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A GEOPHYSICAL REVIEW OF THE CARPENTARIA, LAURA AND OLIVE RIVER BASINS

by

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SUMMARY

Recent geophysical and geological surveys in the Carpentaria, Laura, and Olive River Basins have been reviewed to assess the current knowledge of these basins and to determine the need for further seismic surveys.

The Carpentaria Basin contains Mesozoic sediments to a maximum thickness of 1200 m, and is underlain by metamorphic rocks in the east and by possible Proterozoic sediments in the west. The Laura Basin contains Mesozoic sediments to a maximum thickness of 900 m, and is considered to overlie the Hodgkinson Formation (Hodgk nson Basin). However, seismic evidence in the north of the Laura Basin indicates that several thousand metres of sediments may lie between the Mesozoic sediments of the Laura Basin and the Devonian-Carboniferous Hodgkinson Formation. The Olive River Basin has no surface expression, but the sediments here are indicated by seismic and magnetic results to be 900 m thick overlying metamorphic basement. The stratigraphy of these sediments is unknown but is probably similar to that of the Carpentaria Basin sediments.

Areas which require further geophysical exploration are the Peninsula Trough, which has been mapped solely on the basis of aeromagnetic data, and the north and northwest boundary of the Carpentaria Basin with the Morehead and Money Shoal Basins. A land seismic survey is recommended in the Laura Basin to investigate the geological section below the Mesozoic sediments. Marine seismic surveys over the boundary of the Carpentaria Basin with the Morehead and Money Shoal Basins would provide information on the relationship between these basins. A drill-hole in the Olive River Basin is recommended to determine the stratigraphic section.

1. INTRODUCTION

The previous geological and geophysical exploration in the region of Mesozoic-Cainozoic sedimentation in the Carpentaria, Laura, and Olive River Basins area has been reviewed to determine the need for further seismic work. The Carpentaria Basin covers an area of about 560 000 sq km and contains a maximim thickness of about 1200 m of Mesozoic sediments. The centre of the basin is covered by the Gulf of Carpentaria with water depths of not more than 70 m. The Laura Basin covers about 16 000 sq km onshore and an unknown area offshore, and contains 900 m of Cainozoic to Mesozoic sediments on land. The Olive River Basin is circular, about 45 km in diameter and about 1000 m deep, and has been mapped only by seismic and aeromagnetic methods. Mesozoic sediments are continuous between the Carpentaria and the Laura Basins, which are separated by a subsurface crystalline basement ridge.

Several geological and geophysical surveys have been carried out in the region, but the only economic discovery in the basins to date has been the bauxite deposits in Cretaceous?/Tertiary sediments at Weipa. The land area of the basins in northern Queensland is mainly low-lying, sparsely populated, tropical grasslands and forest. Field work is restricted in the rainy season, from December to April, which makes the rivers high and difficult to cross until mid-July, and also restricts visibility for positioning of airborne surveys. Although the Gulf of Carpentaria is shallow, frequent rough seas at all seasons hamper small boat operations there. Marine surveys on the east coast of Cape York Peninsula are restricted by numerous reefs.

2. GEOLOGY

General

The most detailed geological mapping in the Carpentaria Basin has been done by the Bureau of Mineral Resources (BMR) (Doutch, Ingram, Smart & Grimes, 1970; Doutch, Smart, Grimes, Needham & Simpson, 1972). The geology has been reviewed by Hill & Denmead (1960), Meyers (1969) and Doutch (1973). The Laura Basin was geologically reported on by de Keyser & Lucas (1968). The following is a summary of the main geological features taken from these reports and from others including that by D'Addario (1972). The main features are shown in Plate 1.

The Carpentaria Basin is bounded on the east by the igneous and metamorphic rocks of the Cape York-Oriomo Ridge, the Peninsula Ridge, and the Georgetown Inlier, on the south by the subsurface Euroka Arch (probably a crystalline basement ridge) and the metamorphic Mount Isa

Block, and on the west by the Proterozoic sediments of the McArthur Basin and by the igneous and metamorphic Arnhem Block. The northern boundary with the Morehead Basin, and the northwest boundary with the Money Shoal Basin, are both ill-defined.

The Laura Basin overlies the northern half of the Palaeozoic Hodgkinson Basin. The boundaries of the Laura Basin are the Peninsula Ridge to the west and the sediments and intrusive granites of the Hodgkinson Basin to the south and east. The offshore northern limit of the basin is unknown.

Seismic and aeromagnetic data indicate a circular depression in the crystalline basement in the west of CAPE WEYMOUTH*. This has been named the Olive River Basin. It is bounded on the east by the Peninsula Ridge and on the north, south, and west by the subsurface basement rocks, which rise to about 450 m below sea level around the basin.

The Carpentaria, Laura, and Olive River basins are penecontemporaneous as is the Eromanga Basin to the south. Mesozoic sediments are continuous from the Eromanga Basin over the Euroka Arch, across the Carpentaria Basin, and probably into the Morehead and Money Shoal Basins (Williams, Forman, & Hawkins). The borehole data indicate that the Mesozoic Gilbert River Formation extends over the basement saddle between the Coen Inlier and the Yambo Inlier into the Laura Basin. Mesozoic sediments are also continuous from the Carpentaria Basin into and across the Olive River Basin.

Stratigraphy

The stratigraphy of sediments in the basins is summarized in Table 1 which is based on data from stratigraphic drilling and surface geological mapping. The Quaternary coastal stream and other recent deposits have been omitted from this table.

The basement in the east of the Carpentaria Basin consists of Palaeozoic to Precambrian volcanics, granites, and metamorphics; in the west it consists of the Proterozoic arenite and carbonate sediments of the McArthur Basin. All these rocks have similar seismic velocities, and as there has been a large hiatus before the Jurassic Carpentaria Basin sedimentation, they are all considered as basement to the Carpentaria Basin sediments.

* Throughout this report, the names of 1:250 000 Sheet areas are written in Capital letters to distinguish them from place names.

There is about 200 m of possible pre-Jurassic glacial deposits present only in the Burketown No. 1 well in the southern part of the Carpentaria Basin. These may be of Permian or Triassic age. The Eulo Queen Group and equivalents occur only in the basement lows and in the bottom of grabens; an equivalent contains thin beds of coal at Weipa. Since the Olive River Basin lies in a basement low it is possible that Jurassic or earlier sediments are present in this area.

Shallow drilling offshore in WEIPA in an unsuccessful search for further bauxite indicates that the Cainozoic Wyaaba Beds thicken towards the centre of the Gulf (J. Smart pers. comm.). Seismic evidence supports this westward thickening.

In the Laura Basin the Breeza Plains No. 1 well bottomed in Permian sand, siltstone, and clay, and there is possibly an appreciable thickness of sediments below this. The Jurassic section in the Laura Basin is about 600 m thick, compared with about 200 m in the Carpentaria Basin.

Structure

The east-west seismic sections in the Gulf of Carpentaria (Western Geophysical Co., 1966) show numerous small faults in the basement of the Carpentaria Basin; the north-south sections show only a few. Two faults can be seen on the surface extending north from the Mount Isa Block. The east coast of Cape York Peninsula is also fault controlled in some places. A set of strong northwesterly and northeasterly lineaments is visible on airphotos of the land areas of the Carpentaria Basin (H.F. Doutch, pers. comm.).

The Carpentaria Basin is a relatively stable intracratonic platform area which has sunk gradually during and since Jurassic time, stress being relieved by the normal faulting in the basement.

