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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/122

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EXPLANATORY NOTES ON THE JUNCTION BAY 1:250,000 GEOLOGICAL SHEET

Compiled by

P. Rix

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The Junction Bay Sheet area lies within the Arnhem Land Aboriginal Reserve, in the north-eastern sector of the Northern Territory. It is bounded by latitudes 11° and 12°S and by longitudes 133°30' and 135°E. Land occurs only in the southern part of the Sheet area; the remainder includes part of the Arafura Sea.

The area is uninhabited but Maningrida Settlement lies only four miles south of the Sheet boundary on the adjoining Milingimbi Sheet area. No roads or tracks exist in the area; access may be gained by sea-going vessel or, as in the case of the present survey, by helicopter. Rainfall averages about 45 inches per annum and occurs mainly during the months December to March.

Air photographs and maps covering the area are: air photographs at a scale of 1:50,000 flown by the Royal Australian Air Force in 1950; a photomosaic prepared by the Division of National Mapping, Department of National Development; and a planimetric map at 1:250,000 scale produced in 1961 by the Royal Australian Survey Corps from a controlled, photoscale, slotted template assembly. The accompanying geological map was compiled on the photoscale assembly, reduced, and transferred to a base prepared from the Survey Corps 1:250,000.

PREVIOUS INVESTIGATIONS

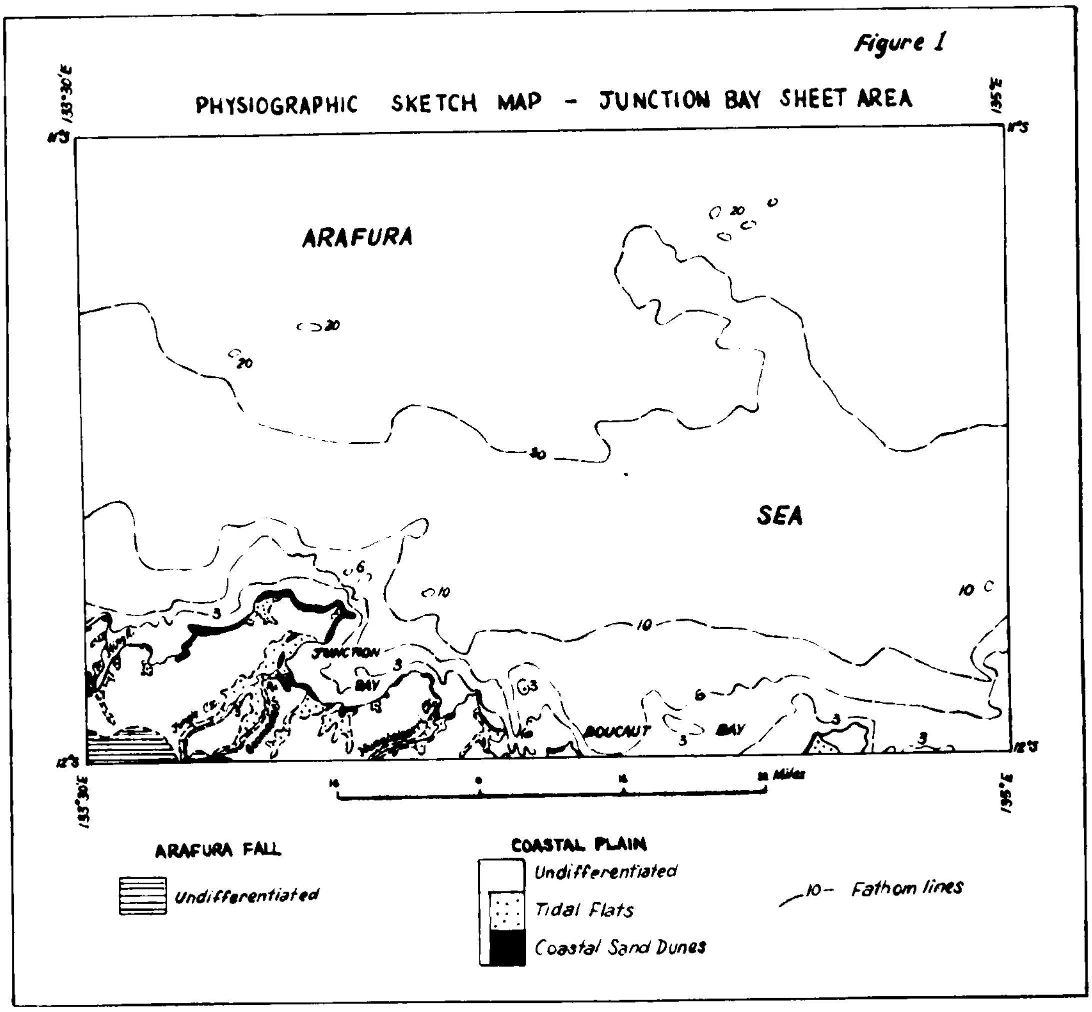
In 1867 Cadell landed in the estuary of the Liverpool River about 10 miles south of Entrance Island, and made several short journeys inland and along the coast (Cadell, 1869). He recorded a few geological observations on the Junction Bay Sheet area. Brown (1908) also recorded observations on the area during his journey along the North Coast of Arnhem Land.

