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CAPE YORK PENINSULA AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, 1973

PRE-SURVEY REPORT

by

K. Horsfall

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SUMMARY

A magnetic and radiometric survey of the Cape York Peninsula will be flown by the Bureau of Mineral Resources commencing in 1973. The area to be covered extends north of latitude 15° and includes part of the Great Barrier Reef and Torres Strait Islands.

This Record describes the known geology, previous geophysical work, and the main objectives of the survey.

1. INTRODUCTION

The Bureau of Mineral Resources (BMR) proposes to conduct a regional airborne magnetic and radiometric survey over the northern part of Cape York Peninsula and the Torres Strait Islands. The area to be surveyed is covered by the 1:250 000 map sheets of CAPE MELVILLE* (part only), EBAGOOLA, HOLROYD, AURUKUN, COEN (part only), CAPE WEYMOUTH (part only), WEIPA, JARDINE RIVER (part only), ORFORD BAY (part only), and TORRES STRAIT (part only).

The survey was requested by the Geological Branch (BMR) and the Geological Survey of Queensland (GSQ) to aid further geological mapping of the region. At present BMR and GSQ are mapping the sedimentary area to the west covered by part of the Carpentaria Basin (Plate 2).

Cape York Peninsula consists of a northerly trending axis of high ranges and plateaux, flanked by plains underlain by flat-lying sediments of the Carpentaria and Laura Basins. The axis is near the eastern side of the Peninsula and continues below the sea at Temple Bay. It is composed predominantly of pre-Mesozoic igneous and metamorphic rocks, although high plateaux of Mesozoic sediments form part of the axis in the north. The axis has low relief in the south, but east of Coen it rises to 800 m before sloping down to about 250 m north of Iron Range. Exposures of the Palaeozoic sediments of the Hodgkinson Basin give rise to mountain ranges reaching 600 m above sea level bordering the east of the Laura Basin.

The islands in the western part of Torres Strait are the peaks of a drowned ridge of pre-Mesozoic igneous rocks, which extends from Cape York to the Papuan coast. The ridge lies to the west of the northern continuation of the Peninsula, and is separated from it by a trough of Mesozoic sediments.

The survey flight-lines will be nominally east-west and spaced at 1.5 km over the igneous and metamorphic Peninsula Ridge and adjacent sea area, 3 km over the onshore basin areas, and 6 km for the remaining offshore work. A fluxgate magnetometer and 4-channel gamma-ray spectrometer will be operated.

2. GEOLOGY

The geology of the metamorphic and igneous areas of Cape York Peninsula and the Torres Strait Islands has been described by Willmott, Whitaker, Palfreyman & Trail (1973). This work and the accompanying

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* Throughout this Record the names of 1:250 000 Sheet areas will be written in capitals to distinguish them from ordinary place names.

1:500 000 Geological Series Sheet (Plate 6) constitute the main source of geological information for this part of the survey.

Geology of the relevant parts of the Laura and Hodgkinson Basins is described in the Explanatory Notes accompanying the CAPE MELVILLE 1:250 000 Geological Series map. Information on the Carpentaria Basin is mostly taken from Doutch (1972), and from discussions with geologists working in the area (Doutch, pers. comm.).

Available 1:250 000 geological mapping is as follows: CAPE MELVILLE sheet exists as a final edition; metamorphic and igneous areas of EBAGOOLA, COEN, CAPE WEYMOUTH, ORFORD BAY, and TORRES STRAIT Sheets exist as preliminary editions, while the remainder are at compilation stage.

In this Record the geology will be described in three main divisions:

1) Peninsula Ridge and Torres Strait
2) Laura and Hodgkinson Basins
3) Carpentaria Basin

The regional geology is displayed in Plate 2.

Peninsula Ridge and Torres Strait

The Peninsula Ridge forms the axis of the Cape York Peninsula and is composed of a north trending sequence of high ranges and plateaux. It is predominantly made up of Precambrian metamorphic and middle Palaeozoic granitic rocks.

Precambrian metamorphic rocks. The Precambrian metamorphic rocks are subdivided into three units: the Coen Metamorphics, the Holroyd Metamorphics, and the Sefton Metamorphics. They consist predominantly of mica-quartz schist, quartzite, and biotite-feldspar-quartz gneiss, but also include low-grade indurated sandstone and siltstone, slate, phyllite, and fine-grained mica-quartz schist. Numerous bands of amphibolite and greenstone occur in the sequence, as well as lenses of schistose limestone, marble, and calc-silicate rocks.

The sediments, before metamorphism, were probably siltstone, sandstone, greywacke, or arkose. The thinly bedded siltstone, shale, and sandstone in the west of the ridge have been only slightly metamorphosed;

small slump structures can be seen in the pelitic rocks, and traces of cross-bedding in some of the quartzite.

Middle Palaeozoic: Cape York Peninsula Batholith. The Precambrian metamorphic rocks have been extensively intruded by granitic rocks of probable middle Palaeozoic age, which have been named collectively the Cape York Peninsula Batholith (Whitaker & Willmott, 1969a). The intrusions are generally concordant and form a northerly-trending belt several hundred kilometres long and from 2 to 60 km wide. Some of the intruded metamorphics have been recrystallized and metasomatized, and in places migmatites have developed.

The batholith is exposed over an area of at least 5 500 km^2 (part not in survey area) and probably underlies another 4 000 km^2 covered by Cainozoic sediments. It contains many small remnants of older metamorphic rocks, and in the Coleman River area small granitic stocks or offshoots intrude the Holroyd Metamorphics several kilometres west of the main body. North of Mount Carter it is overlain by upper Palaeozoic sediments and volcanics and is intruded by Lower Permian granite.

The batholith is a complex body composed of a number of concordant intrusions, all of which probably belong to the same cycle of plutonic activity. The main component, the Kintore Adamellite, forms about 70 percent of the batholith and extends the full length of the body. The Lankelly Adamellite, which crops out east of Coen, appears to be a porphyritic variant of the Kintore Adamellite.

The intrusions of Blue Mountains Adamellite, Wigan Adamellite, and Morris Adamellite, which are exposed between Coen and Wenlock, are distinct mineralogically and texturally and generally have sharp boundaries with the Kintore Adamellite. The Flyspeck Granodiorite, which consists of a number of intrusions scattered over a distance of 230 km between the Alice River (south of the survey area) and Wenlock, is distinctively more basic than the other units. Acid and basic dykes intrude the Kintore Adamellite, and are particularly common in or near the Flyspeck Granodiorite. Near many of the contacts both the granitic and metamorphic rocks are intruded by quartz reefs, some of which contain traces of gold. The batholith is also cut by a number of north-west or north-trending shear zones up to 20 km long, and minor shearing is widespread.

Lower Carboniferous sedimentary rocks. The Lower Carboniferous Pascoe River Beds (Whitaker & Willmott, 1969a) crop out in the valleys of the Pascoe River and its tributaries. They consist of sandstone, arkose, greywacke, siltstone, and shale, with a little coal, conglomerate, and chert which were probably deposited in a small freshwater basin on the metamorphic and granitic rocks. The sequence was folded and faulted before being overlain by upper Palaeozoic Janet Ranges Volcanics.

Upper Palaeozoic volcanic rocks. The volcanics in the Iron Range region crop out in three separate areas, and probably erupted from separate centres. The three sequences have been named the Janet Ranges Volcanics, the Kangaroo River Volcanics, and the Cape Grenville Volcanics (Whitaker & Willmott, 1969a). The small outcrops of volcanic rocks east of Iron Range airstrip and at the 2nd Red Rocky Point have not been named. In Torres Strait the Torres Strait Volcanics (Whitaker & Willmott, 1969b) crop out on numerous islands between Cape York Peninsula and Mabaduan on the coast of Papua. Much of the original area of outcrop is now covered by the sea and, in Cape York Peninsula and in Papua, by younger sedimentary rocks.

In the southern part of Torres Strait the following four members have been recognized: Eborac Ignimbrite, Endeavour Strait Ignimbrite, Goods Island Ignimbrite, and Muralug Ignimbrite (Whitaker & Willmot, 1969b). Each member consists mainly of a number of sheets of welded ash-flow tuff of similar composition, but the composition differs from member to member.

The upper Palaeozoic volcanic rocks consist of rhyolite, welded tuff, and rhyolite with subordinate welded pumice-flow breccia, dellenitic, rhyodacitic, and dacitic welded tuff, andesite, and basalt.

The Torres Strait Volcanics are intruded by the Upper Carboniferous Badu Granite, but the granite is believed to be comagmatic with the volcanics.

Upper Palaeozoic intrusive rocks. The upper Palaeozoic granitic rocks cover an area of over 1700 km^2 in the northern part of Cape York Peninsula; they crop out in Torres Strait, in the Iron Range district, and near Coen. They intrude the acid volcanics and have been dated isotopically as Upper Carboniferous to Upper Permian. In the Iron Range district the Weymouth Granite consists of a suboval batholith 65 km long and a number of stocks and smaller offshoots. Small bodies of diorite occur on the margin of the granite and within the granite, and granophyric and hybrid rocks crop out as an elongate belt along its western margin. Small bodies of dolerite may also be associated with the granite. Farther south the upper Palaeozoic granitic rocks crop out near Bald Hill (the Wolverton Adamellite) and near Coen (the Twin Humps Adamellite). In Torres Strait the granites have been collectively named the Badu Granite. The small bodies of porphyritic microgranite and numerous acid and intermediate dykes are considered to be comagmatic with the Badu Granite.

Most of the intrusions are surrounded by extensive aureoles of recrystallized country rock. In the Iron Range district the intrusion of the granites was accompanied by tin, gold, and tungsten mineralization, and in Torres Strait by tin, tungsten, gold, copper, and lead mineralization.

Age. K-Ar dating on biotite indicates an Upper Carboniferous age of 295 ± 5 m.y. for the Badu Granite (Richards & Willmott, 1970), Lower Permian ages of 262 and 273 m.y. for the Weymouth Granite, and an early Upper Permian age of 253 m.y. for the Twin Humps Adamellite (Trail et al., 1969). Harding (1969) has reported an Upper Permian K-Ar age of 236 m.y. for the basement in Aramia No. 1 well, in southwest Papua. The granitic rocks are similar in age to the high-level granites and comagmatic middle Carboniferous to Lower Permian volcanics in the Georgetown Inlier (Branch, 1966). The Upper Carboniferous Badu Granite may be comagmatic with the Torres Strait Volcanics, but the relation between the Lower Permian Weymouth Granite and the volcanics in the Iron Range district is less certain.

