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RECORD 1973/56

NEW STRATIGRAPHIC NAMES FOR CRETACEOUS AND CAINOZOIC UNITS OF BATHURST AND MELVILLE ISLANDS AND COBOURG PENINSULA, NORTHERN TERRITORY

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SUMMARY

Recent geological mapping of late Cretaceous and Tertiary sedimentary rocks on Bathurst and Melville Islands, and Cobourg Peninsula together with an assessment of the regional geology

(a) resulted in the recognition of probable Tertiary shallow marine quartzose sandstone here named the Van Diemen Sandstone;

(b) showed that the Upper Cretaceous sediments previously mapped as Mullaman Beds were divisible onshore into the Moonkinu Member, Marligur Member, and Wangarlu Mudstone Member of the Bathurst Island Formation, which is here formally defined;

(c) led to the recognition of a distinct lithological unit underlying the Bathurst Island Formation in Tinganoo Bay 1, which is here named Tinganoo Bay Beds.

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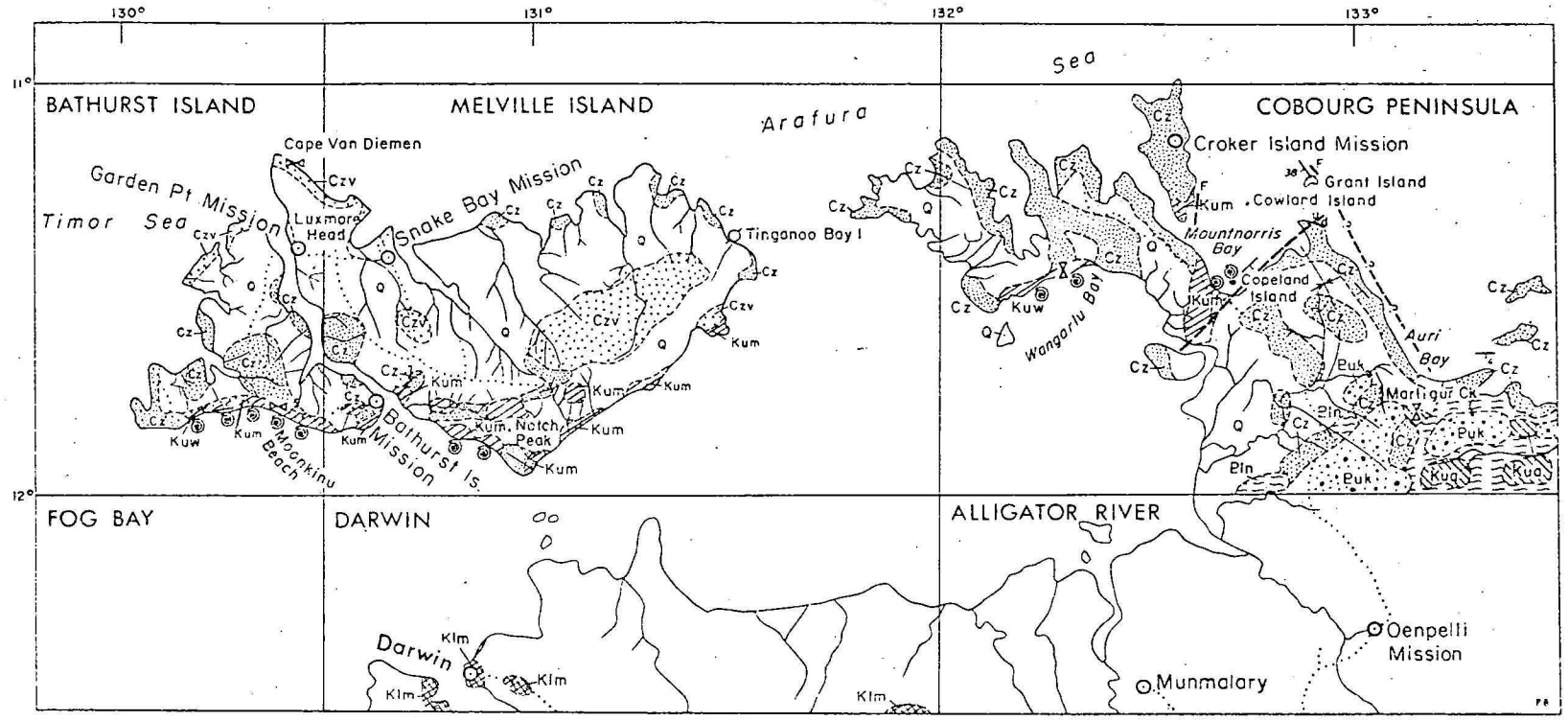
INTRODUCTION