The Laura Basin has undergone more active tectonism than the Carpentaria Basin, and the area is probably still active. The Palmerville Fault complex is the dominant feature in the Laura Basin and marks the west side of the Tasman Geosyncline. The Jurassic and later sediments are also present on the east of the fault and onlap the Precambrian Coen Metamorphics of the Yambo and Coen Inliers. The thickness of the Mesozoic-Cainozoic sediments in the basin is about 900 m and does not increase offshore to the north until the outer edge of the Great Barrier Reef is reached, where the basement plunges to the northeast parallel to the continental slope. Although the Mesozoic sediments are fairly flat-lying, the pre-Mesozoic section shows large dips and faulting. The latter section, especially the Hodgkinson Basin sediments, has been greatly disturbed by the tectonic movements in the Tasman Geosyncline.

3. GEOPHYSICS

Gravity

The Bouguer anomalies on the land and in the Coral Sea, and the free-air anomalies in the Gulf of Carpentaria and Coral Sea are shown in Plate 2. On land, reconnaissance gravity coverage on an 11-km grid has been obtained by BMR (Neumann, 1964; Flavelle, 1965; Shirley, in prep.; Whitworth, 1970). The Coral Sea was surveyed on a systematic line spacing of about 40 km by BMR (Mutter, 1972). The Gulf of Carpentaria was surveyed on a line spacing of about 80 km in an irregular pattern by the U.S. Naval Oceanographic Office (1967). The survey lines for the Coral Sea are shown in Plate 3 along with the magnetic traverses, and for the Gulf of Carpentaria in Plates 2 and 3.

The most significant gravity feature is the chain of positive anomalies running from CLONCURRY to ARNHEM BAY. Four areas have anomalies of more than +20 mGal. The positive anomaly in CLONCURRY and DOBBYN is caused by the denser rocks of the Carpentarian (Middle Proterozoic) Mount Isa Block. The positive anomaly extending from DONORS HILL to MORNINGTON and the positive anomaly extending from PELLEW to PORT LANGDON are both in areas covered by less dense sediments and show no correlation with surface geology. It is possible that these positive anomalies represent Lower Proterozoic basement highs marking the northeastern limit of the McArthur Basin. The positive anomaly in ARNHEM BAY is considered to be due to a large intrusive body (Whitworth, 1970) or to be associated with a block of high-grade metamorphic Lower Proterozoic rocks (K.A. Plumb, pers. comm.).

The Gulf of Carpentaria was surveyed on a wide line spacing which revealed that the broad gravity contour pattern is smooth and undisturbed. This indicates that either the sediments overlying the crystalline basement are possibly much thicker than the 1500 m of the Carpentaria Basin sediments estimated from seismic work or the crystalline basement is of a uniform nature. If the high seismic velocity (5900 m/s) measured below the Carpentaria Basin occurs in sediments then they may be of Proterozoic age equivalent to those of the McArthur Basin.

Cape York Peninsula shows a series of north-trending gravity highs separated by gravity lows. The high along the east coast seems to reflect mainly crustal thinning towards the Coral Sea. The low to the west of this is over the granitic intrusive rocks of the Peninsula Ridge and Coen Inlier. The high in the middle of the Peninsula may be related to the denser metamorphic rocks of the Peninsula Ridge. The low and high along the western coast of Cape York Peninsula occur over areas covered by Mesozoic sediments of the Carpentaria Basin and probably reflect density variations within the crystalline basement.

The small negative anomaly, of about 5 mGal, which would be produced by 400 m extra thickness of sediments in the Olive River Basin is completely masked by the positive anomaly in CAPE WEYMOUTH, which is due possibly to denser basement rocks and crustal thinning towards the ocean.

The gravity anomalies in the Laura Basin area on land show no correlation with the features of the basin. Offshore, however, the basin may extend as far north as 12°30'S where the free-air anomalies show a relative low area.

The major gravity anomalies on land reflect only the density variations in the crystalline basement and the variations in thickness of the crust and not the thickness of sediments in the Carpentaria, Olive River, and Laura Basins. The intense anomaly pattern of deeper origin obscures the relatively small contribution of up to about 15 mGal produced by about 1000 m of sediments in the basins.

Magnetic

Plate 3 shows the location of all magnetic traverses. Between 1962 and 1968 six major aeromagnetic surveys were made over the sedimentary basins in the area primarily for oil exploration (Hartman, 1962a, 1962b; Jenny, 1962, 1968; Adastra Hunting Geophysics Ltd, 1964; Marathon Petroleum Ltd, 1965). Plate 4 shows depths to magnetic basement interpreted from the results of these surveys.

The magnetic basement configuration interpreted from the Gulf of Carpentaria reconnaissance survey (Hartman, 1962b) agrees approximately with the configuration of seismic basement, except that the magnetic basement depths are greater by about 1000 m in the centre of the Gulf. The magnetic basement may represent metamorphic basement, while the seismic basement could be Proterozoic sediments. The detailed Northeast Gulf of Carpentaria Survey (Marathon Petroleum, 1965) showed three small magnetic basement lows about 30 km in diameter; one of 2100 m depth at 140°45'E, 13°30'S, one of 1800 m depth at 141°E, 11°40'S, and one of 1800 m depth at 140°45'E, 10°30'S. In this same area the regional Gulf of Carpentaria survey shows only one broad low of 3000 m depth and 80 km diameter at about 140°E, 13°S. The closer line spacing of the detailed survey resulted in measurement of details of the magnetic field which have been interpreted as being caused by smaller and shallower magnetic features. The north-south trend of the faults is somewhat similar on each survey. The depth contours in the Karumba survey area (Hartmann, 1962a) show two magnetic basement lows bounded by north-south faults. The first, in NORMANTON, is interpreted as being 3000 m deep and about 60 km in diameter, and the second in MILLUNGERA 2250 m deep and 30 km across from east to west and 90 m across from north to south. However, the metamorphic basement as found from drilling is about 250 to 800 m deep in this area, so the magnetic rocks may lie well below this.

In the area of the Olive River Basin, the depth to magnetic basement of 1200 m, and the maximum depth to seismic basement of 1000 m are in fair agreement. But, offshore to the east of the Peninsula Ridge the magnetic basement rocks have been interpreted as having almost twice the depth and dip of the seismic basement.

The preliminary total magnetic intensity contour maps for CAIRNS, MOSSMAN and WALSH have now been released by the Bureau of Mineral Resources. During 1973 BMR proposes to conduct a reconnaissance aeromagnetic survey over Cape York Peninsula and over GEORGETOWN, RED RIVER, WESTMORELAND, and CLONCURRY. The results of this survey will provide more information on the structure of the magnetic basement in these areas, which are mostly covered by sediments.

Seismic

Between 1958 and 1969 fourteen seismic surveys, as listed in Table 2, were made in the region. Plate 5 shows the location of the seismic traverses and drill holes, together with tables summarizing the refraction results. Plate 6 shows the basement depth contours drawn from all the seismic work and drilling, and in the area of the Peninsula Trough, from the magnetic information.

Plate 7 shows the time-depth curves which were used for converting the two-way reflection times to depths in the Carpentaria, Olive River, and Laura Basins. Sonic logs were run only in the three wells indicated. The thicker Jurassic section in the Laura Basin gives rise to average velocities slightly higher than in the Carpentaria Basin.

The results of the seismic surveys in the Carpentaria Basin show that the basement for Mesozoic sediments dips gently to a maximum depth of about 1500 m in the centre of the Gulf of Carpentaria. Several minor faults in the basement can be seen on the reflection sections. Both the BMR Carpentaria Basin survey (Robertson & Moss, 1959) and the Mid-Eastern Oil Karumba survey (Warner, 1963) recorded only two refracting layers: a layer with average vertical velocity about 2100 m/s (sediments) overlying a refraction with velocity about 5750 m/s assumed to represent basement. The low velocity of the sediments would imply that they are young (Cretaceous-Tertiary). The BMR survey found no correlation between the seismic basement topography and the positive gravity anomalies in GALBRAITH. On the land area of the Carpentaria Basin, the basement depths from refraction, reflection, and drilling all agree.