The Milingimbi Sheet area (Rix, 1963) and the Wessel Islands - Truant Island Sheet area (Plumb, 1963), which adjoin the Junction Bay Sheet area, were mapped by the Bureau of Mineral Resources during 1962.

PHYSIOGRAPHY

Two major physiographic units occur on the Junction Bay Sheet area (Figure 1) - the <u>Arafura Fall</u>, a north sloping surface providing drainage to the Arafura Sea, and the <u>Coastal</u>

Plain (Roberts and Dunn, in prep.).



The Arafura Fall is restricted to the south-western part of the Sheet area. The highest point within the Fall is probably on an isolated hill capped by rocks of the Kombelgie Formation, immediately west of the King River; the hill rises to about 200 feet above sea level, but elevations in most of the Fall range between 100 and 150 feet.

The Coastal Plain dominates the physiography of the area; it extends southwards from the coast and terminates against the Arafura Fall. It comprises areas of low relief ranging in elevation from sea level to about 100 feet; laterite probably forms the bedrock to most of the Plain but younger deposits obscure it except along watercourses. Tidal Flats form part of the Coastal Plain; they occur in narrow zones along the coastline and extend up to 20 miles inland along the main watercourses. They are subject to tidal and seasonal flooding and contain fine sand, silt and evaporite deposits. Coastal Sand Dunes also occur within the Coastal Plain, being situated along the present coastline or up to a few miles inland, where they represent ancient strand lines. The form and orientation of the dunes may be partly due to wind action.

Submarine Topography:

Available bathymetric information shows that the submarine topography of the Sheet area has very little relief. The sea floor slopes gently northwards and reaches a depth of twenty fathoms between 20 and 40 miles from the shore.

Drainage: The King, Goomadeer and Liverpool Rivers enter the sea in the Sheet area, the mouth of the latter being between Gumeradji and North-East Points. The relationship of the drainage system to the outline of the coast suggests that a marine transgression occurred in Pleistocene(?) times, submerging part of the drainage system. Subsequent slight emergence of the land is indicated by the relict coastal dunes and by the incision of streams into their own alluvium.

STRATIGRAPHY

The stratigraphy of the Sheet area is summarised in Table 1. The nomenclature used will be fully defined by Roberts and Dunn (in prep.).

Age of the Units: Brown (1908) and Jensen (1914) regarded the rocks along the north coast of Arnhem Land as Permo-Carboniferous. Gray (1915) considered the basement rocks to be of Precambrian age, the sandstone of the Arnhem Land Plateau to be Permo-Carboniferous and younger strata to be Cretaceous. David (1932) showed "older Proterozoic" and Permian rocks on his geological map, while Hossfeld (1954) considered the rocks to be of Lower Proterozoic and Cambrian age.

Walpole (1963) and Dunn (1963) placed the Kombolgie Formation in the Upper Proterozoic but subsequently regarded it as Middle Proterozoic (Davenportian) in age (Walpole et al, in prep.). Dunn (1963) assigned the Nimbuwah Granite (now Nimbuwah Complex) to the Lower Proterozoic but it is now thought to be comprised of granites of two ages; the younger is referred tentatively to the Lower Proterozoic Agicondian System and the older tentatively to the Archaean.

