DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

Record 1973/187

PROGRESS REPORT ON THE GEOLOGY OF THE CARPENTARIA BASIN IN CAPE YORK PENINSULA

by

H.F. Doutch, J. Smart, K.G. Grimes*, D.L. Gibson and
B.S. Powell

* Geological Survey of Queensland;
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CONTENTS

FIGURES

TABLES

APPENDIXES

PLATES

SUMMARY

(H.F. Doutch)

Field work in the northeastern Carpentaria and western Laura Basins in 1972 covered the 1:250 000 Sheet areas of WEIPA, AURUKUN, HOLROYD, CAPE WEYMOUTH, EBAGOOLA, HANN RIVER and part of COEN.

Mesozoic stratigraphy erected in the southern part of the Carpentaria Basin can apparently be applied subsurface everywhere in the survey area. It can be applied without difficulty to outcrops of the Jurassic and earliest Cretaceous sandstone sequence along both basin margins, but basinwards outcrop is too sparse to permit regional subdivision of the overlying Early Cretaceous mudstone sequence by surface mapping.

Cainozoic stratigraphy is concerned with piedmont plain and valley fill deposits and their marine extensions, and with interrupting episodes of deep weathering which produced siliceous, ferruginous, and bauxite crusts.

Bauxite is thought to have formed by in situ weathering of high alumina parent material in a tropical or sub-tropical climate with heavy seasonal rainfall. Its thickest development is on interfluves where groundwater fluctuations are greatest.

INTRODUCTION

(H.F. Doutch)

This Record contains results of reconnaissance geological mapping in Cape York Peninsula in 1972 by a joint field party of the Commonwealth Bureau of Mineral Resources, Geology and Geophysics (BMR) and the Geological Survey of Queensland (GSQ).

Concurrent drilling by a BMR rig is reported by Gibson et al. (1973).

A close stratigraphic analysis of cores, cuttings, and wire-line logs of deep water-bores in the Weipa area is made by D.L. Gibson (BMR) in Appendix 1.

During the field season Dr R.W Day (GSQ) collected macro-fossils in the survey area. His preliminary report on them is included as Appendix 2. Mr D. Haig (University of Queensland) collected material to examine for foraminifera; his work is still in progress.

Fossils and cuttings from a private shallow water-bore at Rutland Plains, south of the survey area, were examined by Drs Day, Palmieri, and Fleming (GSQ). Their report, with comments by Doutch, makes up Appendix 3.

J. Smart (BMR) tempers the findings in recent literature and reports with field observations in a discussion in Appendix 4 on the occurrence and development of bauxite.

Before field mapping started C. Maffi (BMR) prepared photo-geological interpretations of WEIPA, AURUKUN, HOLROYD, and parts of CAPE WEYMOUTH, COEN, and EBAGOOLA. These were on mosaics at approx 1 mile : 1 inch; no written report was prepared. C. Simpson (BMR) prepared a file note on the photogeology of HANN RIVER.

ERRATUM

Work done since preparation of this Record has led to the substitution of the name 'Garraway Beds' for 'Wreath Sandstone' and 'Wenlock Conglomerate Member'.

PHYSIOGRAPHY

(D.L. Gibson)

The area covered in this Record can be divided into three broad physiographic elements: the uplands of Cape York Peninsula (these constitute the Great Dividing Range in this area), the relatively narrow eastern coastal plains, and the extensive western plains. Physiographic subdivisions are shown on Figure 1 and discussed below. Many of the boundaries between physiographic units coincide with geological boundaries because of the varying intensities and effects of weathering and erosion on different rock types, and the effect that landform has on sedimentation and vice versa. Depositional land forms are mostly a consequence of downwarping or downfaulting.

Some of the physiographic units have been described before (Doutch et al., 1972); some modifications to units described by Trail et al. (1968, 1969) and Willmott et al. (1971) have been necessary. Physiographic units in the southern half of the area correspond roughly with Land Systems units erected by Galloway et al. (1970).

The uplands and associated landforms

The Richardson Uplands (new name) is an area of low rounded hills on Mesozoic sandstone with local relief of up to 75 m; the highest peak is just under 150 m. A small dissected scarp separates the uplands from the Olive River Dunefield in the east and the Olive-Pascoe Lowlands in the south. The uplands merge with the Merluna Plain in the west.

The Glennie Tableland (called Mesozoic Escarpment by Trail et al., 1969) is a dissected area of Mesozoic sandstone and siltstone at the eastern margin of the Carpentaria Basin in CAPE WEYMOUTH and Coen. Scarps within the tableland are up to 100 m high; some scarps are fault-controlled. Local relief is up to 200 m. The tableland is generally less than 300 m above sea level.