The results from the Archer River survey (Compagnie Generale de Geophysique, 1965) show a layer of V = 2600 m/s overlying a refractor of V = 5100 m/s to 6000 m/s. This refractor, which also corresponds to a good reflector, deepens gradually to the west and ties in with the top of the metamorphic rocks at Weipa No. 1 well. As shown on the east-west cross-section across the Carpentaria Basin (Plate 8), the seismic basement from the Marathon ATP 58P survey (Western Geophysical Co., 1966) would project eastwards to tie with the metamorphic basement at Weipa No. 1 well only if the average velocity of the sediments is assumed to decrease westward. This decrease is supported by t: t analysis of the Marathon seismic records. There is also geological support for this change in average velocity since the lower-velocity Cainozoic Wyaaba Beds are reported to thicken gradually offshore, whereas the Mesozoic section may not. A 2300 m/s refractor at 300 m depth in the centre of the Gulf may mark the Cainozoic/Mesozoic boundary.

The Cape Arnhem survey (Western Geophysical Co., 1964a) recorded poor discontinuous reflections. First-arrival analysis shows only two refracting layers here also (V_1 = 2000 m/s, V_2 = 5950 m/s).

The Marathon ATP 104P survey (Western Geophysical Co., 1964b) recorded one fairly continuous reflecting horizon, considered to be seismic basement, which dips, with minor folds and faults, from 600 m depth in the east of the survey area to 1200 m in the west.

The basement depth contours in the area of the Morehead Basin, northeast of the Carpentaria Basin, are a composite of several different interpretations (Meyers, 1969; Stach, 1964; Geological Society of Australia, 1971, Jenkins, 1970; Grund, 1971). The seismic surveys in the east Torres Strait area (Tenneco Australia Inc., 1967; Vetters, 1968; Texaco Overseas

Petroleum Co., 1969), which covers the shelf bordering the southwest limb of the Papuan Geosyncline, indicate that the sediments thicken from the crystalline basement outcrop on Cape York to about 4000 m estimated at Anchor Cay No. 1. No deep reflection corresponding to the basement has been recorded here, but several events within the Mesozoic have been mapped and the aeromagnetic data were used to obtain basement depths. A large fault, downthrown to the northeast, traverses the area in a southeasterly direction; some interpretations show a complex fault system in the area.

The Torres Strait and Princess Charlotte Bay survey (Western Geophysical Co., 1965) did not record a reliable reflection from the crystalline basement in the area of the Peninsula Trough, and the basement in this area has been mapped only on the basis of aeromagnetic data. The best-quality reflections along the east coast occur on the seismic sections obtained by the Offshore Laura Basin Survey (Jessop, 1969). The deepest reflection here correlates with a refractor of 5750 m/s which may represent crystalline basement. The basement depth contours plotted from this survey are parallel to the coast.

The Marina Plains (Burke, Harwood & Vind, 1963) and Breeza Plains (United Geophysical Co., 1969) seismic surveys in the Laura Basin area recorded a good reflection, which correlates with a refractor of velocity 4000 m/s, from a horizon estimated to be near the top of the Jurassic Dalrymple Sandstone. This reflector occurs at about 740 m depth and is flat-lying throughout most of the survey area, rising to 400 m at the east and west margins. About 600 m below the Jurassic reflector, seismic sections show an angular unconformity below which the reflections dip westward to a maximum depth of 8000 m at the Palmerville Fault. These reflections are fairly continuous and may represent sediments.

The three exploration wells in the Laura Basin reached the following formations:

Marina Plains No. 1	Basalt	at 1130 m
Breeza Plains No. 1	Permian sandstones etc.	at 933 m
Lakefield No. 1	Granite	at 921 m

On this information the metamorphic basement was mapped at about 900 m in the deepest part of the onshore basin area (Plate 6). The survey in Princess Charlotte Bay (McCutchen, 1969) did not record any seismic reflections; a refraction probe, however, recorded a velocity of 5592 m/s at 912 m; this could represent metamorphic basement.

Marine refraction profiles off the east coast of Cape York Peninsula (Western Geophysical Co., 1965) recorded a refractor with velocity of about 4500 m/s at a depth of 500 m to 900 m, and another of velocity 5600 m/s about 400 m deeper. The first refractor could represent the top of lower Jurassic or Permian sediments, and the lower refractor possibly metamorphic basement.

4. INTERPRETED CROSS-SECTIONS

Plates 8 and 9 are interpreted cross-sections across the Carpentaria Basin; their locations are shown in Plate 1. The east-west cross-section (Plate 8) is based on surface geology, the data from Weipa No. 1 well, and several seismic lines as marked. It crosses the centre of the basin just north of the deepest point. The main feature of this section is the gentle dips of the basement surface and the outcropping granite masses, of different ages, which define the two edges of the basin. The correlation of the bottom of the Cainozoic sediments with the shallow refractors in the centre of the Gulf is uncertain. The north-south cross-section (Plate 9) is based on data from four wells but only one seismic line. The interesting feature here is the thinning of the Cretaceous sedimentary section over the Cape York-Oriomo Ridge, and the continuation of the sediments into the Morehead Basin. The lithology of the sediments in the Morehead and Weipa wells is very similar, although at present they have different formation names. Thus, on the basis of meagre seismic evidence the Carpentaria Basin Mesozoic sediments seem to join over the subsurface flank of the Cape York-Oriomo Ridge with the Morehead Basin sediments on the north.

5. CONCLUSIONS AND RECOMMENDATIONS

Aeromagnetic data give greater basement depths than the seismic data in most areas, and in places, such as the Karumba survey area, they give anomalous results. The gravity features are caused mainly by density contrasts within the basement rocks, and anomalies due to the varying sedimentary thickness are observed.

Seismic and drilling data in the Carpentaria Basin have defined its general shape and the age and maximum thickness of sediments. However, more subsurface information is necessary, particularly along its boundaries with the Money Shoal and Morehead Basins.

The offshore part of the Laura Basin is ill defined as the seismic results in Princess Charlotte Bay are very poor. Onshore, it is uncertain if the metamorphic basement to the Laura Basin is relatively flat-lying at 900 m depth, or if the deeper reflections indicate that sediments of Triassic age and older occur to depths of several thousand metres.

Seismic and aeromagnetic results indicate the existence of the Olive River Basin, but the stratigraphy of the sediments there is unknown. The Peninsula Trough is mapped solely on aeromagnetic data since the nearest offshore seismic survey did not record a reliable basement reflection.

No immediate seismic work is recommended on the land area of the Carpentaria Basin since the general structure of the sediments and metamorphic basement is known. However, deep drill-holes on the east side of the Basin to extend knowledge of the stratigraphic details from the numerous wells in the BURKETOWN/MORNINGTON area are recommended; the results of these may indicate a need for further seismic work. Marine seismic surveys would provide useful information on the boundary of the Carpentaria Basin with the Money Shoal and Morehead Basins.

A land seismic survey is recommended in the Laura Basin to investigate the geological section below the Jurassic sediments; prospective hydrocarbon-bearing sediments could occur here. This survey could take the form of one multiple-coverage CDP reflection traverse passing through one of the wells in a northwesterly direction, which is the dip direction of the previously observed deep reflections. Combined with refraction probes this traverse could investigate the extent and nature of these deep seismic events.

A stratigraphic drill-hole in the Olive River Basin is recommended; this may indicate the need for a later seismic survey. This basin may contain coal in the Jurassic Eulo Queen Group equivalent.