Recent radiometric age determinations made at the Australian National University indicate a Lower Proterozoic age for regional correlates of the Kambalgie Formation (A. W. Webb, I. McDougall and J. A. Cooper, pers. comm.).

Rocks of the Wessel Group are placed tentatively in the Cambrian - because of their stratigraphic relationships and because of the presence of *Scolithus* ("pipe-rock"), which is common in (although not restricted to) the Cambrian rocks of

Central Australia.

LOWER PROTEROZOIC (AGICONDIAN SYSTEM AND ARCHAEN)

The Nimbuwah Complex extends onto the Sheet area from the Milingimbi and Alligator River Sheet areas; on the latter it was mapped as Nimbuwah Granite (Dunn, 1963). The older part of the Complex comprises porphyritic granite with a distinct gneissic fabric and contains abundant biotite knots, and hornblende; the younger part is massive, non-porphyritic and, in places, fine-grained and equigranular. Areas mapped as granite include a considerable amount of residual soil. No attempt has been made to differentiate the two granite types on the accompanying map.

LOWER PROTEROZOIC

Only one small exposure of post-Agicondian Proterozoic rocks occurs on the Sheet area. It lies to the west of King River and consists of a outlier of horizontal quartz sandstone of the Kombolgie Formation, which is exposed extensively on the adjoining Milingimbi Sheet area (Rix, 1963).

CAMBRIAN(?)

The Cambrian(?) rocks of the Sheet area were deposited in the Arafura Basin (Roberts & Dunn, in prep.), the southern margin of which follows an arcuate course across the northern part of Arnhem Land. The north-westernmost exposures of rocks deposited in the Basin occur in the Junction Bay Sheet area. The rocks dip shallowly to the north-east. Wessel Group. The exposed succession of Cambrian(?) rocks is termed the Wessel Group and has been divided into four formations. Only two of the formations are exposed in the Sheet area.

The Buckingham Bay Sandstone is the basal unit of the Cambrian(?) succession. It crops out near the Goomadeer River where it consists of massive, white, cross-bedded quartz sandstone.

The Raiwalla Shale overlies the Buckingham Bay Sandstone on the Milingimbi Sheet area (Rix, 1963), but is not exposed on the Junction Bay Sheet area due to the poorly resistant nature of the rocks.

The Marchinbar Sandstone overlies the Raiwalla Shale and crops out very close to sea level at the mouth of the Liverpool River, at Entrace Island on the east side of Rolling Bay. It is usually exposed as flat, jointed pavements overlain by laterite and, in places, by ferricrete. The Marchinbar Sandstone is overlain by the Elcho Island Formation in the Wessel Islands -

Truant Island Sheet area (Plumb, 1963), but is not exposed on the Junction Bay Sheet area, although it may underlie parts of the eastern half of the area.

LOWER CRETACEOUS

The Mullaman Beds unconformably overlie the Cambrian(?) and Precambrian rocks, and on fossil evidence (Skwarko, 1963) are placed in the Lower Cretaceous. The rocks are horizontal and usually deeply lateritized; areas where complete lateritization has occurred have been mapped as laterite.

CAINOZOIC

Cainozoic laterite, lateritic soils, and ferruginous cemented detritus (ferricrete) are widely distributed in the Sheet area. Laterite formed on a late Cretaceous or early Tertiary erosion bevel (probably a peneplain). The Cretaceous rocks were particularly susceptible to lateritic alteration and most of the existing laterite appears to have been derived from them although it may also have developed directly on rocks of the Nimbuwah Complex and Elcho Island Formation. Residual soils on laterite have been, for mapping purposes, included with laterite. Likewise, ferricrete - thought to have been derived primarily from the mechanical and chemical destruction of laterite - has been included. Exposures of ferricrete are most common along low parts of the coastline, where they may overlie downwarped laterite profiles.

Erosion and weathering subsequent to the uplift of the lateritised surface has led to the development of residual soil; the deposition of and and soil over extensive areas; and to the development of coastal sand dunes.