The Wolverton Adamellite has many features in common with the Weymouth Granite, to which it is probably closely related, but the early Upper Permian Twin Humps Adamellite apparently represents a distinctly younger event.

Sediments. The Precambrian and Palaeozoic basement rocks of Cape York Peninsula and Torres Strait are overlain and surrounded by gently dipping Mesozoic sediments of the Laura, Carpentaria, and Papuan Basins. The basement rocks of the Peninsula Ridge are partly covered by thin deposits of poorly consolidated continental sandstone (the Lilyvale Beds and Yam Creek Beds) and by residual sand, alluvium, dune sand, and coastal marine sediments. The basement rocks and surrounding Mesozoic sediments are capped by ferricrete in places. The numerous coral reefs in Torres Strait are part of the Great Barrier Reef on the edge of the continental shelf.

Laura and Hodgkinson Basins

These basins cover most of CAPE MELVILLE, in which three structural and depositional regimes are distinguished:

(i) A pre-Mesozoic basement composed of steeply folded and partly metamorphosed Palaeozoic and Precambrian rocks. The Palaeozoic basement forms the northern part of the geosynclinal Hodgkinson Basin.

(ii) The central-northeastern part of the Laura Basin, which consists of Mesozoic sediments dipping gently to the southwest.

(iii) Unconsolidated Cainozoic deposits and some basalt.

(i) Palaeozoic

Lower Carboniferous/Middle Devonian. The oldest rocks in CAPE MELVILLE are the folded, slightly metamorphosed Hodgkinson Formation. It consists of alternating beds of greywacke and slate in various proportions (Amos & de Keyser, 1964). Exposures of these sediments can be seen along the eastern boundary of the Laura Basin.

Permian granites. Four main granite bodies are known in the coastal belt; the hard rocks of Howick Island, Lizard Island, and several other islets are also granite. These granites are small post-orogenic high-level plutons of regular shape. Petrologically they fall into three groups: the Finlayson Granite (Lizard Island and Direction Island), the Puckley Granite (Jeannie River Valley), and the Altanmoui Granite.

The intruded sediments of the Hodgkinson Formation are generally contact-altered and hornfelsed and may contain andalusite and cordierite.

Dykes are uncommon. A concordant dyke of granophyric and porphyritic biotite microadamellite intrudes the sediments of Ninian Bay, and fine-grained thin and extremely siliceous quartz porphyry dykes are closely associated with the auriferous quartz veins of the Starke No. 2 goldfield.

(ii) Mesozoic

Jurassic. The Dalrymple Sandstone is the basal formation of the Laura Basin. It was laid down on an irregular basement of granite and folded Devonian sediments. It is thickest on Flinders Island (although a thicker sequence of 600 m was penetrated in Cabot-Blueberry Marina No. 1 well 13 km west of the western boundary of CAPE MELVILLE. It becomes thinner towards the south. The main rock type is a coarse to medium-grained sandstone. Other rock types include ferruginous micaceous shale.

Lower Cretaceous. The Battle Camp Formation (Lucas, 1965) is exposed mainly along the coastal range area and on Flinders Island. It appears to be represented by about 400 m of sediments in Marina No. 1 (Evans, 1962). The main constituents of the formation are quartz sandstone, glauconite sandstone, conglomerate, and sandy to silty shale. Thin layers of coal occur in some of the shales.

A 150 metre section has been measured on Stanley Island, and a 270 metre section in the eastern side of the Bathurst Range, but the boundary between the latter section and the underlying Dalrymple Sandstone is not precisely known. In the Flinders Islands the boundary is marked by a thin ferruginous zone.

The Wolena Claystone (Lucas, 1965) was intersected, beneath Cainozoic sediments, from 80 m to about 150 m in Marina No. 1 well. Possibly it extends under the Cainozoic sediments in CAPE MELVILLE.

(iii) Cainozoic

In general, except for the northwest band of Lower Cretaceous sandstone, CAPE MELVILLE is covered by Cainozoic sandy clay, sandstone and chert, and sand dunes. These abut and overlie the Proterozoic Coen Metamorphics to the west in the Cape York Peninsula Ridge.

A small outlier of the Tertiary Piebald Basalt (Lucas, 1964) occurs in the valley of the upper Starke River in the southeast. Details of formation thicknesses are given in the stratigraphic table (Appendix 1).

Carpentaria Basin

The Carpentaria Basin forms part of Cape York Peninsula to the west of the Peninsula Ridge and extends west into the Gulf of Carpentaria. It consists mainly of Mesozoic sediments which gradually thicken to approximately 2000 m in the centre of the basin. The following details of formations should be read in conjunction with Figure 1, which shows the regional setting of the basin.

The oldest Mesozoic rocks in the Peninsula are the Jurassic and early Cretaceous clayey quartzose sandstone and conglomerate (JKl). These are known as the Gilbert River and Battle Camp Formations. The latter is seen to be quite extensive on the eastern side of the Peninsula Ridge in the Laura Basin. The sequence is up to 600 m thick, and dips gently west off the Great Dividing Range towards the centre of the basin, beneath the Gulf of Carpentaria. For the most part the beds are continental, but the youngest are probably shallow marine. South of the survey area in HANN RIVER where the Carpentaria and Laura Basins meet these two formations are seen to be the same.

Overlying the quartzose clastics in the Carpentaria Basin are marine sandstone, siltstone, and labile sandstone of the Rolling Downs Group (Klr). The group is about 580 m thick in Z.C.L. Weipa No. 1; it may lie disconformably on the quartzose sandstone sequence. The formations that make up the Group in the southern part of the basin are difficult to map in the north because of poor outcrop, the apparent absence of the Toolebuc Limestone, and almost total lack of drill holes. However, wireline and lithological logs of Weipa No. 1 (Fig. 1) suggest that equivalents of the Normanton Formation, Allaru Mudstone, and Wallumbilla Formation were laid down in the north. All the formations are marine except possibly the youngest beds of the Normanton Formation, which may be continental.

In late Cretaceous and/or early Tertiary times erosion of older rocks after moderate uplift resulted in an ancestral Great Dividing Range with a topography much like the present one. The valley fill and piedmont plain deposits of the Bulimba Formation and equivalent Lilyvale and Yam Creek Beds reduced relief by Pliocene times. These formations are clayey and quartzose, in places arkosic, and are up to 100 m thick. Their tops are commonly ferruginized or silicified; in WEIPA and AURUKUN, bauxite overlies ferruginized Bulimba Formation.

The Bulimba Formation, its equivalents, and older rocks were eroded in late Cainozoic times. The clayey quartzose sediments produced were deposited as the continental Wyaaba Beds west of the Great Dividing Range, in HOLROYD and HANN RIVER, where the unit may be up to 100 m thick. East of the range no equivalent of the Wyaaba Beds have been recognized, but they may be present east of the coast.

At present the Great Dividing Range and the country west of it is being eroded, although colluvial sand is widespread. East of the range, river distributaries are depositing wide thin spreads of clayey and silty alluvia.

Below the eastern scarp along the Great Dividing Range, between Coen and Port Stewart, a north-south line of low hills of basalt, dolomite, and olivine nephelenite may mark a fault or faults. Due south of these hills, hot-water springs in a tributary of the Annie River appear to be part of the same complex, which probably reflects Cainozoic activity of the Palmerville family of faults.

Appendix 2 shows the stratigraphy of the Carpentaria Basin and equivalent formation in the Laura Basin.

3. ECONOMIC GEOLOGY

Gold was the most important mineral produced in the Cape York Peninsula before the discovery of bauxite during the 1950's. Locations of some of the gold and mineral fields can be seen in Figures 2 and 3. (Appendix 3 shows details of gold mines and ore production). The following are brief details of the known mineral occurrences.

Gold

Most of the gold found has been associated with quartz lodes and acid dykes related to the granitic rocks of the Cape York Batholith. At Ebagoola, Hayes Creek, Wenlock, Claudia River, and Iron Range the gold has probably been introduced by the Kintore Adamellite along the metamorphosed contact with the Coen Metamorphics (Willmott et al., 1973). In the Coen Gold Field the deposits lie within the Lankelly Adamellite, where quartz and gold were probably deposited from hydrothermal fluids introduced after the rocks were sheared. Elsewhere, gold has been associated with Flyspeck Granite (Yarraden), Weymouth Granite (Packers Creek), and quartz porphyry (Starke Gold Field, No. 2).

Aluminium

The following details of bauxite deposits at Weipa are taken from Thieme (1970). The deposit is the largest in Australia and is mostly concentrated around Weipa with smaller areas near Turtle Head Island.

The Tertiary Weipa Formation consists of claystone, siltstone, and arkose sandstone capped by laterite. The bauxite, which is a mixture of gibbsite (anhydrate) and bohemite (monohydrate), is a flat-lying surface deposit ranging in thickness from a few metres to a maximum of 10 metres. The bauxite is in the form of pisolites, 1 to 20 mm in diameter, in a loose matrix of reddish brown clayey sand.

Exploration work has shown that the bauxite covers 793 sq. km; Crawford (1970) states that 526 million tonnes have been proved by drilling, and probable reserves are much greater.

Iron and manganese

The deposits around Iron Range consist of large steeply-dipping lenses of schist and quartzite (Sefton Metamorphics) rich in magnetite and hematite. The iron-bearing rocks also contain substantial amounts of manganese.

Canavan (1965a) gives the indicated reserves at 1 million tonnes of ore containing between 54 and 62 percent iron (including manganese), and inferred reserves of 300,000 tonnes containing 45 to 55 percent iron (including manganese).

Tin

Cassiterite has been found at four places on the Peninsula: three areas between Coen and Temple Bay; near Archer River; at Tine Creek; and at Stony Point. Other finds have been recorded 8 km southwest of Cape York. Total production from these is less than 200 tonnes. The deposits have probably developed from Upper Palaeozoic granite.

In the Cape Melville district alluvial deposits were found at Barrow Point with traces in creeks and beach sands. Drilling by Broken Hill Pty Ltd did not reveal any economic deposits (Ball, 1939).

Tugsten

Wolfram has been produced from two main areas: Bowden Mining Field (71 tonnes between 1905 and 1916) and Moa Island (84 tonnes).

The wolfram at Bowden occurs within or close to the Weymouth Granite while the deposits on Moa Island occur in quartz lodes in the Badu Granite or hornfelsed Torres Strait Volcanics.

Small deposits have been found on Noble Island and in the Altanmoui Range in CAPE MELVILLE.