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STRATIGRAPHIC CORRELATION BETWEEN CARPENTARIA AND LAURA BASINS

TABLE 1 - (after Doutch et al. 1972)

Era	Period	Rock unit in Carpentaria Basin	Symbol	Thickness(m)*	Lithology and comments	Laura Basin equivalent
Cainozoic	Quaternary to Tertiary	Wyaaba Beds	Czy	10	Poorly sorted grey clayey quartzose sand, sandstone, and granule gravel and conglomerate, commonly pebbly; claystone. Overlies KT disconformably.	Lilyvale Fm or Briston Fm
	Late Cretaceous or Tertiary	Bulimba Formation	KTi	10	Poorly sorted clayey quartzose sandstone and granule conglomerate pebbly in places; interbedded sandy claystone. Overlies Kln unconformably. Surface "lateritized". (Bauxitized at Weipa).	
Mesozoic	Early Cretaceous	Rolling Downs Group Klr: Normanton Formation	Kln	400	Sandy clayey siltstone, silty mudstone, minor limestone and sandstone. Conformably overlies Kla	Wolena Claystone?
		Rolling Downs Group Klr: Allaru Mudstone	Kla		Shale, mudstone, some siltstone, limestone. Conformably overlies Klo. Marine	Wolena Claystone
		Rolling Downs Group Klr: Toolebuc Limestone	Klo	10	Calcareous shale, limestone. Conformably overlies Klu. Marine only present in south. Contains oil shale.	
		Rolling Downs Group Klr: Wallumbilla Formation	Kla	240	Mudstone, some siltstone, minor limestone, some glauconite. Conformably overlies JKg. Marine	"Battle Camp shale"
	Late Jurassic to early Cretaceous	Gilbert River Formation	JKg	100	Clayey quartzose sandstone, glauconite in upper part. (Unconformably overlies basement rocks in places.)	Battle Camp Sandstone
	Jurassic	Eulo Queen Group Jue: Loth Formation	Jul	50	Soft clayey sandstone, minor siltstone. Continental. Conformable on Jh. (Unconformable on basement rocks in places)	Dalrymple Sandstone
		Eulo Queen Group Jue: Hampstead Sandstone	Jh	50	Coarse quartzose sandstone, pebbly sandstone and conglomerate. Continental	" "
		unnamed			Unnamed sandstones	unnamed
Mesozoic - Palaeozoic	Permian or Triassic	unnamed			Possible glacial or tilloid sediments in Burketown 1 well. Possible sediments in Laura Basin	unnamed
Palaeozoic & Precambrian					Various metamorphics, metasediments, intrusive igneous rocks, sediments(?) Basement to Carpentaria, Laura** and Gilve River Basins.	

* The thickness is an approximate average of the sections measured at Weipa, Burketown, and Karumba wells. It is intended only as a guide and will generally be greater in the centre of the basin.

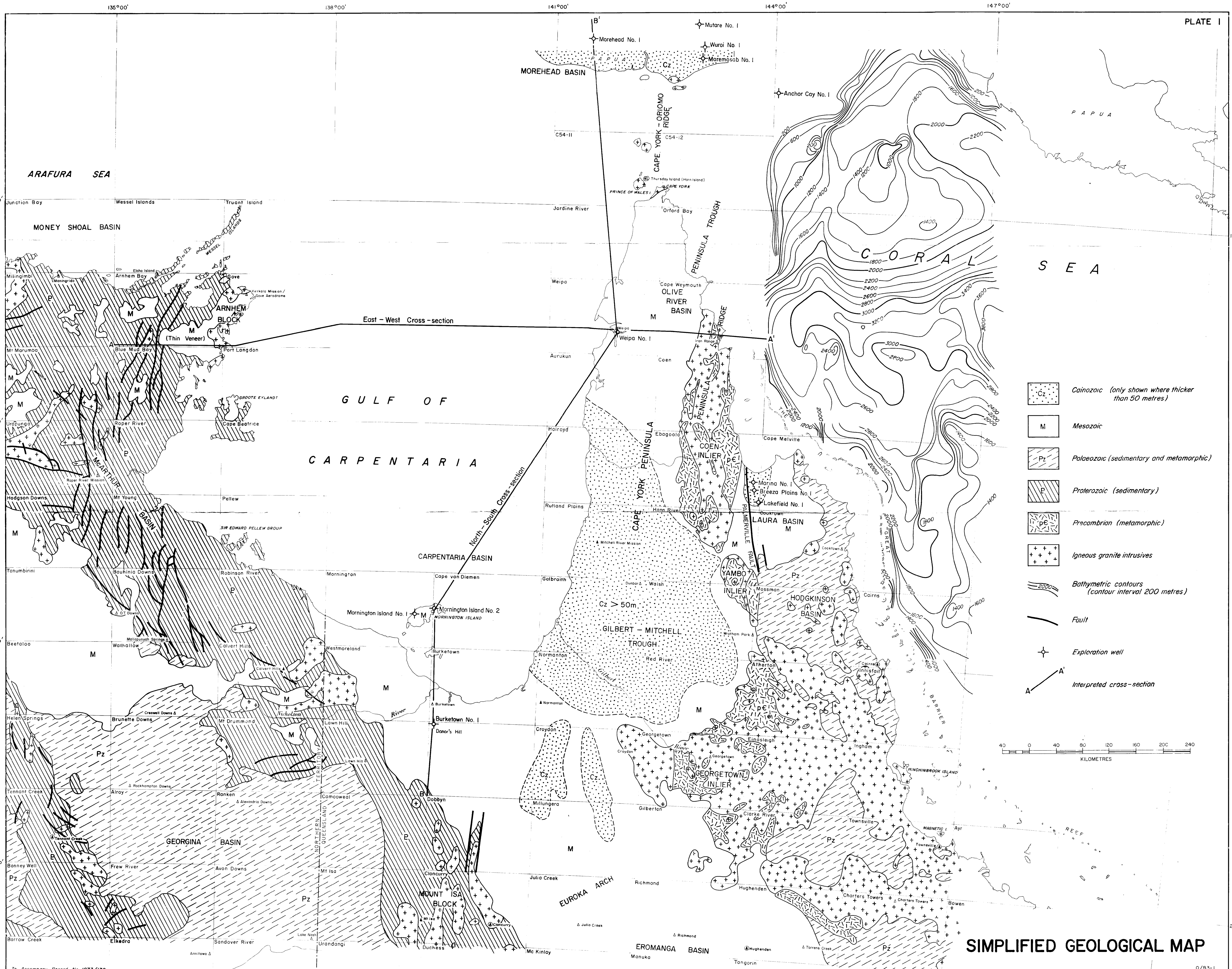
** The basement to the Laura Basin may include the Palaeozoic sediments of the Hodgkinson Basin.