Riverine alluvium, coastal silt, sand, and evaporite deposits are extensive in the north-eastern part of the Sheet area. The coastal deposits have been differentiated from the normal riverine alluvium on the accompanying map.

STRUCTURE

The rocks of the Nimbuwah Complex are exposed in the south-western part of the area where they are unconformably overlain by horizontal beds of the Kombolgie Formation, the basal unit of a thick and widespread succession of sedimentary and volcanic rocks deposited in the McArthur Basin during Lower and Upper(?) Proterozoic times. Only one small exposure of the Kombolgie Formation occurs in the area; on the Milingimbi Sheet area (Rix, 1963) the McArthur Basin strata dip gently to the south-east and although faulted in places, they have, in general, been little disturbed.

Rocks of the Cambrian(?) Wessel Group were deposited in the Arafura Basin. In the Junction Bay Sheet area they rest unconformably on rocks of the Nimbuwah Complex, but to the south (Rix, 1963) they rest unconformably on rocks of the Katherine River Group (Lower Proterozoic) and to the east (Plumb, 1963; Dunnet, 1963) they unconformably overlie rocks of the Habgood Group (Lower(?) Proterozoic), and Roper and Malay Road Groups (Upper(?) Proterozoic). The strata have a slight north-easterly dip, and although minor faults have been noted at several localities no faults or folds of regional significance have been distinguished. The thickness of the exposed part of the Wessel Group is difficult to estimate, but on the Milingimbi Sheet area an assumed regional dip of 1° gives a thickness of 5,500 feet (including the Elcho Island Formation).

The Lower Cretaceous rocks are horizontal and have not been faulted.

GEOLOGICAL HISTORY

The oldest rocks in the Sheet area (the gneissic granite of the Nimbuwah Complex) suffered deformation either during its formation or subsequently, but prior to the intrusion of the Lower Proterozoic granite. The latter is thought to have been emplaced during the time of the Agicondian Orogeny in the Pine Creek Geosyncline.

Following a period of erosion of the Archaean - Lower Proterozoic terrain, regional subsidence resulted in the development of the McArthur Basin, and the deposition in it of a thick - (in places over 35,000 feet) - sequence of sediments. On the Junction Bay Sheet area only isolated remnants of the basal beds of this succession survived a period of erosion which followed the faulting and folding of the Proterozoic sediments and preceeded the development of the Arafura Basin. A succession of lutites and arenites, possibly over 5,000 feet thick, accumulated in the Arafura Basin during Cambrian(?) times.

Epeirogenic movements since the deposition of the Cambrian (?) rocks resulted in their exposure and erosion; and, in Lower Cretaceous times, to a marine incursion and deposition of the Mullaman Beds. Post Lower Cretaceous epeirogenic uplift exposed the Mullaman Beds to lateritization and further uplift initiated the present cycle of erosion. A comparatively recent (Pliestocene(?)) marine transgression, resulting in drowned topography along the coast, was followed by regression and coastal emergence in very recent times.

ECONOMIC GEOLOGY

No economic mineral occurrences are known in the Sheet area although discoveries outside the Sheet area suggest that bauxite deposits could be present. The Arafura Basin may warrant investigation as a potential site of petroleum accumulation.

Water

With the possible exception of Jungle Creek all the creeks in the area are seasonal and persist only as disconnected waterholes in the dry season.

Bauxite

Bauxite occurs extensively along the coastal districts of Arnhem Land. Silica-rich bauxite occurrences have been noted on Elcho Island (Plumb, 1963), where they are associated with laterite developed on rocks of the Elcho Island Formation. Similar types of deposit, obscured by soil, sand or alluvium may occur on the Junction Bay Sheet area.

Petroleum

Wade (1924) reported on bitumen occurrences on Elcho Island in rocks near the base of the Elcho Island Formation (see Dunnet, 1963). Until the present survey the existence of the Arafura Basin as a geologic entity was not known. Its possible Palaeozoic age, its lack of major structural deformation and the apparent marine origin of the strata it contains make the Basin worthy of investigation as a potential site of petroleum accumulation.

In August 1963 the author examined the supposedly bituminous strata on Elcho Island but was unable to confirm Wade's 1924 report. However, numerous small, flat "cakes" of pliable bitumen were found along the beaches on the west coast of the Island, but they appear to have been washed up from the sea under the influence of the north-west monsoon. The source of the bitumen is unknown.