Coal

Coal has been found in the Lower Carboniferous Pascoe River Beds. These are up to several centimetres thick (Willmott et al., 1973). A 30-centimetre seam was found on Stanley Island (Lee-Bryce, 1905). Deposits are probably near the base of the Dalrymple Formation.

Other minerals

Small deposits of lead, copper, molybdenum, and antimony have been found, but none of these proved of any economic significance.

Oil

Petroleum exploration has been confined mainly to the sediments of the Laura, Carpentaria, and Papuan Basins. Results of relevant geophysical surveys are discussed in Section 4.

4. PREVIOUS GEOPHYSICAL EXPLORATION

A summary of the geophysical work carried out in the survey area is found in Pinchin (1973). This has been used as a basis for the following discussion.

Magnetic surveys

The three main magnetic surveys in the area were:

(1) Wenlock River Survey.

(2) Corbett Reef Survey.

(3) Magnetic survey of AP 88P for Gulf Interstate Overseas Limited.

The results from these surveys have been contoured and a depth-to-basement map produced (Plate 3).

(1) An airborne magnetometer survey of Wenlock River (Cape York Peninsula) was carried out by Adastra Hunting Geophysics Pty Ltd for Australian Aquitaine Petroleum Pty Ltd during 1964. The area surveyed was bounded in the south by latitude 14°05', in the west by longitude 141° 55'E, and in the east by longitude 143°05'E.

Flight-lines were flown east-west in groups of five lines with 3 km between individual lines and 19 km between groups. Tie-lines were flown north-south at intervals of 30 km. Magnetic contours were produced at a scale of 1:250 000 with a 10-gamma interval, together with the depth-to-basement contours using a 300 m (1000 ft) interval.

(2) The Corbett Reef aeromagnetic survey covered an area extending from latitude 13°S to 15°45'S and from the Great Barrier Reef westward to the coast. The traverses were flown in May-June 1969 by Aero Service Limited for Corbett Reef Limited with a 3-km spacing of 93 east-west flight-lines. The survey altitude was 300 m above sea level.

Intense magnetic anomalies yielding a shallow basement depth are indicated along the coast and in the area of Cape Melville. Farther east and along the Great Barrier Reef weak magnetic anomalies indicate basement depths of below 3000 m.

Results from the survey are presented as magnetic contours and depth-to-basement contours at 1:250 000 scale.

(3) The airborne magnetic survey of AP 88P Queensland for Gulf Interstate Overseas Limited by Micro Magnetics extends north of Princess Charlotte Bay to within a few kilometres of the coast of southwestern Papua. The eastern boundary coincides with the outer edge of the Great Barrier Reef. Survey lines were flown east-west at 10-km spacing in the Charlotte Bay region and also north of Cape York. In addition, offshore lines were flown north-south along the edge of the Great Barrier Reef with parallel lines, 40 km apart, west of there to Thursday Island.

The data were produced as magnetic contour maps and depth-to-basement contours. The depths range from zero (outcrop) to 2600 m in the Laura Basin and to 2000 m in the Peninsula Trough. The Oriomo Basement Ridge which separates the Carpentaria Basin from the Papuan Basin is marked by zero to 600 m contours.

Two magnetic surveys were flown outside the survey boundary for Marathon Petroleum Australia Ltd by Adastra Hunting Geophysics Pty Ltd. The areas covered are bounded by the following latitudes and longitudes:

Area A: 10°00'S to 12°00'S, 140°00'E to 142°00'E.

Area B: 12°00'S to 13°45'S, 139°00'E to 141°00'E.

The flight-lines were flown east-west, 3 km apart at an altitude of 600 m above sea level. Interpretation, which is at 1:250 000 scale, consists of a magnetic contour map with superimposed depth-to-basement contours.

Canavan (1965b) reports that a magnetic survey was conducted in the Iron Range district for Broken Hill Pty Ltd. The aim of the survey was to assist in determining the areal extent of the low-grade banded iron formation. It showed that the iron-bearing beds do not extend out under the schists, but dip conformably with associated rocks. The survey tended to confirm that the iron-bearing bands have been subjected to en echelon faulting.

Seismic surveys

Several seismic surveys have been made in the region. These are discussed in Pinchin (1973). Plate 4 displays depths to basement based on the seismic data.

Plates 3 and 4 show similar contour patterns, but the basement depths calculated from magnetic data are greater than those obtained from seismic data. Both maps clearly define the boundary of the Olive River Basin (Plates 3, 4).

The Torres Strait and Princess Charlotte Bay seismic survey (Western Geophysical Co., 1965) did not record a reliable reflection from the basement in the area of the Peninsula Trough; therefore both here and in the offshore part of the Laura Basin where no seismic data were recorded, the basement contours are derived only from the magnetic data.

Gravity surveys

On land, reconnaissance gravity coverage, on an 11-km grid has been obtained by BMR. The Coral Sea was surveyed on a systematic line spacing of about 40 km by BMR (Mutter, 1972), and the Gulf of Carpentaria surveyed on a line spacing of about 80 km, in an irregular pattern, by the U.S. Naval Oceanographic Office (1967).

Plate 5 displays the relevant part of the Bouguer anomaly map of Australia. It shows a series of north-south gravity highs separated by gravity lows. The high along the coast seems to reflect mainly the crustal thinning towards the Pacific Ocean. The low to its west is over the granite of the Cape York Batholith. A high occurs in the centre of the Peninsula Ridge. The low and high along the western coast of the Peninsula occur over areas covered by Mesozoic sediments of the Carpentaria Basin and probably reflect density variations within crystalline basement.

The gravity anomalies in the Laura Basin show no correlation with geological features in the basin. Offshore, however, the data suggest that the basin may extend as far north as latitude 12°30'. Thus, the gravity anomalies on land seem to reflect only the major density variations in the crystalline basement and the deeper parts of the crust rather than the thickness of the sediments in the Carpentaria, Olive River, and Laura Basins.

Drilling

There have been three exploration wells drilled in the Laura Basin (Plate 2). These revealed the following:

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

On this information the depth to metamorphic basement was interpreted to be at about 900 m in the deepest part of the onshore basin area.

Shallow offshore drilling in WEIPA, in an unsuccessful search for bauxite, indicated that the Cainozoic Wyaaba Beds thicken towards the centre of the Gulf of Carpentaria (Power & Lindhe, 1958). This is supported by seismic evidence.

5. SURVEY OBJECTIVES

The survey will provide systematic magnetic and radiometric data which should assist the geological mapping of the region. The more specific aims of the survey are:

(1) It is expected that the airborne survey will provide a more detailed depth-to-basement map over the basin areas. This is needed particularly in the Laura Basin, where there has been little magnetic surveying.

(2) The nature of the Peninsula Ridge, after it enters the sea, is not well known. This survey should provide further information.

(3) It is expectcd that the closer flight-line spacing will provide useful information about the Olive River Basin.

(4) The bauxite-bearing laterite deposits of the west coast of the Peninsula should exhibit a relatively high thorium count on the gamma-ray spectrometer. This might assist in prospecting for bauxite.

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APPENDIX 1: STRATIGRAPHY OF THE CAPE MELVILLE 1:250,000 SHEET AREA

Age	Formation	Symbol	Thickness (feet)	Lithology	Correlation (Approximate)	Stratigraphic Relations	Economic Geology	Principal References
Quaternary	Alluvium	Qa	Up to 200(?)	Grey silty clay, sand, gravel	Qm, Qs	Overlies older rocks; also cut and fill	Gold	
	Marine	Qm	Up to 600(?)	Reef and associated deposits, salt pans, beach sands, pumice berms	Qa, Qs; may be partly Tertiary	Overlies older rocks, intertongues with Qa	Salt, lime, heavy minerals(?)	Richards & Hill, 1942
	Residual sand	Qs	Up to 20(?)	Loose orange and white sand	Qa, Qm	Overlies Mesozoic sandstones and Czx	Water storage(?)	
Undifferentiated Cainozoic	Ferricrete		0-10	Sandy ferricrete, underlain by mottled zone	Variable age(?)	Overlies Klc, Jl, Czx, Czt, Czd		
	Dune sand	Czd	Max. 300 above sea level	Younger: white quartz sand and peat Older: ferruginous dune sand, kaolinitic sand, peaty sand	Qa, Qm, Qs	Overlies and abuts against older rocks	Water storage; possible glass sand	
	Talus	Czt	5-100	Ferruginous earthy matrix containing sandstone and chert blocks	At least two stages; Czx	Overlies Hodgkinson Form. below scarps of Mesozoic sandstone		
	Sand and clay	Czx	5-150(?)	Pebbly quartz gravel	Includes two stages; Lynd Formation	Coarse fossil alluvia. Overlie and abut against older rocks; Qa, Qs overlie, Qa with cut-and-fill	Poor, inhomogeneous aquifer(?)	Laing & Power, 1959 (Lynd Formation); Lucas, 1965
	Piebald Basalt	Czp	5-100(?)	Olivine basalt and nepheline basanite	McLean Basalt, Atherton Basalt, Czx, (to the south)	Overlies older talus?, overlain by younger talus		Morgan, 1964b
Tertiary		Tl	Not exposed in Sheet area	Mottled pebbly clayey sand and sandy clay	Louisa Formation			Woods, 1961
Lower Cretaceous	Wolena Claystone (Albian)	Klo	Not exposed in Sheet area; 200 ft. in Marina No. 1, 8 miles to west	Olive calcareous claystone		Less extensive than Battle Camp, disconformable beneath Cainozoic	Small saline aquifers	Lucas, 1965
	Battle Camp Formation (Aptian-Neocomian)	Klc	Up to 900 exposed; 800-1450 in Marina No. 1 (Core 6 critical)	White quartz sandstone, thin conglomerate, clayey and glauconitic sandstone, shaly siltstone, sandy and silty shale	Wrotham Park Sandstone and Blackdown Formation (to the south)	Overlaps Dalrymple Sandstone, underlies Wolena Claystone conformably(?)	Aquifer	Lucas, 1965
Jurassic	Dalrymple Sandstone	Jl	Up to 800 exposed, 1650-2300, in Marina No. 1	Off-white quartz sandstone, conglomerate, shale, impure coal		Unconformable upon older rocks, overlapped by Battle Camp Formation	Aquifer	Lucas, 1965
Permian	Altanmoui Granite	Pgi		Porphyritic (muscovite-) biotite adamellite, with marginal variations	All approximate correlatives of Mareeba Granite	Intrude Hodgkinson Formation; unconformably overlain or abutted by post-Palaeozoic rocks	Source of mineralization (Au?, W, Sn, Cu, etc.)	Ball, 1909 (gold) Morgan, 1964a, b
	Puckley Granite	Pgk		Medium-grained tourmaline-bearing porphyritic biotite adamellite				
	Finlayson Granite	Pgf		Coarse even-grained locally porphyritic biotite-muscovite granite with tourmaline				
Lower Carboniferous(?) to Middle Devonian	Hodgkinson Formation	D-Ch	10.000	Greywacke, slate, some conglomerate and meta-volcanic		Unconformable beneath Mesozoic rocks (and any Permian strata). Intruded by granites. Unconformable on Precambrian and Silurian rocks at depth(?)		

