterite profile)
MESOZOIC	UPPER CRETACEOUS	* Bathurst Island Formation	Kub	Sublabile sandstone, siltstone and mudstone, calcareous in part section only
	LOWER CRETACEOUS	Mullaman Beds	Klm	Sublabile sandstone, siltstone and mudstone
PALAEOZOIC	PERMIAN		Pl	Sandstone, siltstone, exotic clasts of quartz, quartzite and granite
PROTEROZOIC	CARPENTARIAN OR ADELAIDEAN	Fitzmaurice Group Moyle River Formation	Efm	Orthoquartzite, sheared quartzite, schists, and minor conglomerate. Profuse quartz veining in part
			Eg	Biotite granite
	CARPENTARIAN		E	Metamorphic and igneous basement, section only

* Name not yet approved

Geological boundary, position approximate
Syncline: where location is concealed, line is dotted
Strike and dip of strata
Specimen locality, with reference number
Dyke; q-quartz
Hand drill auger hole, with reference number
Petroleum exploration well, dry, abandoned
Waterhole
Swamp
Mangroves
Mud
Rock ledges, coral reef
Bathymetric contour, depth in metres
Former strand lines
Coastal cliffs
Vehicle track
Landing ground
Building
Fence

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Base map compiled by Royal Australian Survey Corps from aerial photography at 1:50,000 Scale.
Transverse Mercator Projection

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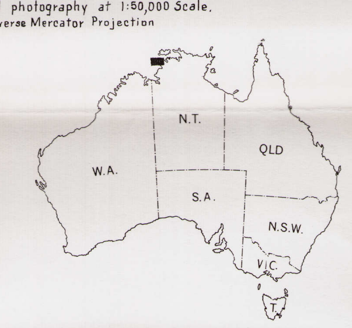
Brown numbered lines (with larger upright numbers), indicate the 20,000 metre intervals of the superimposed Australian Map Grid Zone 52, AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection



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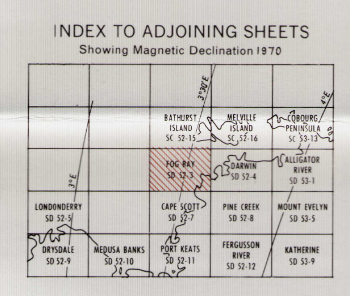

Scale 1:250 000

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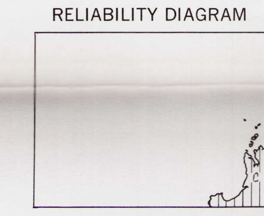
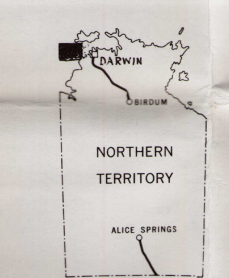
5 0 5 10 MILES

RELIABILITY DIAGRAM



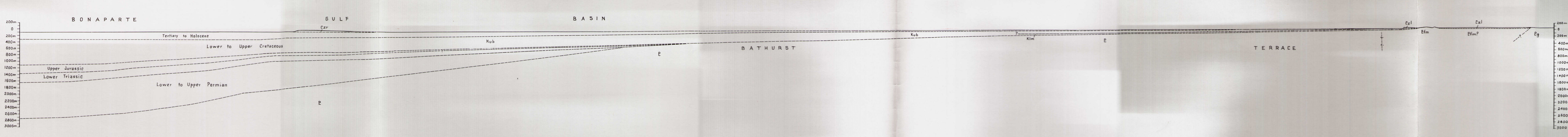
C General reconnaissance: many traverses, and air-photo interpretation

Geology 1972 by B.R. Senior
Compiled 1973 by B.R. Senior and D. Green
Cartography by Geological Branch B.M.R.
Drawn by D. E. Green



Section
Superficial Quaternary sediments omitted from section
Scale: $\frac{V}{H} = 4$

Section and bathymetric contours based on Hyland Seismic Survey 1970 for Australian Aquitane Petroleum Pty Ltd