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TABLE 1. STRATIGRAPHY OF THE JUNCTION BAY SHEET AREA

ERA	PERIOD	ROCK UNIT AND SYMBOL	LITHOLOGY	MAXIMUM THICKNESS IN FEET	PHYSIOGRAPHIC EXPRESSION	DISTRIBUTION	STRATIGRAPHIC RELATIONSHIPS AND REMARKS
CAINOZOIC	QUATERNARY	(Qa)	Unconsolidated coastal silt, sand, and evaporite deposits.	50?	Low swampy tidal flats: mangroves common.	Along coast, and inland along major watercourses.	Sediments exposed by coastal emergence. Subject to tidal and seasonal flooding.
		(Qa)	Alluvium	50?	River flats	In flood plains of drainage system.	Eroded in places since coastal emergence.
	UNDIFFERENTIATED	(Czs)	Sand	50?	Coastal dunes and bars	Along coast and up to 3 miles inland.	Form and orientation of dunes modified by winds.
		(Czs)	Sand, residual soil	50?	Plains and gentle slopes.	Extensive.	Mostly sand derived locally from erosion of sandstones.
			Laterite, lateritic soil, ferruginous cemented detritus (ferricrete)	50?	Plains and gentle slopes. Where dissected forms small scarp.	Mainly in west, but numerous exposures (ferricrete) along coast.	Laterite may be aluminous in places.
MESOZOIC	LOWER CRETACEOUS	Mullaman Beds (Klm)	Siltstone, claystone, sandstone	50?	Low lateritised hills, with small marginal scarp in places.	Small exposures in west.	Unconformably overlies rocks of Wessel Group. Contains fossils elsewhere.
				UNCONFORMITY			
PALAEOZOIC	CAMBRIAN(?)	WESSEL GROUP: Marchinbar Sandstone (Ꞓm)	Flaggy, thin-bedded, ripple-marked, cross-bedded, medium-grained, white quartz sandstone and slightly feldspathic sandstone.	800?	Moderately resistant; crops out as jointed pavements along coast.	Few small exposures along coast to east of Nungbalgarri Creek.	Conformably overlies Raiwalla Shale on the Milingimbi Sheet area (Rix 1963).
		WESSEL GROUP: Raiwalla Shale (Ꞓr)	Rocks not exposed. On the Milingimbi Sheet area (Rix, 1963) the unit consists of: fissile grey, green and purple shales, laminated, fine grained slightly dolomitic sandstone; and fissile, brown to purple siltstone.	3000?	Low, flat, soil covered areas.	Probably underlies more recent deposits in Majari Creek - Cuthbert Point District.	Conformably overlies the Buckingham Bay Sandstone on the Milingimbi Sheet area. Thickness doubtful.
		WESSEL GROUP: Buckingham Bay Sandstone (Ꞓk)	Massive, white, medium-grained, cross-bedded quartz sandstone.	500?	Forms low sand covered ridges.	Goomadeer River district.	Unconformably overlies rocks of the Nimbuwah Complex. Unconformably overlies Roper Group on Arnhem Bay Sheet area.
				UNCONFORMITY			
PRECAMBRIAN	LOWER PROTEROZOIC	KATHERINE RIVER GROUP: Kombolgie Formation (Ehk)	Massive medium to coarse-grained, white, cross-bedded, ripple-marked quartz sandstone; minor pebble conglomerate.	100+	Strongly resistant, caps small hill.	Small exposure to west of King River.	Unconformably overlies rocks of the Nimbuwah Complex (Milingimbi Sheet area)
				UNCONFORMITY			
	LOWER PROTEROZOIC (AGICONDIAN SYSTEM) & ARCHAEAN	Nimbuwah Complex (A/Egn)	Massive non-porphyritic biotite-hornblende granite; gneissic porphyritic biotite-hornblende granite.	-	Poorly resistant forms very low rises.	Very poor exposures near Goomadeer River and in south-west of Sheet area.	Areas mapped as Nimbuwah Complex include considerable areas of residual soil.