In 1972 the Bureau of Mineral Resources mapped the Bathurst Island, Melville Island, and Cobourg Peninsula 1:250 000 Sheet areas (Hughes & Senior, 1973) (Fig. 1). Preliminary geological maps at 1:250 000 scale will be available during the latter half of 1973. Six new stratigraphic names are proposed for units mapped. Previously, all the Cretaceous sediments occurring in these Sheet areas were referred to as Mullaman Beds. However, it is here proposed to restrict this name to the Lower Cretaceous sediments on the mainland south of the islands and Cobourg Peninsula.

The Bathurst Island Formation is formally defined as the interval between 412 and 1329 m in Arco Petrel 1 petroleum exploration well. Three members of the formation have been recognized as mappable units on the three Sheets. In addition, a new probable Tertiary Formation and a new Lower Cretaceous stratigraphic unit are described. The stratigraphic relationships of these units are summarized in Figure 2.



QUATERNARY	Q	*Alluvial and colluvial sediments, beach deposits of sandy coquinite*	
CAINOZOIC	Czv	*Van Diemen Sandstone. Quartzose cross-bedded sandstone, ferruginized in part*	
	Cz	*Chemically weathered sediments, laterite*	
UPPER CRETACEOUS — Bathurst Island Formation	Kum	*Moonkinu Member*	*Fossiliferous sublabile sandstone, siltstone and mudstone, calcareous and carbonaceous in part*
	Kuw	*Wangarlu Mudstone Member*	*Mudstone, siltstone, pyritic in part*
	Kug	*Marligur Member*	*Quartzose sandstone and siltstone*
LOWER CRETACEOUS	Klm	*Mullaman Beds*	
UPPER PROTEROZOIC	Puk	*Kombolgie Formation; quartzose sandstone, quartz pebble conglomerate*	
LOWER PROTEROZOIC	Pln	*Nimbuwah Complex. Gneiss, granite, migmatite, dolerite*	