SUMMARY OF SEISMIC SURVEYS MADE IN THE REGION

TABLE 2

Date	Survey name	Reference	Subsidy Report No.	Survey Type	Dynamite Charge size	Charge Depth	Multiplicity of Coverage	Spread layout	Geophone array	Instruments	Reflection Quality	Additional Comments
July-Dec1958	Carpentaria Basin	Robertson and Moss (1959)	BMR Record No. 1959/4	Land refraction and reflection	10 Kg	10-17m	Isolated probes	405-0-405m	6 in line at 7m	Analog	Fair	Notrecorded on magnetic tape section displayed on wiggletrace only
May-Aug 1963	Karumba	Warner (1963)	63/1520	Land refraction and reflection	2½ Kg	10-30m	Single coverage	405-0-405m	8in line at 10m	Analog	Fair/good	
June-Oct 1963	Marina Plains	Burke et al.(1963)	63/1517	Land detailed reflection	10 Kg	26m	Single coverage	405-0-405m	12 or 18 at 5m	Analog	Fair	
May 1964	Cape Arnhem	Western Geophysical (1964a)	64/4526	Marine reconnaissance	7½-11Kg	2m	2-fold	1200-0-1200m	2 at 2m	Analog	Very poor	
Nov 1964	A.T.P. 104P.	Western Geophysical (1964b)	64/4554	Marine detailed	22 Kg	2m	3-fold	1200-0-1200m	2 at 20m	Analog	Fair/poor	Multiples present
May-July 1965	Torres Strait and Princess Charlotte Bay	Western Geophysical (1965)	65/4599	Marine reconnaissance	15 Kg	2m	6-fold	1200-0-1200m	4 at 12m	Analog	Poor	
July-Oct 1965	Archer River	C.G.G. (1965)	65/11019	Land refraction and reflection	55 Kg in pattern of 60 holes	3m	Single coverage	600-0-600m	36 in 3 lines	Analog	Fair	
July-Sept 1966	Northern Great Barrier Reef	Tenneco (1967)	66/11086	Marine reconnaissance	15 Kg	2m	3-fold	824-0-824m	12 at 3m	Digital	Poor/Fair	
Oct-Dec 1966	A.T.P. 58P.	Western Geophysical (1966)	66/11123	Marine reconnaissance	15 Kg	2m	3-fold	1200-0-1200m	4 at 12m	Digital	Fair	
Dec67-April68	Triangle Reef	Vetters (1968)	68/3008	Marine detailed	15-22Kg	2m	6-fold	580-0-580m	4 at 12.5m	Binary gain (Digital)	Very good	Lines not shown on map
July 1969	Offshore Laura Basin	Jessop (1969)	69/3041	Marine detailed	(Air gun)	-	6-fold	0-1220m	4 at 10m	Binary gain (Digital)	Fair	
Aug 1969	Princess Charlotte Bay	McCutchen (1969)	69/3047	Marine detailed	(Air gun)	-	6-fold	0-1220m	4 at 10m	Binary gain (Digital)	Poor	
Sept 1969	Pearce Cay	Texaco (1969)	69/3024	Marine detailed	(Air gun)	-	6-fold	0-1600m	4 at 23m	Binary gain (Digital)	Very good	Lines not shown on map
Sept-Oct 1969	Breeza Plains	United Geophysical (1969)	69/3059	Land detailed reflection	2½-5Kg	17-21m	Single coverage	405-0-405m	12 at 3m	Analog	Fair	

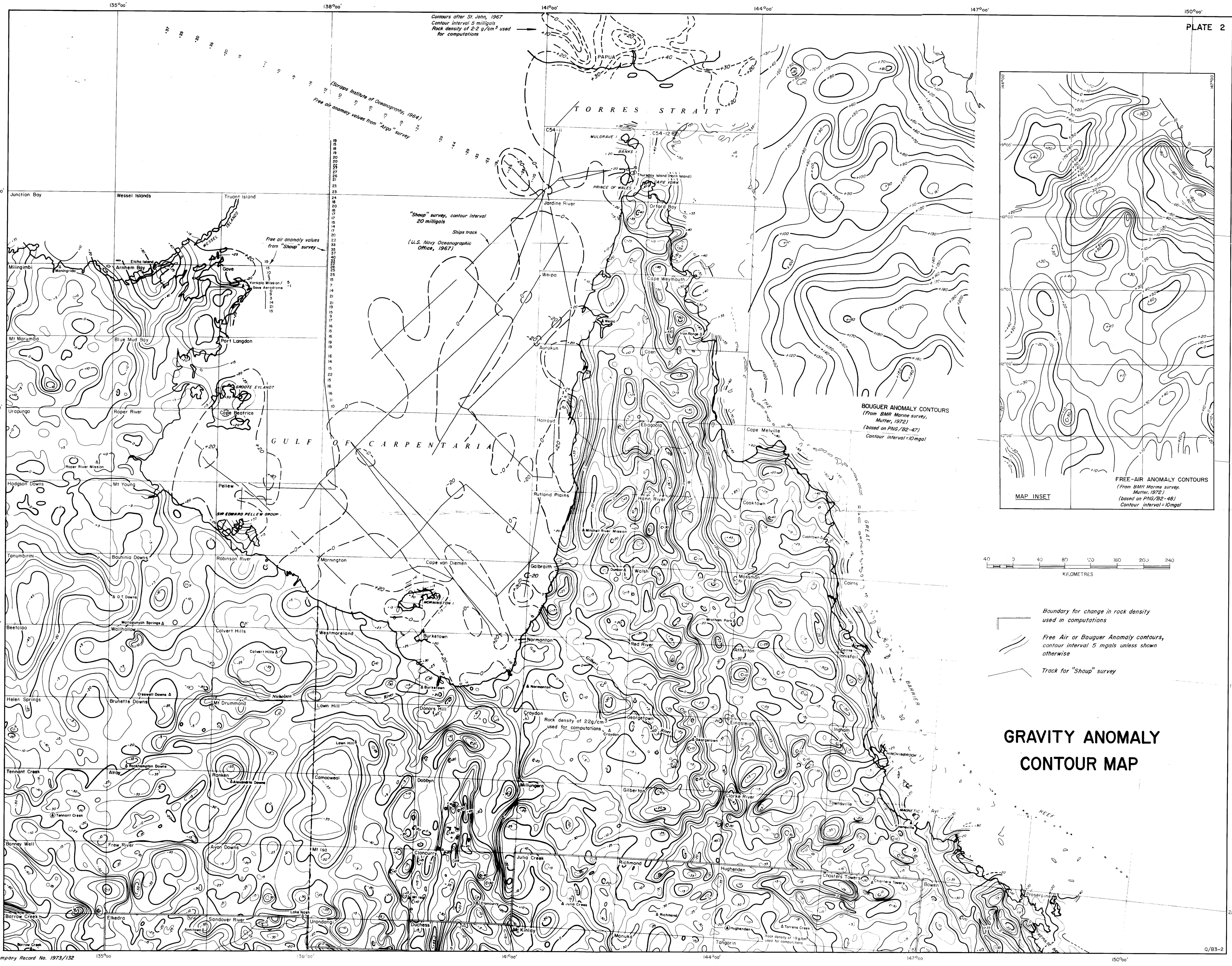
PLATE 1



SIMPLIFIED GEOLOGICAL MAP

To Accompany Record No. 1973/132

Q/B3-1



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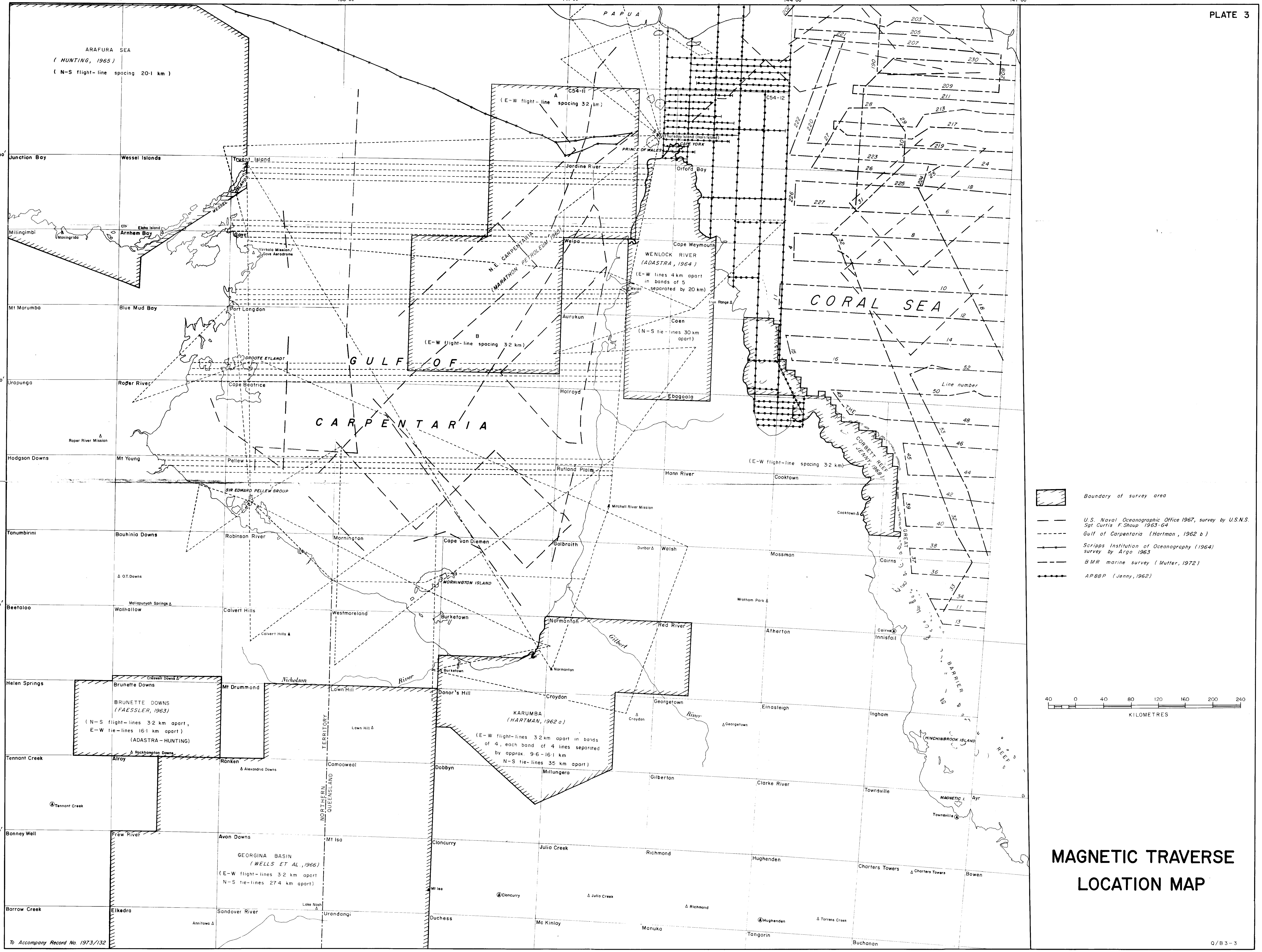