AUSTRALIA 1:250,000

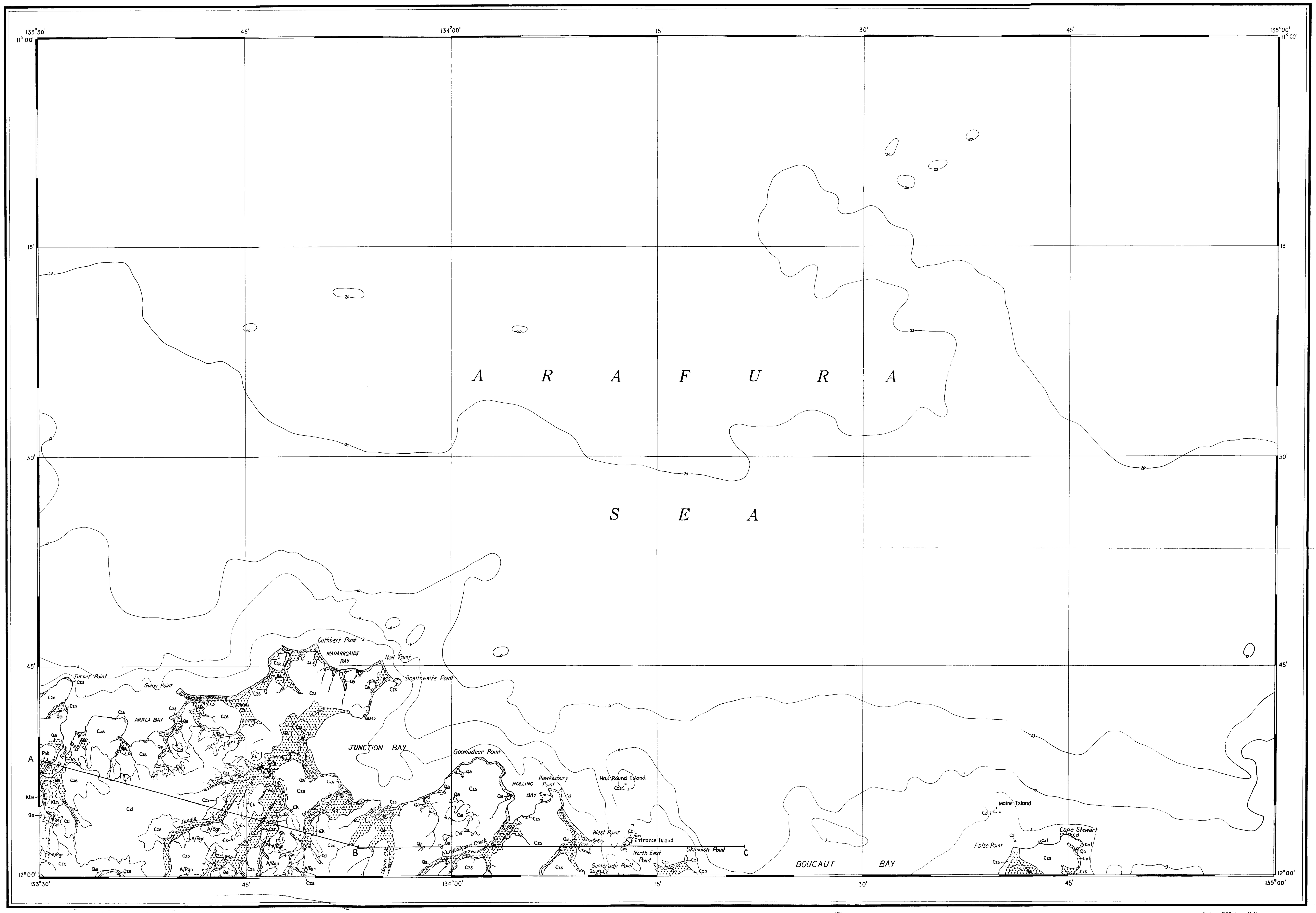
JUNCTION BAY

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SC 53-14

PRELIMINARY EDITION, 1963

SUBJECT TO AMENDMENT



Reference

CAINOZOIC	QUATERNARY			Qa (stippled)	Coastal silt, sand, evaporite deposits
				Qa	Alluvium
	UNDIFFERENTIATED			Czs (stippled)	Sand dunes
				Czs	Sand, residual soil
				Czl	Laterite, lateritic soil, ferriginous cemented detritus
MESOZOIC	LOWER CRETACEOUS		Mullaman Beds	Klm	Siltstone, claystone, sandstone
PALAEOZOIC	CAMBRIAN (?)	WESSEL GROUP	Marchinbar Sandstone.	Ꞓm	Flaggy thin-bedded quartz sandstone
			Raiwalla Shale	Ꞓr	(Section only)
			Buckingham Bay Sandstone	Ꞓk	Massive medium-grained quartz sandstone
PRECAMBRIAN	LOWER PROTEROZOIC	KATHERINE RIVER GROUP	Kombolgie Formation	Ᵽhk	Massive white quartz sandstone
	LOWER PROTEROZOIC (AGICONDIAN SYSTEM) & ARCHAEAN		Nimbuwah Complex	A/Ᵽgn	Massive and gneissic biotite-hornblende granite

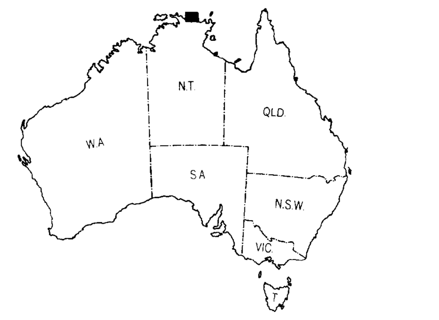