APPENDIX 2

Stratigraphy of the Carpentaria Basin and Equivalent Formation in the Laura Basin

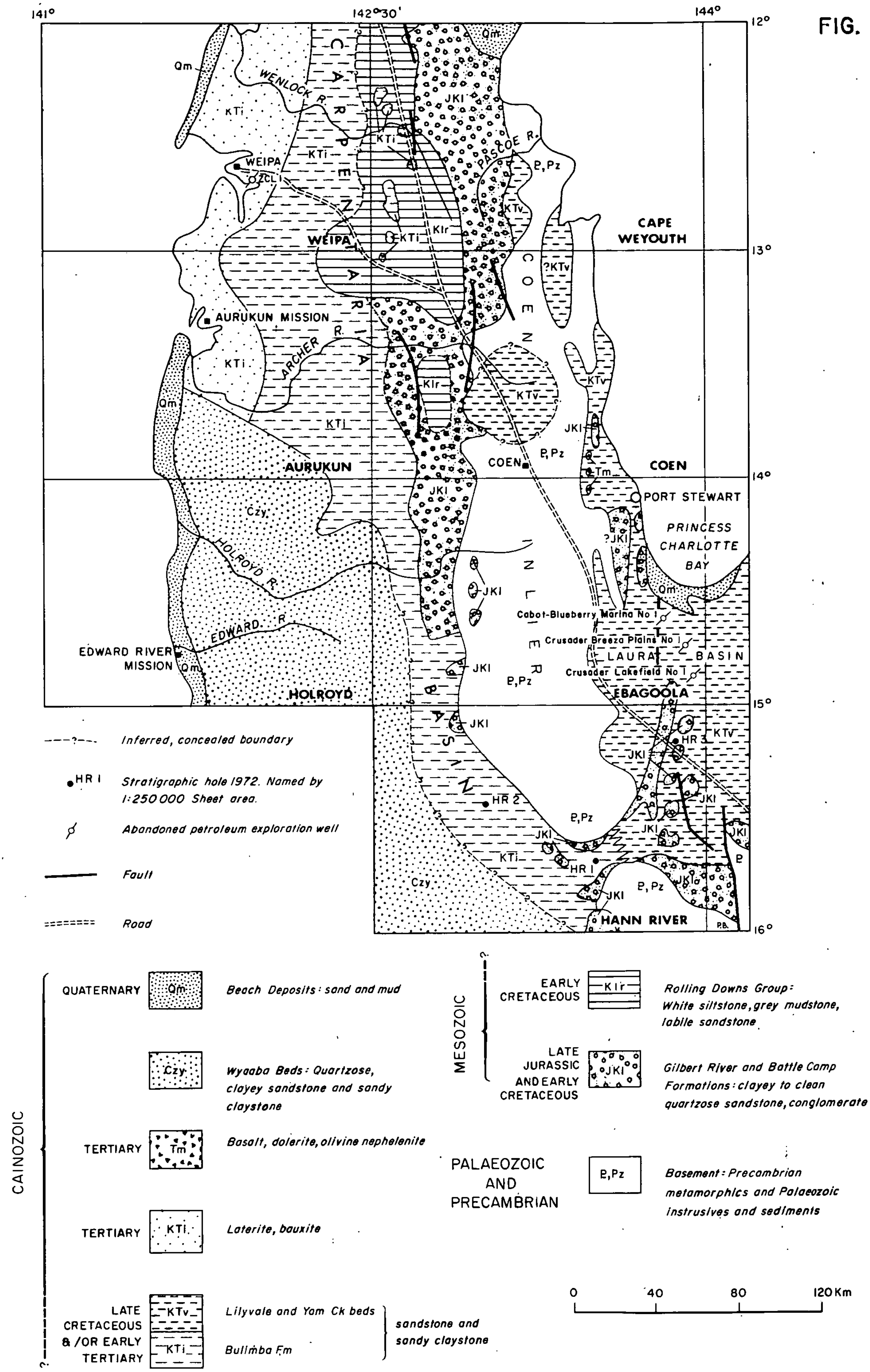
Era	Period	Carpentarian Basin Rock Unit	Symbol	Thickness, m.	Laura Basin Rock Equivalent	Lithology and Comments
Cainozoic	Quaternary to Tertiary	Wyabba	CZY	10	Lilyvale Form. or Buxton Form.	Poorly sorted grey clayey quartzose, sand, siltstone, and granular conglomerate. Overlies disconformably KTi.
	Tertiary or Late Cretaceous	Bulimba Formation	KTi	10		Poorly sorted clayey quartzose, sandstone and granular conglomerate overlies Kln unconformably. Surface laterized (bauxite at Weipa).
Mesozoic	Early Cretaceous, Rolling Downs Group	(Normanton (Formation	KLn	400	Wolena Claystone	Siltstone, mudstone, limestone, sandstone. Unconformably overlies KLa.
		(Allura Mudstone	KLa			Shale, mudstone, siltstone, limestone. Conformably overlies KLo. Marine.
		(Toolebuc (Limestone	KLo	10		Calcareous shale, limestone. Conformably overlies KLu. Marine.
		(Wallumbilla (Formation	KLu	240	Battle Camp shale	Contains oil-shale, mudstone, siltstone, minor limestone, some glauconite. Conformably overlies JKg. Marine.
	Early Cretaceous to Late Jurassic	Gilbert River Formation	JKg	100	Battle Camp Sandstone	Clay quartzose sandstone, Unconformably overlies basement rocks in places.
		Loth Formation	Jul	50	Dalrymple Sandstone	Soft clayey sandstone, minor siltstone. Continental. Conformably overlies Jh.
		Homestead Sandstone	Jh	50	Dalrymple Sandstone	Coarse quartzose sandstone and conglomerate. Continental.
Mesozoic to Palaeozoic	Jurassic	Unnamed			Unnamed	Unnamed sandstone
	Permian or Triassic	Unnamed			Unnamed	Possible glacial tilloid sediments in Bourketown No. 1 well. Possible sediments in Laura Basin
Palaeozoic to Precambrian						Various metamorphics, meta sediments, intrusive igneous rocks. Basement to Carpentaria, Laura and Olive River Basins.

APPENDIX 3

Gold Mines and Recorded Production

Mining Field	Discovered	Mining Area	Mines	Mining Period	Production (kg)
Hamilton Gold & Mineral Field	1900	Ebagoola	Caledonia, Hamilton King, May Queen, Hit or Miss, Violet, Hidden Treasure, All Nations, Golden Treasure	1900-1951	2291.58
		Yarraden	Golden King, Savannah, Lukin King, Gold Mount, Hiaki		
Coen Gold & Mineral Field	1876	Coen	Great Northern, Hanging Rock, Homeward Bound, Lankelly, Long Tunnel, Trafalgar, Wilson, Daisy	1892-1916	2332.86
		The Springs	Westralia, Goolha Goolha, Rothwell, Sidar	1890s-1901	
		Klondyke	Springfield	1898-1902	
Blue Mountains	pre 1934	Blue Mountains	Golden Ladder, Convict, Yarraman	1935, 1938-46, 1948-51	33.53
Lochinvar Provisional Gold Field	-	Tadpole Creek	-	1904	2.2
Rocky River Gold & Mineral Field	1893	Neville Creek	-	1896-1901, 1910-1911	151.41
Hayes Creek Provisional Gold Field	1880	Hayes Creek	Golden Gate	1909-1914	13.21
Wenlock Gold & Mineral Field	1892	Retreat Creek, Bairdville, Downs Gully Choc-a-Block creek	-	1905-1911	93
	1910	Plutoville Main Leader (later known as Lower Camp & Wenlock)			190 1089
Claudia River Gold & Mineral Field	1933	Iron Range Scrubby Creek Packers Creek	Gordon's 'Iron Range'	1934-1942	333.12
Possession Island Gold & Mineral Field	1896	Possession Island	-	1897-1905	155.42 (includes some from Horn Island)
Horn Island Gold & Mineral Field	1894	Horn Island	-	1894-1900	207.74
Starke Gold Field No. 2 (CAPE MELVILLE Area)	1890	Diggers Creek Munburra	-	1890-1909	347

FIG. 1

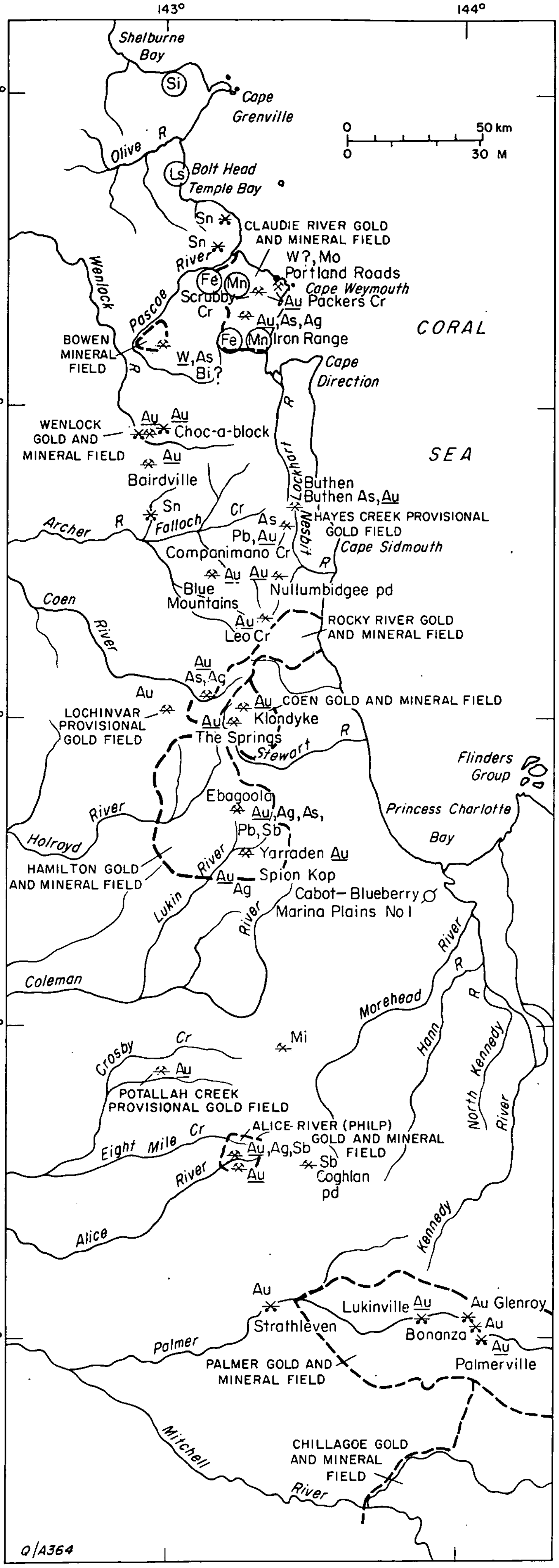


GEOLOGICAL MAP OF PART OF CAPE YORK PENINSULA

(After Doutch, 1972)