Syncline

Fault

Dip and strike of strata

Fossil locality

Type section

Track or road

0 20 40 60 80 Km

FIG. 1 GEOLOGICAL SKETCH MAP OF BATHURST ISLAND, MELVILLE ISLAND, AND COBOURG PENINSULA 1:250,000 SHEET AREAS

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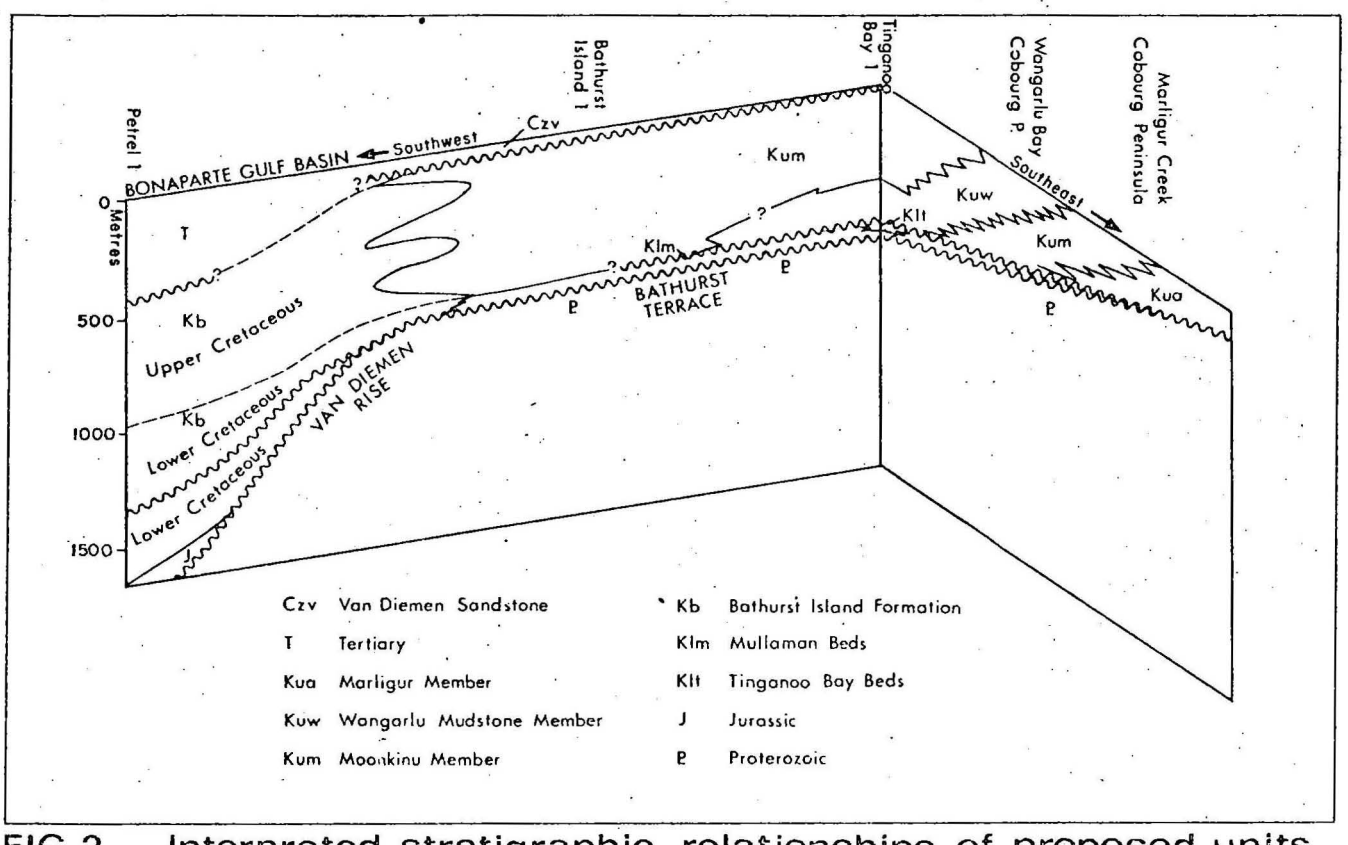

FIG. 2 Interpreted stratigraphic relationships of proposed units from Bonaparte Gulf Basin across the Bathurst Terrace

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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 the cliffs exposed on the northeastern headland of Cape Van Diemen.

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 lenses of hard calcareous sandstone. The sandstone is poorly sorted and composed predominantly of subangular to rounded quartz with a small percentage of opaque minerals and rare tourmaline grains. Little matrix is present 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.

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. However, the base of the sandstone was not seen and the total thickness may be much greater.

Contacts: The Van Diemen Sandstone rests unconformably on the weathered surface of the Cenomanian Moonkinu Member at Moonkinu Beach on the south coast of Bathurst Island (Fig. 3) and at Luxmore Head, Melville Island. Offshore it is possible that a more conformable sequence of Late Cretaceous and Tertiary sediments is present. 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 and the age is thought to be Tertiary on rock-stratigraphic position.

Bathurst Island Formation (Kb)

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

The type section of the Bathurst Island Formation is defined as the interval between 412 and 1,329 m in Arco Petrel 1 petroleum exploration well (Arco, 1969a). Arco Petrel 1 was drilled on the southeastern edge of the Bonaparte Depression (Van Andel & Veevers, 1967) at latitude 12°48'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 (Geological Society Australia, 1971) and is represented in outcrop on Bathurst Island, Melville Island, and Cobourg Peninsula by three members (Fig. 2). The formation thickens northward over the terrace and probably extends into the Money Shoal area (Hughes & Senior, 1973).

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

The section intersected by Arco Lacrosse 1 petroleum exploration well (Arco, 1969b) indicates that the 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, and further over the Van Diemen Rise and eastwards across the Bathurst Terrace. In Flinders-Pexa Tinganoo Bay 1 petroleum exploration well (Pemberton, 1971) on northeast Melville Island, the 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. On Bathurst and Melville Islands it lies unconformably below the Van Diemen Sandstone; elsewhere on the Bathurst Terrace it is succeeded by thin 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 and are defined below. They are laterally equivalent and represent facies changes across the terrace from deeper water, 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.