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FOG BAY
SHEET SD 52-3

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

MELVILLE ISLAND

NORTHERN TERRITORY

SHEET SC 52-16

Reference

CAINOZOIC	QUATERNARY		Qa	Silt, fine sand, minor gravel: alluvium
			Qc	Quartzose sand, shell and coralline debris
			Qp	Saliferous organic mud and silt
			Qs	Quartzose sandstone, poorly consolidated sand and silt, sandy soil
			Czp	Ferruginous to bauxitic pisolitic laterite
		Van Diemen Sandstone	Czv	Poorly sorted quartzose sandstone, minor siltstone and calcareous lenses, cross-bedded in part, strongly weathered in outcrop, iron-stained in upper part
				Ferruginized laterite (ferruginous zone) vesicular and concretionary in part
				Chemically altered sediments (kaolinized and mottled zones of laterite profile)
MESOZOIC	UPPER CRETACEOUS	Bathurst Island Formation	Kb	Sublabile sandstone, siltstone and mudstone, glauconitic and calcareous in part, laterized in outcrop
		Moonkinu Member	Kum	Sublabile sandstone, lignitic mudstone, calcareous in part; calcareous and limonitic concretions, cross-bedded in part, fossiliferous
	LOWER CRETACEOUS ?	Tinganoo Bay Beds	Klt	Quartzose to sublabile glauconitic sandstone, sandy conglomerate; minor siltstone and mudstone (Section only)
PROTEROZOIC			p	Igneous and metamorphic basement (Section only)

- Geological boundary, position approximate
- Fault, position accurate
- Fault, concealed
- Lineament, airphoto interpretation
- 33 Strike and dip of strata
- 14 Macrofossil locality (with reference number)
- 8 Microfossil locality (with reference number)
- X 7 Specimen locality (with reference number)
- HD 29 Hand auger drill hole (with reference number)
- Petroleum exploration well, dry, abandoned
- Subartesian water-bore
- Subartesian water-bore (sand spears hole)
- Abandoned water-bore
- 5598 Bore registration number of Northern Territory Administration records
- WH Waterhole
- Spring
- Swamp
- Mangroves
- Coral reef
- Submerged rocks
- Mud
- 10 Bathymetric contour, depth in metres, approximate
- Cliff
- Former strand line
- Road
- Vehicle track
- Village
- Building
- Landing ground
- Astronomical station
- Trigonometrical station
- ·87 Elevation in metres, approximate

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Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50 000 scale
Transverse Mercator Projection

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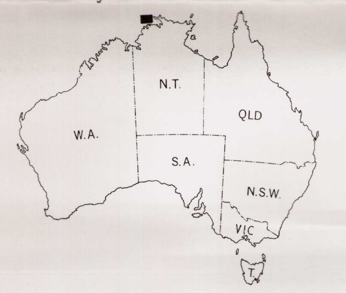
Brown numbered ticks (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 52 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection



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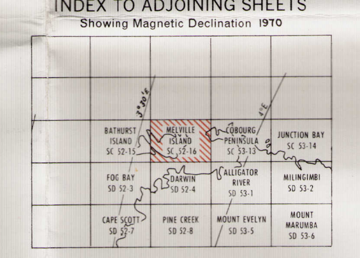
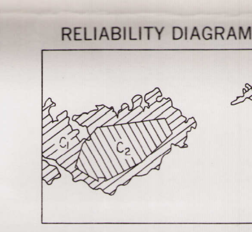


Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

RELIABILITY DIAGRAM



Geology C_1 General reconnaissance: many traverses, and airphoto interpretation

C_2 General reconnaissance: few traverses, mainly airphoto interpretation

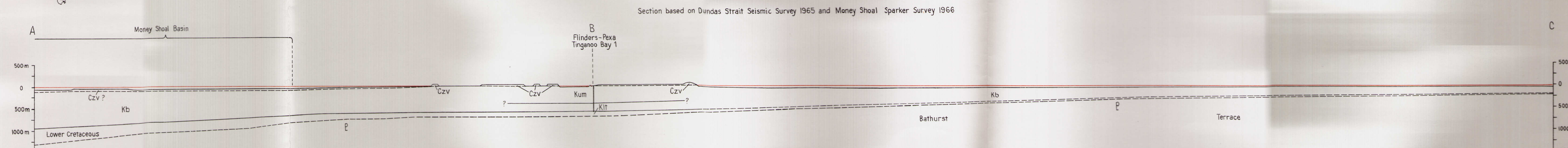
Geology 1972 by R.J. Hughes, B.R. Senior
Photogeology 1972 by C.J. Simpson
Compiled 1972-73 by R.J. Hughes and D.M. Pillinger
Cartography by Geological Branch, BMR
Drawn 1973 by J.F. Stirzaker

Section

Superficial Quaternary sediments omitted

Scale: $\frac{V}{H} = 4$

Section based on Dundas Strait Seismic Survey 1965 and Money Shoal Sparker Survey 1966



PRELIMINARY EDITION 1973
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