Based on D54/A/6   *To accompany Record No. 1973/159*   D54/B1-7A

FIG. 2

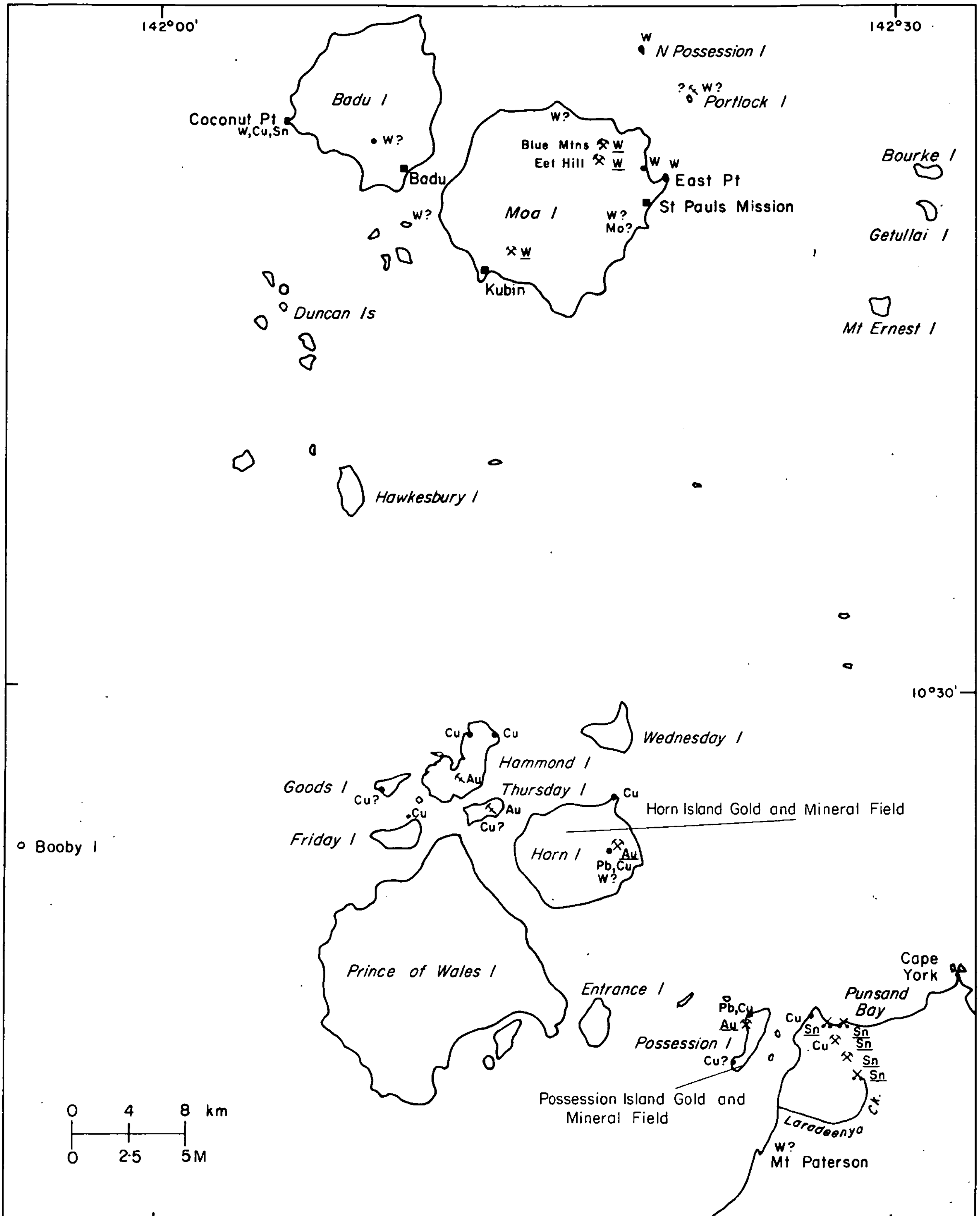


Ø Petroleum exploration well, abandoned
•W Minor mineral occurrence
Ag Silver
As Arsenic
Au Gold (Au, significant production)
Bi Bismuth
Fe Iron
Ls Limestone
Mi Mica
Mn Manganese
Mo Molybdenum
Pb Lead
Sb Antimony
Si Silica
Sn Tin
W Tungsten
(Si) Unworked deposit
Bi? Mineral occurrence uncertain
Prospect, not worked
Mine
Mine, abandoned
Alluvial workings, abandoned
pd Position doubtful

MINES, MINERAL FIELDS AND MINERAL OCCURRENCES IN CAPE YORK PENINSULA

(after Willmott et al., 1973)

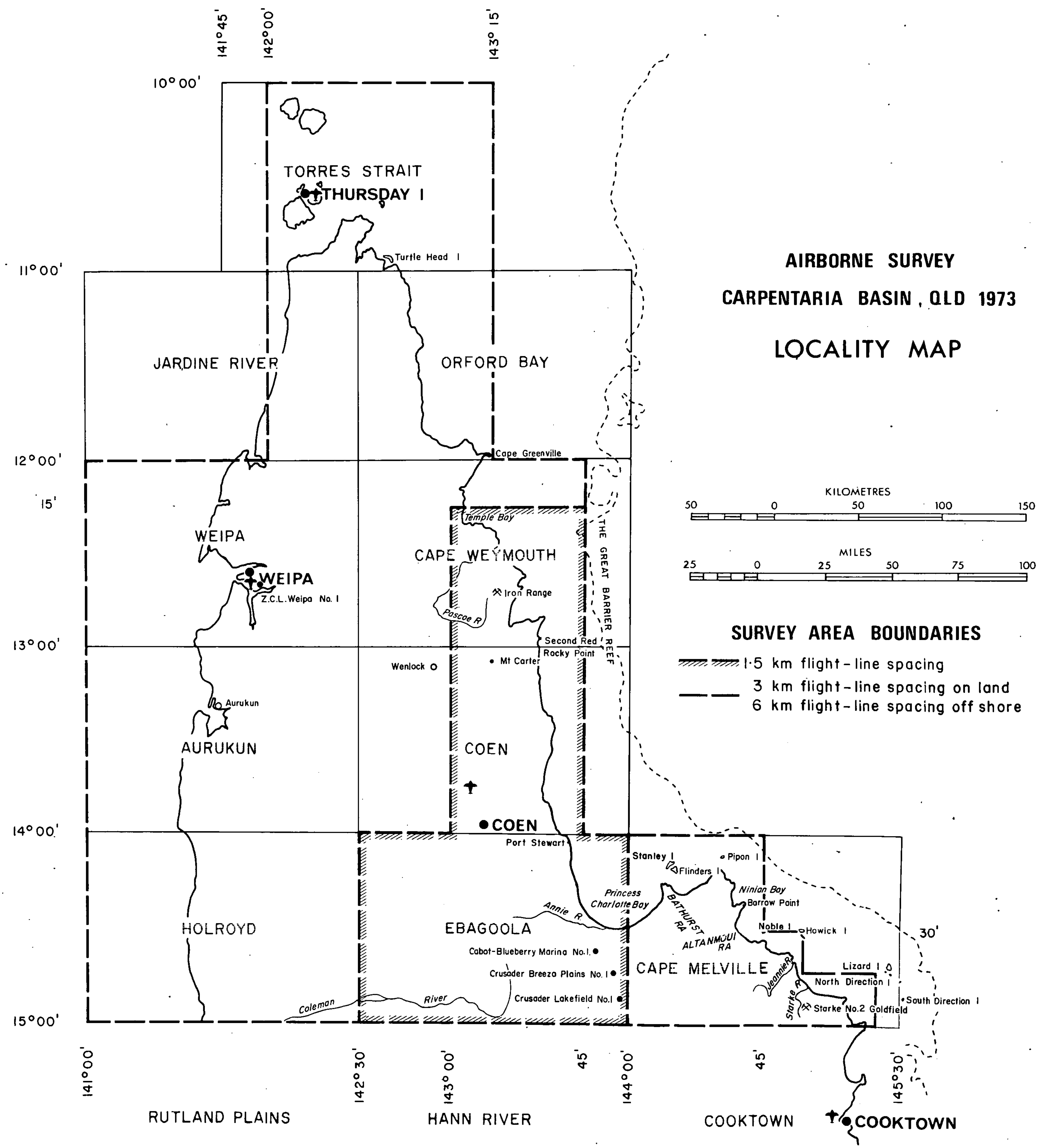
FIG. 3



⚒	*Mine, abandoned*	Mo	*Molybdenum*
⛏	*Prospect, abandoned*	Pb	*Lead*
✕	*Alluvial workings, abandoned*	Sn	*Tin*
Au	*Gold*	W̲	*Tungsten, significant production*
Cu	*Copper*	•	*Mineral occurrence*