Structure: The Bathurst Island Formation is a virtually undisturbed sequence; its regional dip is less than 10° to the northwest. Shallow folding and compaction faults with small throws are common in outcrops. The only large-scale fold reported, onshore or offshore, is a possible

syncline trending from central southern Cobourg Peninsula north to Malay Bay.

Fossils and age: The interval between 412 and 1329 m in Arco Petrel 1 ranges in age from Aptian to Cenomanian or possibly Turonian, on fossil evidence.

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 of Cobourg Peninsula between Wangarlu and Wurgurlu Bays and at Guialung Point along the west part of Mountnorris Bay. Inland its outcrop is restricted to a few lateritic rises. Similar sediments, correlated with the 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 iron pyrite which on oxidation leaves sulphurous encrustations. Scattered dark grey pyritic nodules are present, especially at the Bathurst Island outcrop; a few occur 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: The maximum thickness observed at Wangarlu Bay is 14 m, and at Guialung Point 4 m. The upper and lower contacts of the Member are not exposed, so an estimate of total thickness is 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 sediments. To the northwest of the type section the sediments mapped as chemically weathered sediments may belong to the Member; but they are so weathered that parent rock textures have been obliterated and correlation on the basis of lithology is difficult. To the southeast the Wangarlu Mudstone 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 Member has a slight regional dip of about 1° to the northwest. Photointerpreted 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-grained 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 cliffs adjacent to Moonkinu Beach. Figure 3 shows a detailed stratigraphic section measured at the type locality.