Geological boundary
Where location of boundary is approximate, line is broken

Trend lines } air-photo interpretation
Horizontal dip }

Astronomical station

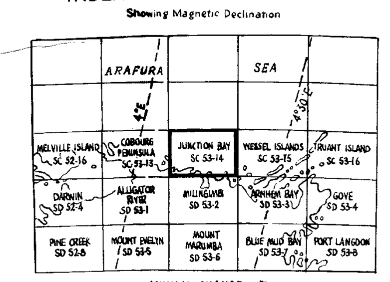
Fathom lines

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



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



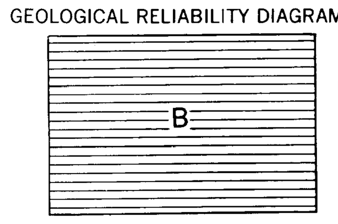
ANNUAL CHANGE 30"E

Scale 1 : 250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM

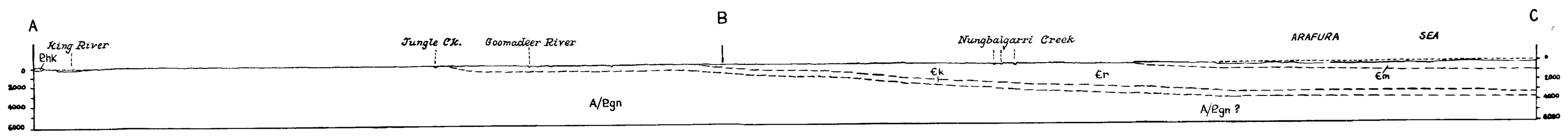


B - Reconnaisance - air-photo interpretation and helicopter traverses

Section A-B

Scale V/H = 2

(Cainozoic sediments omitted from section)



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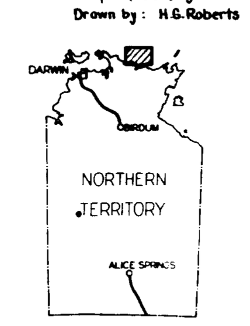
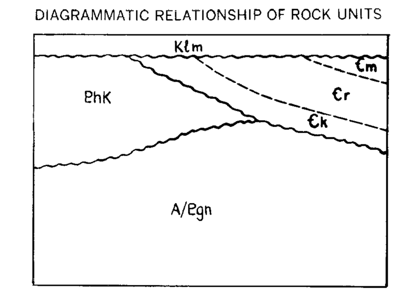
Compiled, 1963, by : H.G. Roberts
Drawn by : H.G. Roberts



DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity

JUNCTION BAY

SHEET SC 53-14

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