MAGNETIC TRAVERSE LOCATION MAP

To Accompany Record No. 1973/132

Q/B3-3

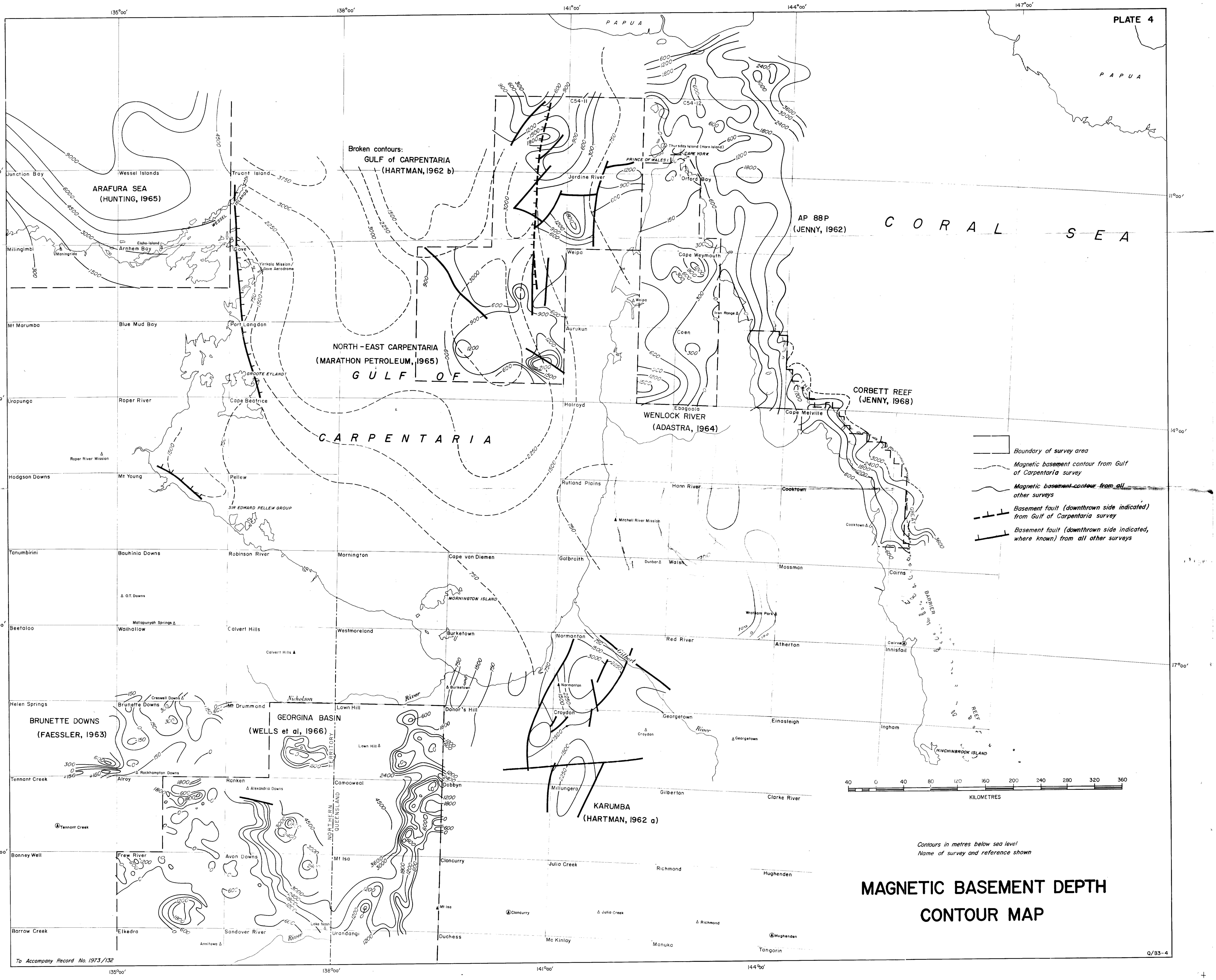
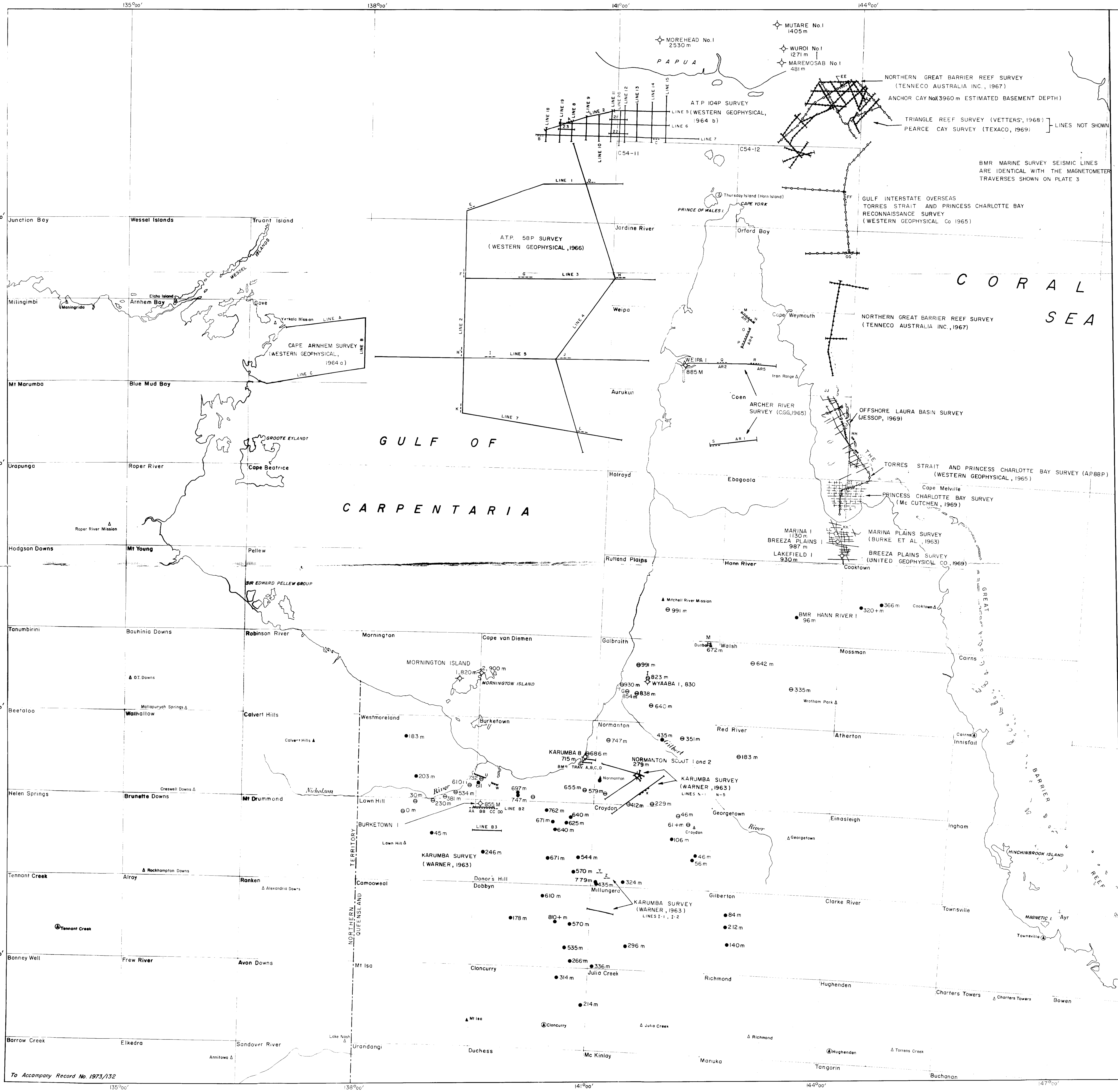