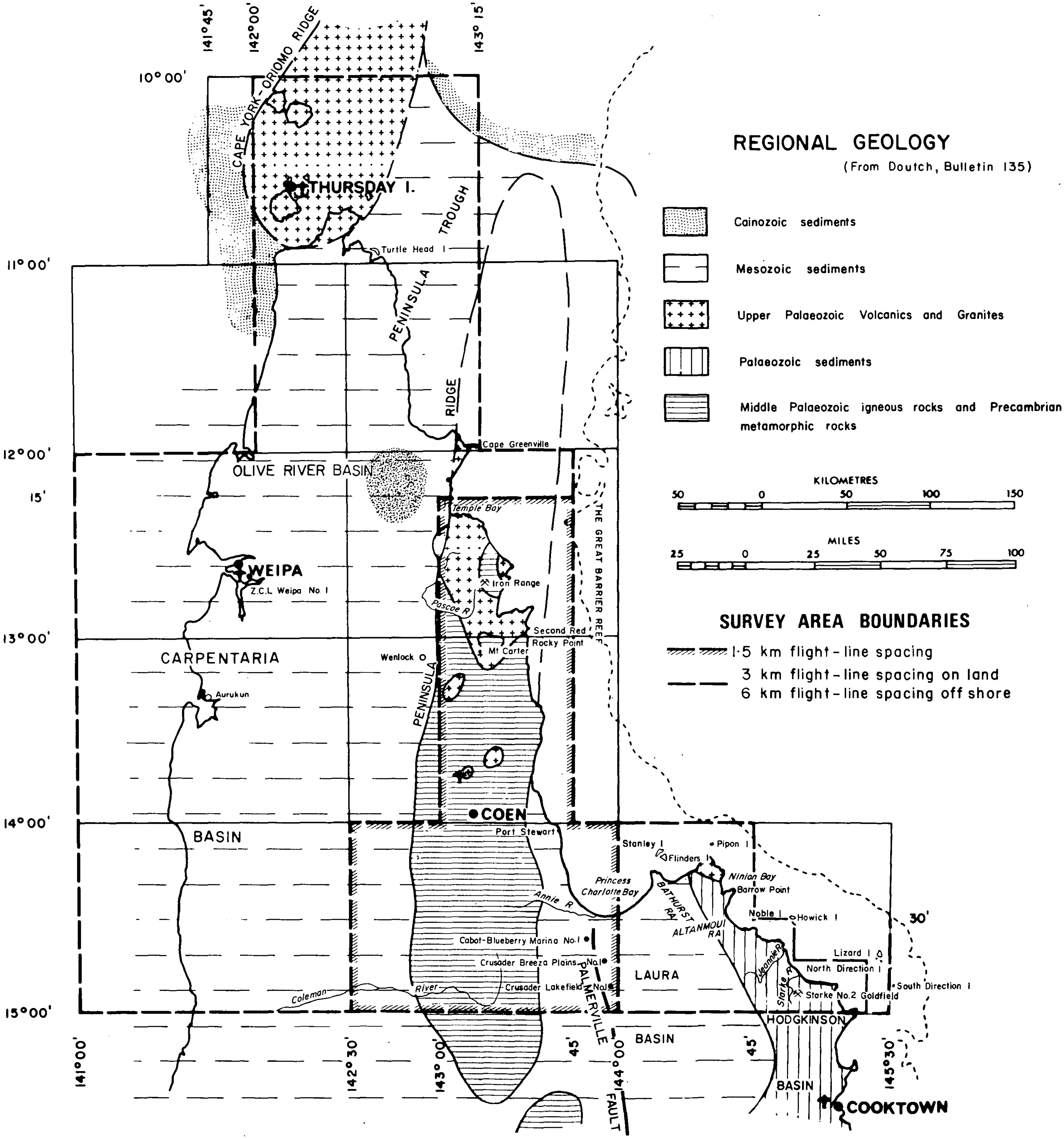
MINES, MINERAL FIELDS AND MINERAL OCCURRENCES IN TORRES STRAIT
(after Willmott et al., 1973)

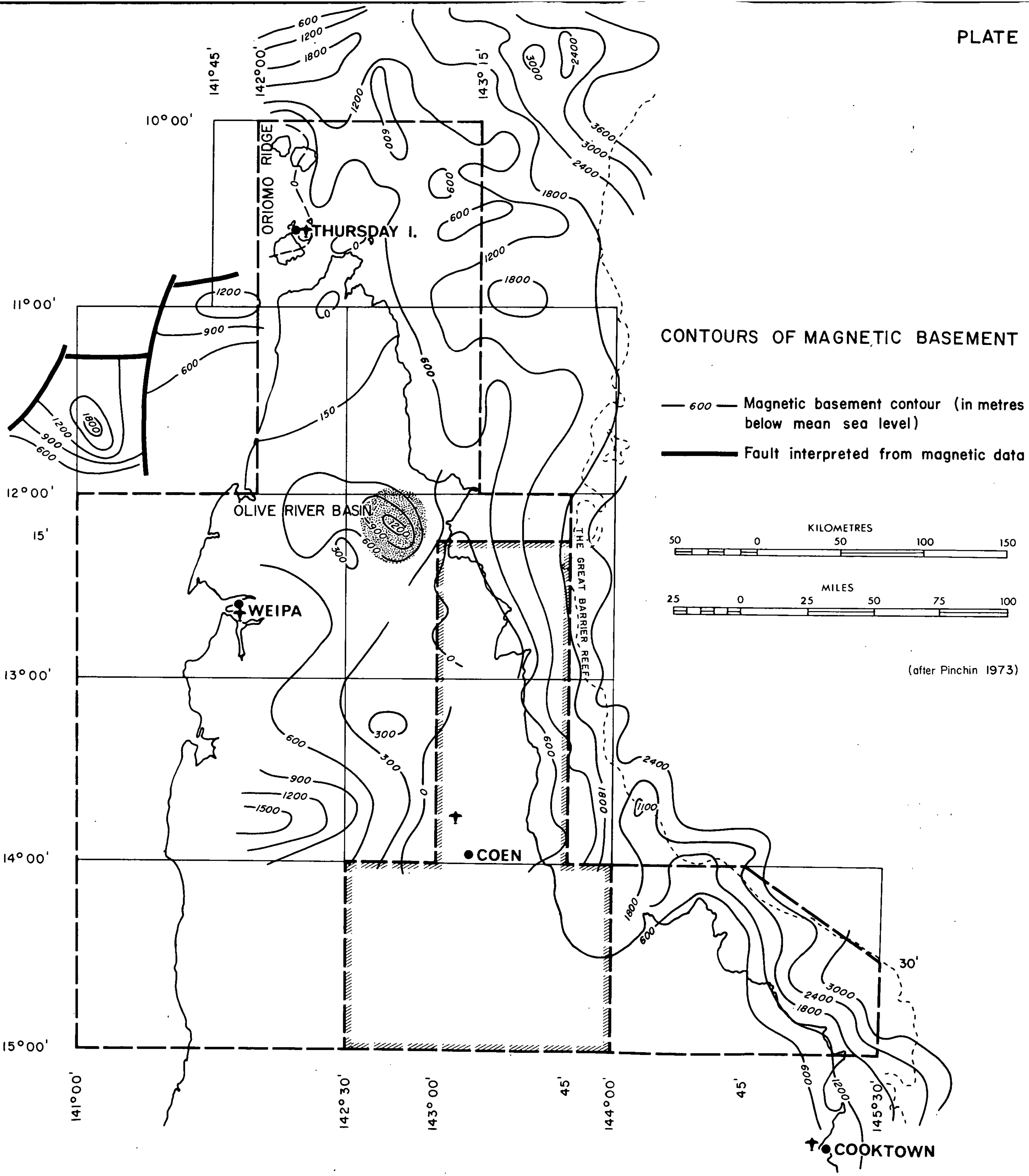
Based on C54/A12/4 *To accompany Record No. 1973/159* D54/B1-9A



To accompany Record No. 1973/159

D54/B1-2


REGIONAL GEOLOGY
(From Doutch, Bulletin 135)
Cainozoic sediments
Mesozoic sediments
Upper Palaeozoic Volcanics and Granites
Palaeozoic sediments
Middle Palaeozoic igneous rocks and Precambrian metamorphic rocks
KILOMETRES
50 0 50 100 150
MILES
25 0 25 50 75 100
SURVEY AREA BOUNDARIES
1·5 km flight-line spacing
3 km flight-line spacing on land
6 km flight-line spacing off shore
141°45'
142°00'
143° 15'
10° 00'
11° 00'
12° 00'
15'
13° 00'
14° 00'
15° 00'
30'
141°00'
142° 30'
143° 00'
45'
144° 00'
45'
145°30'
CAPE YORK-ORIOMO RIDGE
THURSDAY I.
PENINSULA TROUGH
Turtle Head I
PENINSULA RIDGE
Cape Greenville
OLIVE RIVER BASIN
Temple Bay
THE GREAT BARRIER REEF
WEIPA
Z.C.L. Weipa No 1
Iron Range
Pascoe R
Second Red
Rocky Point
Mt Carter
Wenlock
CARPENTARIA
Aurukun
COEN
BASIN
Port Stewart
Stanley I
Pipon I
Flinders I
Princess Charlotte Bay
Ninian Bay
Barrow Point
BATHURST RA
ALTANMOUI RA
Noble I
Howick I
Annie R
Cabot-Blueberry Marina No.1
Crusader Breeza Plains No.1
Crusader Lakefield No.1
PALMERVILLE FAULT
LAURA
BASIN
Lizard I
North Direction I
South Direction I
Jeannie R
Starke R
Starke No.2 Goldfield
Coleman River
HODGKINSON
BASIN
COOKTOWN