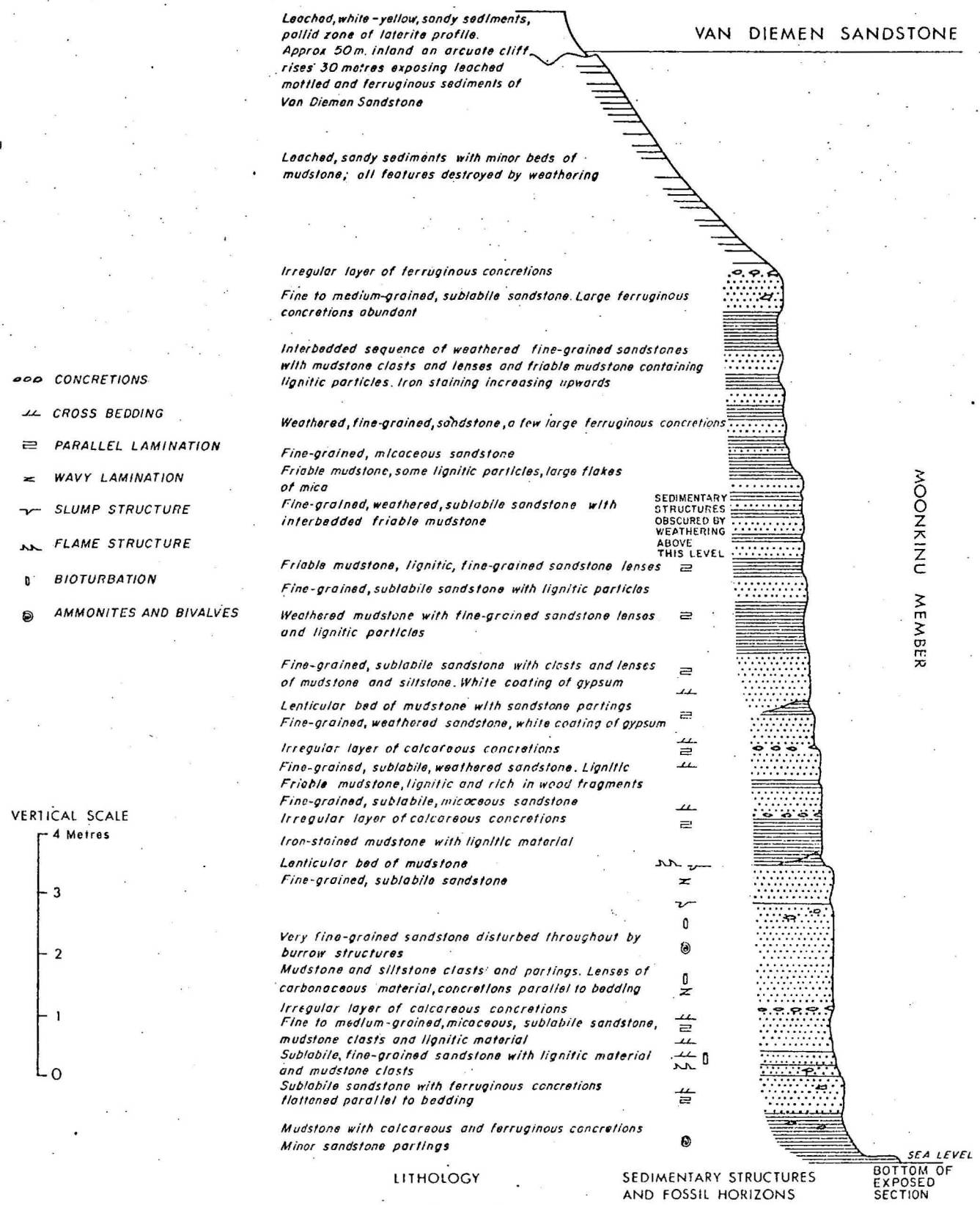

FIG. 3 TYPE SECTION OF THE MOONKINU MEMBER, MOONKINU BEACH, BATHURST ISLAND, N.T.

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Distribution: The Moonkinu Member crops out in the cliff sections exposed along the southern coasts of both Melville and Bathurst Islands. Inland, on both islands, outcrop is poor and is generally restricted to low cliffs adjacent to streams which 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 highly weathered outcrops in the central portion of the peninsula. Three small areas of unweathered outcrop are present at southern Mountnorris Bay, Copeland Island, and Cowlard Island.

Lithology: Fine to very fine-grained sublabile 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 a little muscovite, glauconite, tourmaline, and zircon. Clasts and lenses of mudstone occur at irregular intervals in the sandstone beds. The mudstone is finely laminated, lignitic, and soft, and is friable where weathered. Fine-grained sandstone lenses and partings are common.

Calcareous and limonitic concretions are present in both the sandstone and the mudstone beds and are aligned 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.

Thickness: 150 m along the southern coast of Bathurst Island including 20 m at the type section (Fig. 3). Alliance Bathurst Island Nos 1 and 2 petroleum exploration wells (Hare & Associates, 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.

Contacts and relationships: The Moonkinu Member is unconformably overlain by Van Diemen Sandstone (Fig. 3). Its base is tentatively picked at 400 m in Flinders-Pexa Tinganoo Bay 1, where lithology changes 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 very gently towards the northwest. Shallow folding and compaction faults with small throws are common. Close to the larger faults the bedding steepens, 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 a Cenomanian age. Skwarko (1966) came to the same conclusion.

A fauna of macrofossils including ammonites, bivalves, gastropods, and fish teeth was collected during this survey. The ammonites identified by R. Henderson (pers comm.) include Acanthoceras tapara, Chimbuites mirindowensis, ?Collignoniceras 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.

Diagnostic features: Regularly interbedded fine sublabile sandstone, siltstone, and mudstone with well defined bedding distinguish the Moonkinu Member. In Arco Petrel 1 the lithology of the Bathurst Island Formation is

similar to the Moonkinu Member, except for the regular interbedding which is absent. Lack of regular bedding offshore might relate to open marine conditions controlling sedimentation, which, to the east, grade to a deltaic environment.

Marligur Member (Kua)

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

Distribution: Numerous but very poor exposures occur in the Wellington Range (Cobourg Peninsula Sheet) and extend to the northeast portion of the Alligator River and western part of 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-grained 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.

Structure: Photo-interpreted lineaments probably reflect differential compaction of the sediments across basement features.

Fossils and age: Chemical weathering has obliterated most organic material at outcrop. 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 the Marligur Member in the Junction Bay Sheet area. Worm borings and burrows are present on some bedding surfaces. The formation is probably Cenomanian in age.

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

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.).

Lithology: Coarse-grained quartzose sandstone and conglomerate containing angular to rounded pebbles of quartz and quartzite, grading down into a fine-grained 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) it is probable that at Tinganoo Bay there is 100 m of sediment between the base of the Bathurst Island Formation and Proterozoic basement.

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

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