PLATE 4
MAGNETIC BASEMENT DEPTH
CONTOUR MAP
Contours in metres below sea level
Name of survey and reference shown
Boundary of survey area
Magnetic basement contour from Gulf of Carpentaria survey
Magnetic basement contour from all other surveys
Basement fault (downthrown side indicated) from Gulf of Carpentaria survey
Basement fault (downthrown side indicated, where known) from all other surveys
KILOMETRES
ARAFURA SEA
(HUNTING, 1965)
Broken contours:
GULF of CARPENTARIA
(HARTMAN, 1962 b)
NORTH-EAST CARPENTARIA
(MARATHON PETROLEUM, 1965)
GULF OF CARPENTARIA
AP 88P
(JENNY, 1962)
CORAL SEA
CORBETT REEF
(JENNY, 1968)
WENLOCK RIVER
(ADASTRA, 1964)
BRUNETTE DOWNS
(FAESSLER, 1963)
GEORGINA BASIN
(WELLS et al, 1966)
KARUMBA
(HARTMAN, 1962 a)
C54-11
C54-12
PAPUA
NORTHERN TERRITORY
QUEENSLAND
GREAT BARRIER REEF
135°00′
138°00′
141°00′
144°00′
147°00′
11°00′
14°00′
17°00′
20°00′
To Accompany Record No. 1973/132
Q/B3-4



REFRACTION RESULTS

A.T.P. 104P SURVEY

PROFILE	Vo	V1	Z1	V4	Z4	V4A	Z4A
A	1740	2610	210	5620	1480	6450	1600
B	1690	2730	280	5660	1770	6230	1890
C	1710	2390	90	5630	670	6200	780

A.T.P. 58P SURVEY

PROFILE	Vo	V1	Z1	V4	Z4
D	1680	2370	130	5740	1230
E	1660	2550	310	6940	1380
F	1680	2500	280	5810	1220
G	1670	2370	240	6420	1080
H	1720	2510	310	5660	1020
H'	1820	2520	310	5370	1540
I	1590	2330	390	5940	1510
J	1680	2120	250	5850	1480
K	1610	2260	240	6060	1460
L	1680	2360	350	5980	1590

BMR CARPENTARIA BASIN SURVEY

For all probes, $V_1 = 2140$ m/s, $V_4 = 5500$ m/s

The depth to basement is shown next to each probe

ARCHER RIVER SURVEY

PROFILE	V1	V4	Z4
M		5850	550
N		5850	1000
O		6000	300
P		5400	500
Q		5750	550
R		5700	300
S	2600	5100	600

KARUMBA SURVEY

PROFILE	V4	Z4
T	5800	650
U	6000	690
V	6030	760
W	5780	785
X	5900	325
Y	5880	470
Z	5990	370
AA	6190	620
BB	5660	570
CC	5690	623
DD	5930	594

TORRES STRAIT AND PRINCESS CHARLOTTE BAY SURVEY

PROFILE	Vo	V1	Z1	V2	Z2	V3	Z3	V4	Z4
EE		2637	404	3452	625	4503	840	—	—
FF		2390	94	3109	383	4497	900	—	—
GG		2786	236	—	—	4557	570	5410	945
HH		2571	58	—	—	—	—	5670	693
II		—	—	3530	320	4600	530	5592	912

MARATHON OIL MARINA PLAINS SURVEY

PROFILE	Vo	V1	Z1	V2	Z2	V3	Z3	V3A	Z3A	V4	Z4
KK	2134	2503	68	3540	160	—	—	3976	600	5454	1400
LL	2134	2552	34	3600	200	3802	370	4180	850	5945	2050

OFFSHORE LAURA BASIN SURVEY

PROFILE	Vo	V1	Z1	V4	Z4
JJ	2290	2740	400	5750	685

V_0 = *Near surface velocity*
V_1 = *Shallow refractor velocity*
V_2, V_3 = *Intermediate refractor velocity*
V_4 = *Basement refractor velocity*
V_{4A} = *Alternative basement refractor velocity*
— *in metres/sec*
(Z) *Depths in metres*

LEGEND

- *Seismic refraction line*
- *Seismic reflection lines*
- *Exploration well*
- *BMR refraction depth probe (Robertson and Moss, 1958)*
- *Water bore*
- *Refraction profile (results in table above)*