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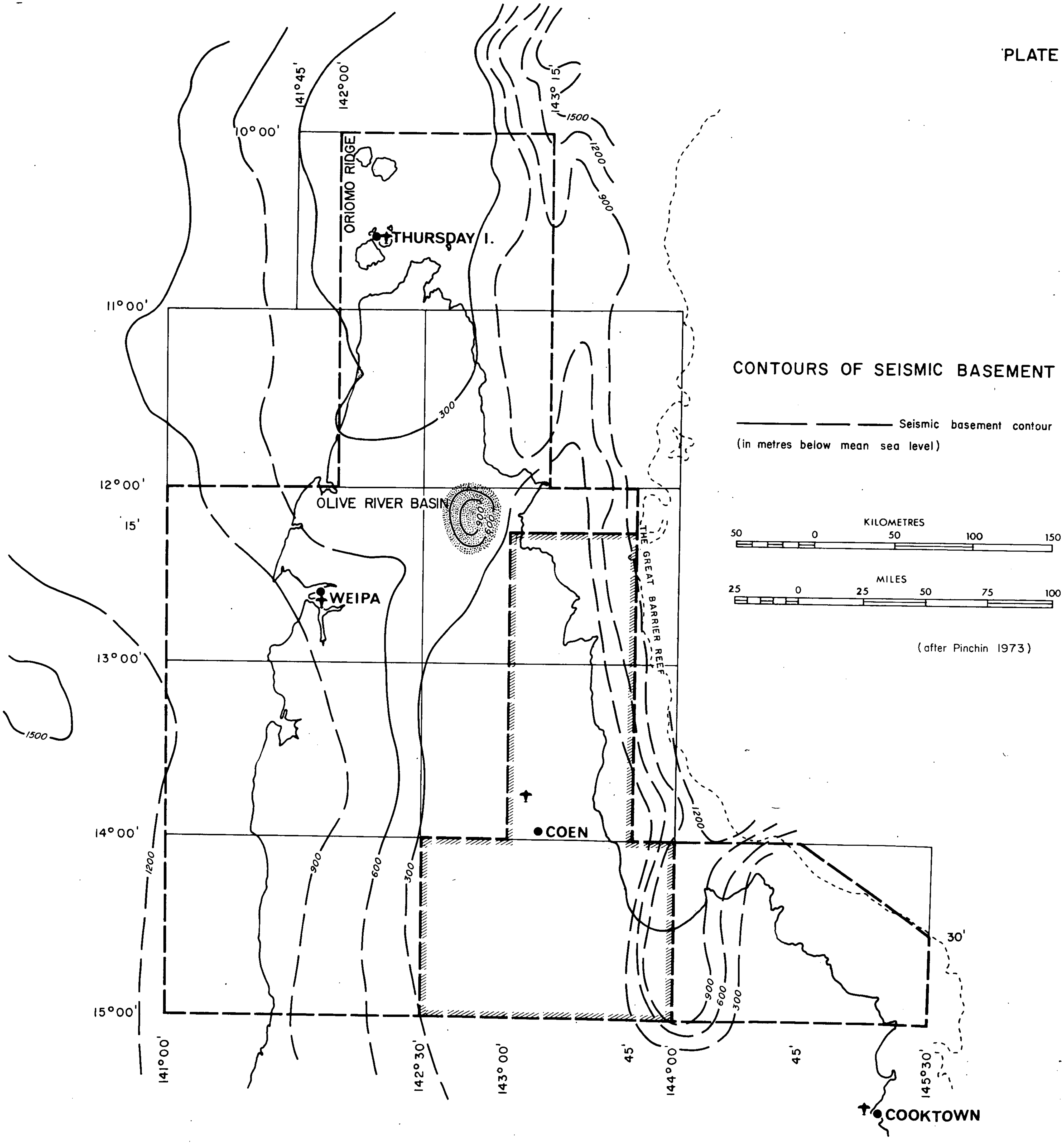

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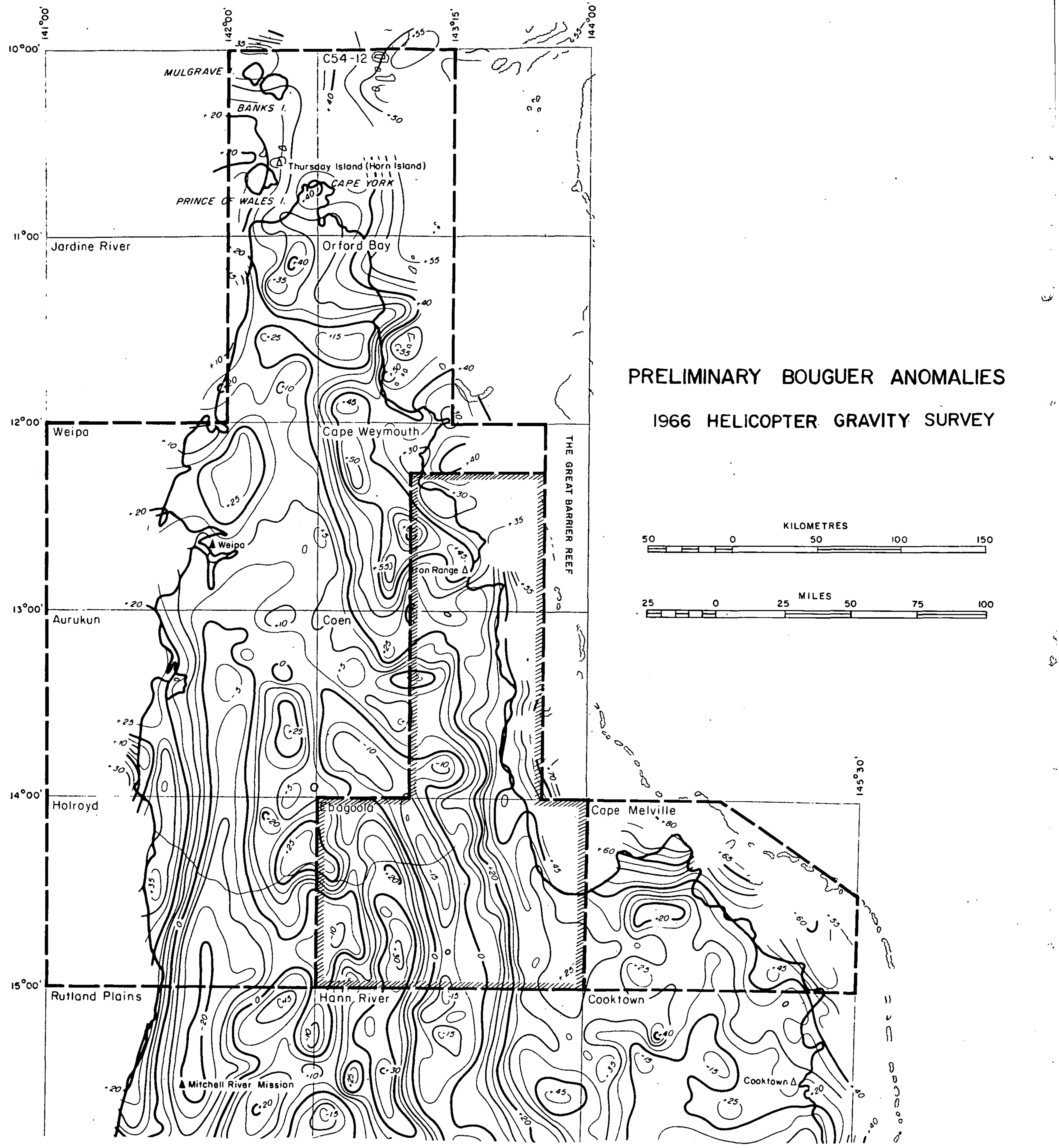
PRELIMINARY BOUGUER ANOMALIES

1966 HELICOPTER GRAVITY SURVEY



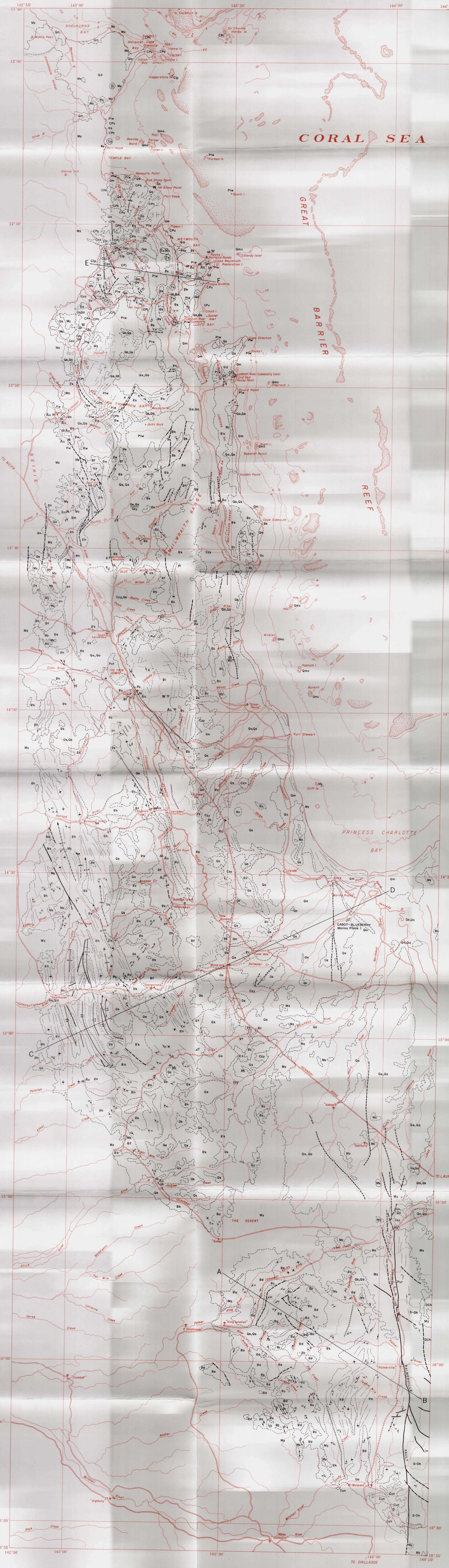
PRELIMINARY EDITION, 1970
SUBJECT TO AMENDMENT

IGNEOUS AND METAMORPHIC ROCKS
CAPE YORK PENINSULA AND TORRES STRAIT
QUEENSLAND AND PAPUA

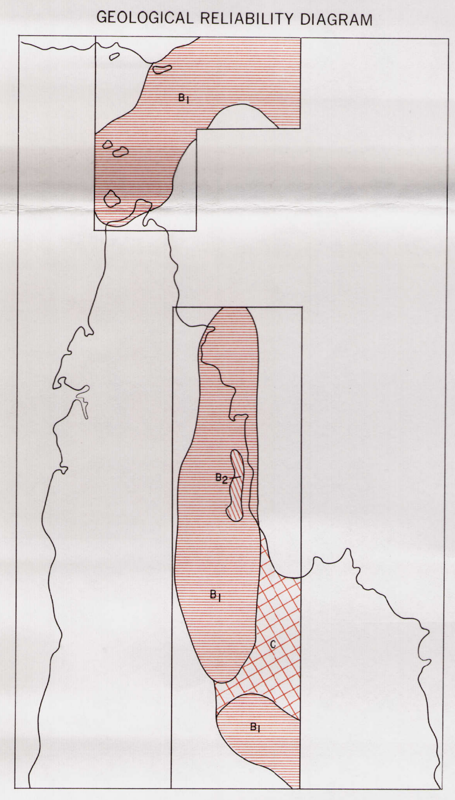
Scale 1:500,000

Compiled and published by the Bureau of Mineral Resources, Geology and Geophysics, in conjunction with the Geological Survey of Queensland. Issued under the authority of the Hon. R.W. Swartz, Minister for National Development