40 0 40 80 120 160 200 240
KILOMETRES

SEISMIC SURVEY AND DRILLING LOCATION MAP

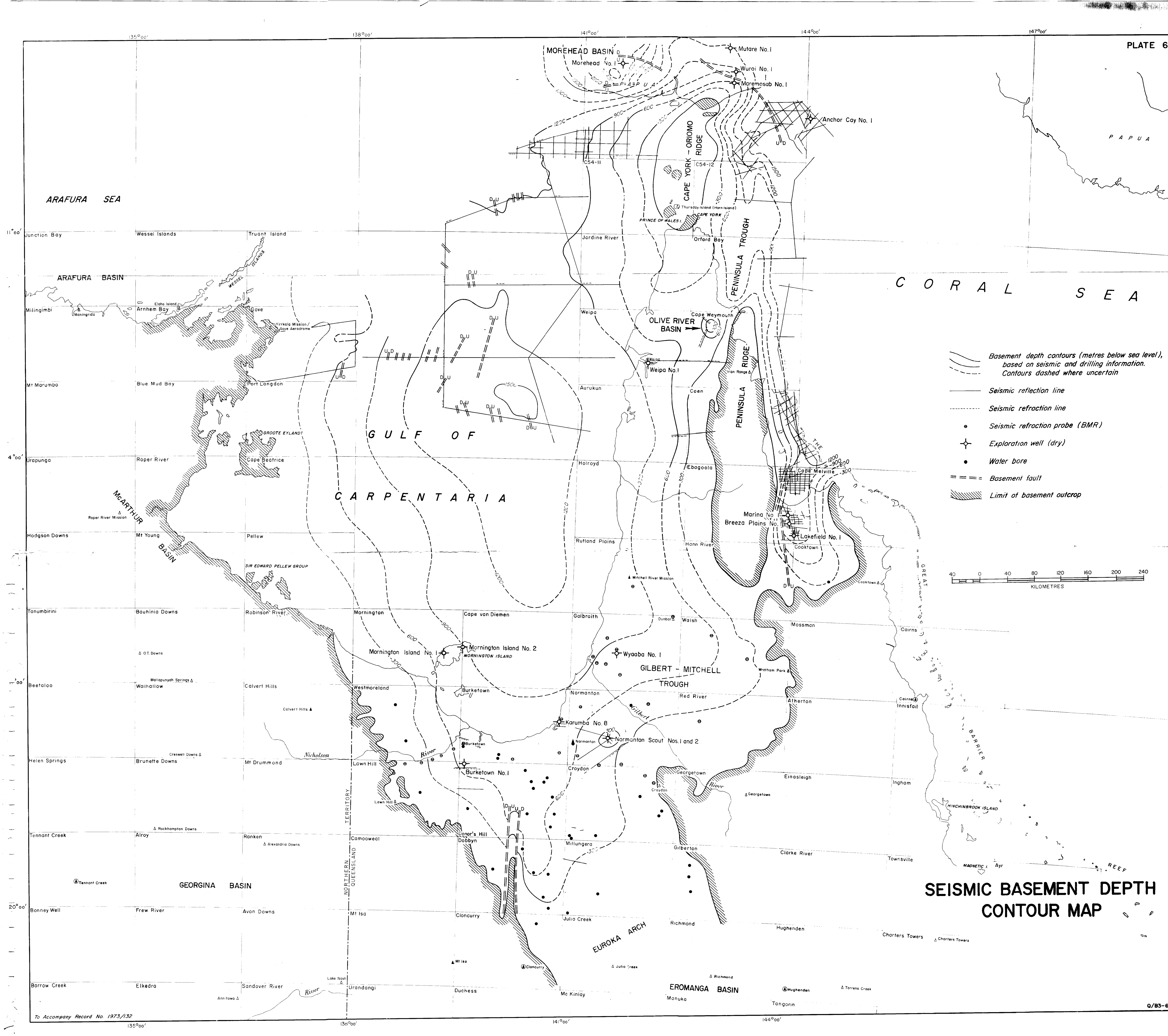
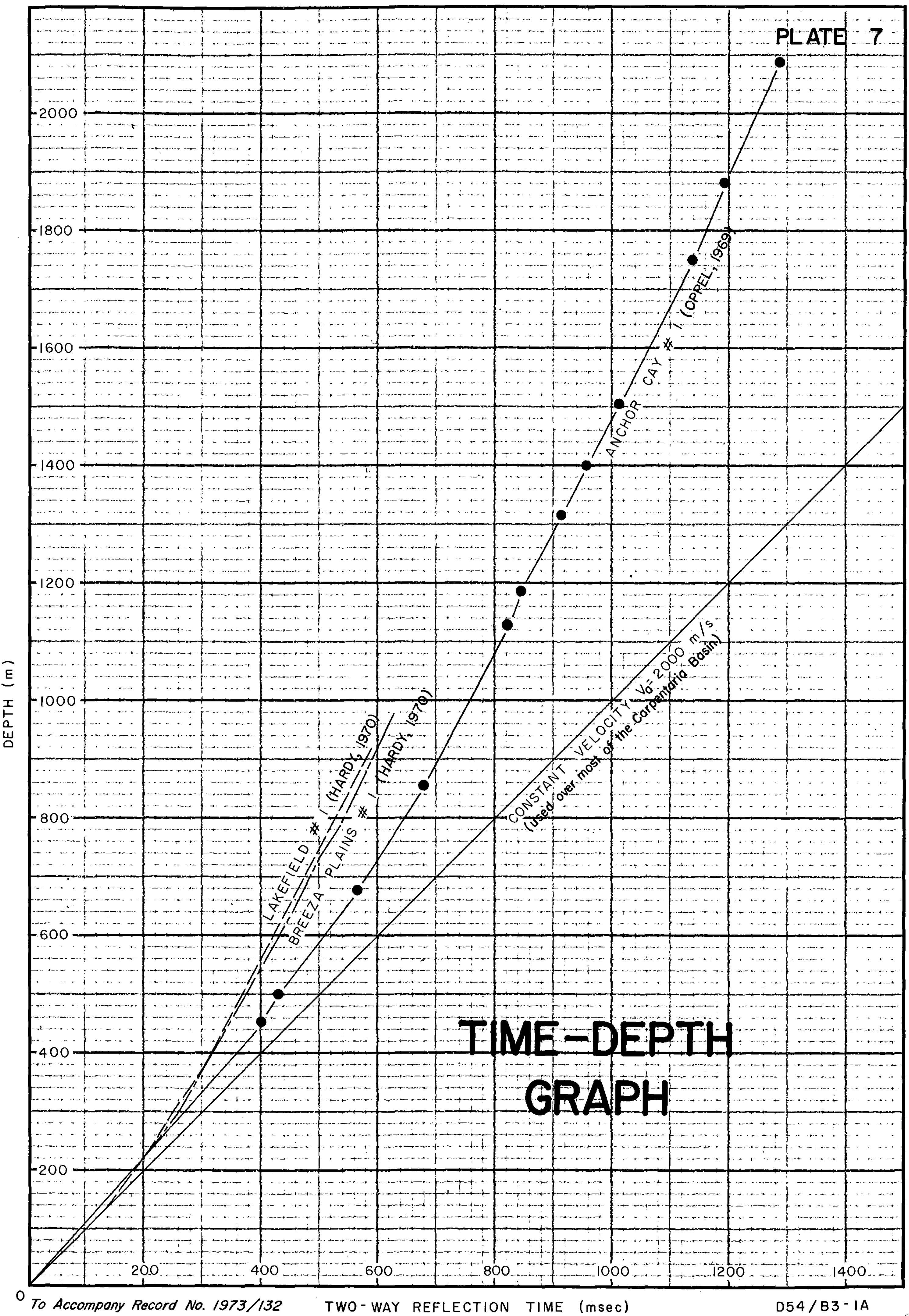


PLATE 6
SEISMIC BASEMENT DEPTH CONTOUR MAP
Basement depth contours (metres below sea level), based on seismic and drilling information. Contours dashed where uncertain
Seismic reflection line
Seismic refraction line
Seismic refraction probe (BMR)
Exploration well (dry)
Water bore
Basement fault
Limit of basement outcrop
KILOMETRES
40 0 40 80 120 160 200 240
ARAFURA SEA
ARAFURA BASIN
GULF OF CARPENTARIA
CORAL SEA
PAPUA
MOREHEAD BASIN
Morehead No. 1
Mutare No. 1
Wuroi No. 1
Maremosab No. 1
Anchor Cay No. 1
CAPE YORK - ORIOMO RIDGE
PENINSULA TROUGH
PENINSULA RIDGE
OLIVE RIVER BASIN
Weipa No. 1
McARTHUR BASIN
GILBERT - MITCHELL TROUGH
Wyaaba No. 1
Mornington Island No. 1
Mornington Island No. 2
Karumba No. 8
Normanton Scout Nos. 1 and 2
Burketown No. 1
Marina No. 1
Breeza Plains No. 1
Lakefield No. 1
GEORGINA BASIN
EUROKA ARCH
EROMANGA BASIN
NORTHERN TERRITORY
QUEENSLAND
GREAT BARRIER REEF
To Accompany Record No. 1973/132
Q/B3-6



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EAST–WEST CROSS-SECTION ACROSS THE CARPENTARIA BASIN

To Accompany Record No 1973/132

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NORTH-SOUTH CROSS-SECTION OF THE CARPENTARIA BASIN

To Accompany Record No. 1973/132

G/83-8