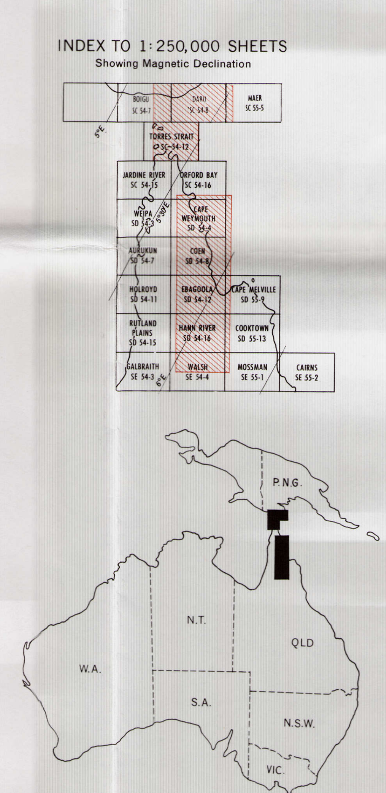
Geology, 1966-68 by D.S. Trail, W.F. Willmott, W.D. Palfreyman, I.R. Pontifex, R.F. Spark (B.M.R.) W.G. Whitaker (G.S.Q.)
Compiled, 1969-70 by W.F. Willmott and I. Chertok
Cartography by Geological Branch, B.M.R.
Drawn, 1970 by I. Chertok



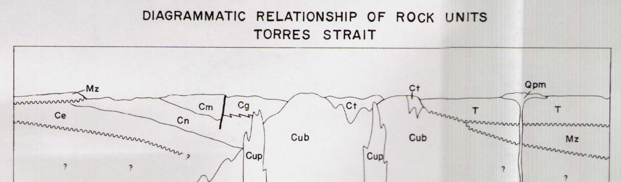
GEOLOGICAL RELIABILITY DIAGRAM



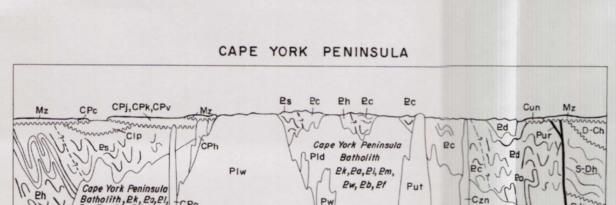
INDEX TO 1:250,000 SHEETS
Showing Magnetic Declination



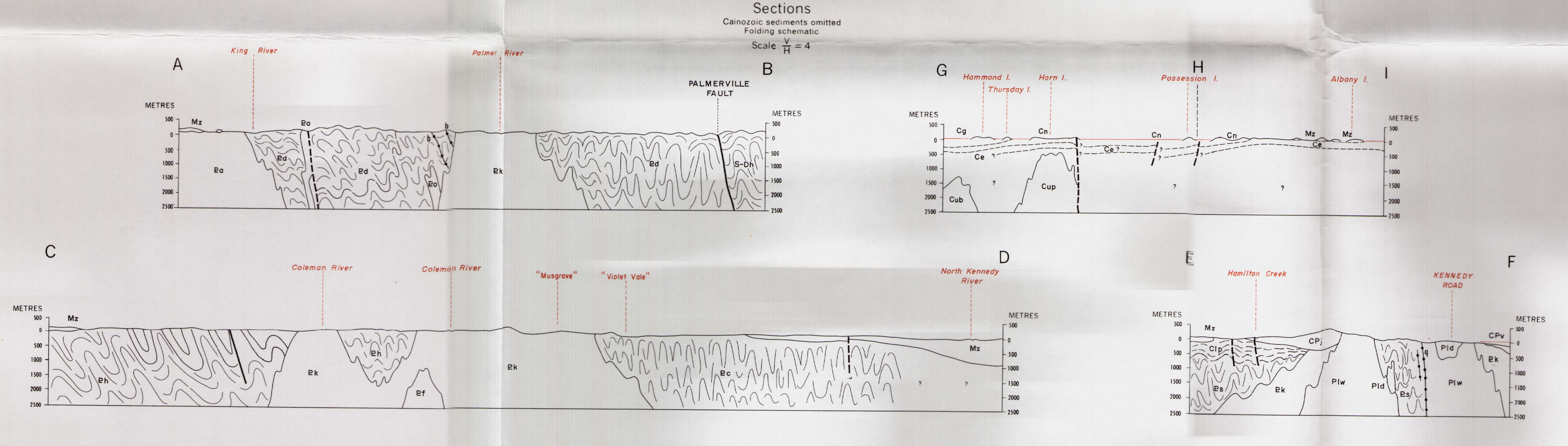
DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS
TORRES STRAIT



CAPE YORK PENINSULA



Sections



Reference

CAINOZOIC	QUATERNARY		Qm	Estuarine and coastal mud, beach sand; beach rock
			Qmc	Coral sand, shingle and beach rock
			Qd	Dune sand
			Qa	Alluvium, mainly silt
			Qs	Residual sand
	PLEISTOCENE	Maer Volcanics	Qpm	Basalt lava and tuff
	TERTIARY TO QUATERNARY	Yam Creek Beds	Cza	Poorly consolidated sandstone, some conglomerate
		Lilyvale Beds	Czy	Poorly consolidated sandstone and conglomerate
			Czn	Olivine nephelinite
	TERTIARY		T	Limestone, some mudstone, sandstone, conglomerate
MESOZOIC			Mz	Sandstone, conglomerate, siltstone
PALAEOZOIC	UPPER PERMIAN	Little River Coal Measures	Pur	Sandstone, shale, impure coal, limestone
		Twin Humps Adamellite	Put	Hornblende-biotite adamellite
	PERMIAN ?	Wolverton Adamellite	Pw	Leucocratic biotite adamellite and granite
	LOWER PERMIAN	Weymouth Granite	Plw	Biotite granite and adamellite, commonly porphyritic; some microgranite
			Pld	Biotite-hornblende diorite and tonalite
	LOWER CARBONIFEROUS TO LOWER PERMIAN		CPh	Granophyric and hybrid adamellite, granodiorite and granite
			CPo	Dolerite
		Cape Grenville Volcanics	CPc	Bedded volcanic breccia and tuff, welded tuff, rhyolite
		Kangaroo River Volcanics	CPk	Acid welded tuff, rhyolite, andesite; dacite ? and rhyodacite ? welded tuff
		Janet Ranges Volcanics	CPj	Rhyolite welded tuff, rhyolite, welded pumice-flow breccia; volcanic breccia, agglomerate; some hornfels
			CPv	Acid welded tuff, agglomerate; some andesite and meta-basalt
	UPPER CARBONIFEROUS		Cup	Porphyritic microgranite
		Badu Granite	Cub	Leucocratic biotite granite, porphyritic biotite granite and adamellite, hornblende-biotite adamellite and granodiorite
		Nychum Volcanics	Cun	Rhyolite welded tuff, andesite, basalt tuff, arkose, shale, coaly shale
	CARBONIFEROUS ?	Torres Strait Volcanics	Ct	Acid welded tuff, hornfels
		Muralug Ignimbrite	Cm	Grey rhyolite welded tuff; some rhyolite, volcanic breccia, and dacite ? welded tuff
		Goods Island Ignimbrite	Cg	Dark grey dacite, rhyodacite and dellenite welded tuff; some siltstone and sandstone
		Endeavour Strait Ignimbrite	Cn	Greenish grey rhyolite welded tuff, some agglomerate, volcanic breccia, rhyolite and andesite; local hornfels
		Eborac Ignimbrite	Ce	Light grey rhyolite welded tuff, some rhyolite and agglomerate
	LOWER CARBONIFEROUS	Pascoe River Beds	Clp	Sandstone, arkose, greywacke, siltstone, shale; some chert, tuff, coal and conglomerate
	MIDDLE DEVONIAN TO LOWER CARBONIFEROUS	Hodgkinson Formation	DCh	Greywacke, siltstone, slate; some chert, andesite, spilite and conglomerate
	LOWER SILURIAN TO LOWER DEVONIAN	Chillagoe Formation	SDh	Limestone, chert, quartz greywacke, siltstone, sandstone, conglomerate, basalt
	PROTEROZOIC OR UPPER DEVONIAN (Cape York Peninsula Batholith)	Blue Mountains Adamellite	Eb	Biotite adamellite, hornblende-biotite adamellite
		Morris Adamellite	Em	Porphyritic biotite adamellite
		Wigan Adamellite	Ew	Biotite adamellite and granite
		Lankelly Adamellite	El	Porphyritic biotite adamellite; some leucocratic muscovite granite and banded pegmatitic granite
		Kintore Adamellite	Ek	Biotite-muscovite adamellite, leucocratic muscovite granite and banded pegmatitic granite
		Aralba Adamellite	Ea	Porphyritic biotite-muscovite adamellite
		Flyspeck Granodiorite	Ef	Biotite granodiorite, hornblende-biotite tonalite, biotite-hornblende diorite
PRECAMBRIAN	PROTEROZOIC ?		Eo	Dolerite
		Sefton Metamorphics	Es	Muscovite schist, quartzite, mica-feldspar schist, hematite and magnetite-bearing schist and quartzite, greenstone amphibolite, calc-silicate rocks, limestone
				Mainly greenstone
		Holroyd Metamorphics	Eh	Fine to coarse mica schist, phyllite, slate, indurated sediments, quartzite, greenstone, amphibolite; some feldspathic schist, gneiss and migmatite
				Mainly quartzite
				Greenstone
		Coen Metamorphics	Ec	Mica schist, quartzite, biotite gneiss, amphibolite; some garnet-amphibole gneiss and calc-silicate rocks
				Mainly biotite gneiss and amphibolite
		Dargalong Metamorphics	Ed	Biotite gneiss, feldspar-mica schist, quartzite, amphibolite and migmatite
				Mainly sillimanite-muscovite schist and quartzite

Geological boundary
Anticline
Overturned anticline, showing direction of plunge
Syncline
Overturned syncline, showing direction of plunge
Fault
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 foliation
Vertical foliation
Plant fossil locality
Dyke: a - acid, i - intermediate, b - basic, q - quartz, p - porphyry
Oil exploration well, abandoned

Sn Tin
Si Silica
Ls Limestone
Road
Vehicle track