The McIlwraith-Tozer Uplands (new name) consists of the upland pre-Mesozoic basement rock areas in COEN and CAPE WEYMOUTH, and corresponds to the McIlwraith Plateau, Birthday Mountain, the Mount Carter Block, 'Undulating Country', part of the Pascoe River Plateau, the

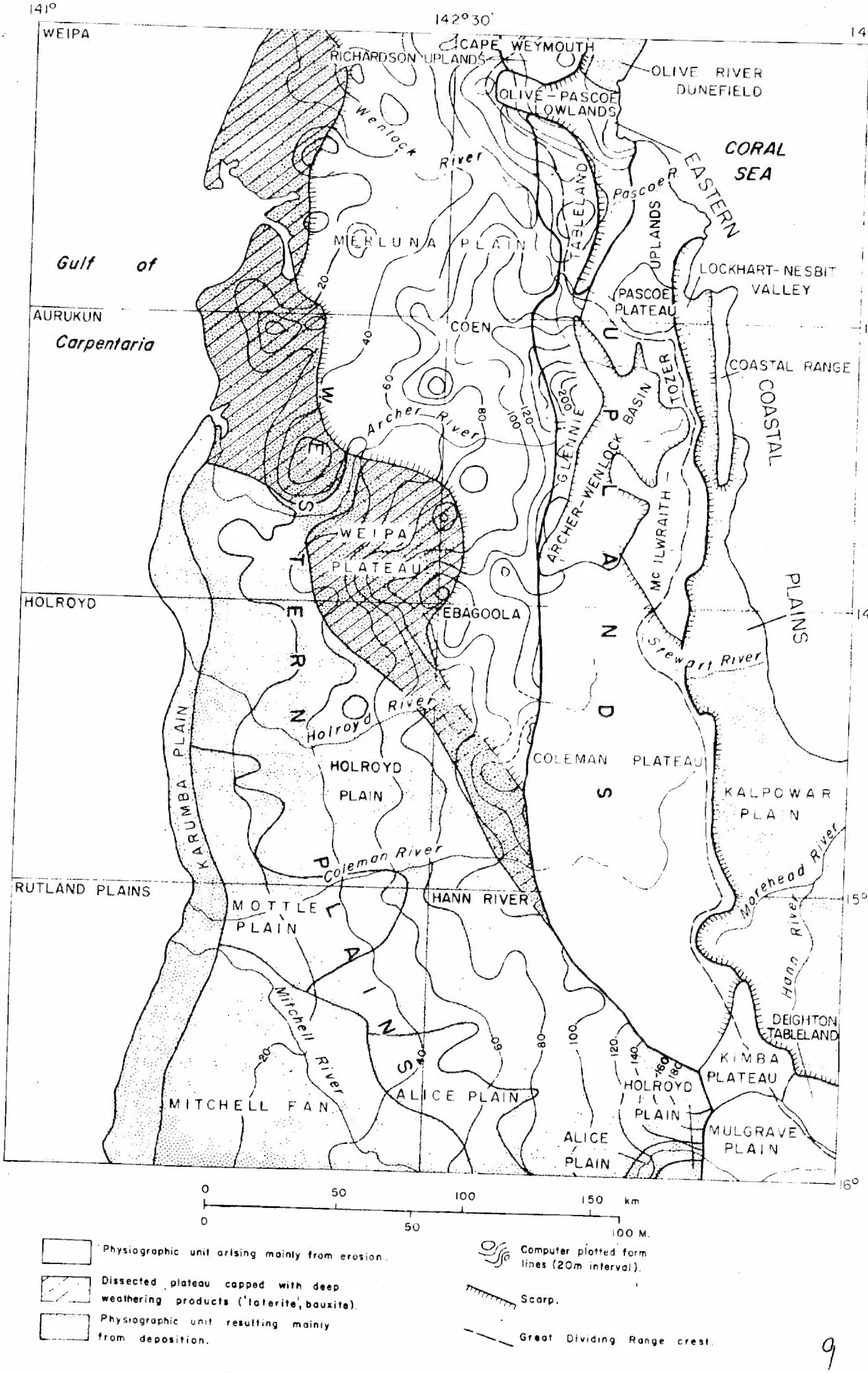

Figure 1. Physiographic units.

To accompany Record 1973/187

Janet Mountain Block and the Iron Range Coastal Lowlands, of Trail et al., 1969. These units are valid, but not comprehensive - e.g., the McIlwraith Plateau, consisting of granite and metamorphic rocks, can be subdivided in COEN into at least four separate units of different elevations between 600 and 200 m. Mount Carter in northern COEN consists of metamorphic rocks and rises abruptly to over 600 m. To the west and northwest of this, the part of the Sir William Thompson Range developed on basement rocks forms a plateau at about 300 m in northern COEN and southern CAPE WEYMOUTH. Further north, several ranges of granite and acid volcanics with peaks up to 500 m (the Janet Ranges Mountain Block) make up the northern part of the uplands. East of this block the Iron Range Coastal Lowlands consist of low strike ridges of metamorphic rocks up to 150 m high and somewhat higher granite hills.

The Pascoe Plateau (new name: the Pascoe Plateau corresponds to part of the 'Pascoe River Plateau' of Trail et al., 1969) is a plateau with respect to the Lockhart-Nesbitt Valley in the east, although at about 220 m it is lower than the McIlwraith-Tozer uplands which surround the plateau on three sides. It is a flat subcircular sand-covered (Czs) area of granite about 20 km across. The Pascoe River rises at the eastern margin of the plateau and has cut down through the western edge.

The Archer-Wenlock Basin, which includes the Archer River Piedmont Basin of Willmott et al. (1971) is the large flat-floored enclosed valley of the Archer and Wenlock Rivers which has been cut back into the McIlwraith-Tozer Uplands and the Glennie Tableland. Some of the material derived from this erosion has been deposited over the floor of the basin as poorly consolidated sandstone and conglomerate - the 'Falloch Beds' (this Record), which may be up to 30 m thick. The basin is bounded to the east and north by the scarp of the McIlwraith-Tozer Uplands which is up to 300 m high. Many streams running from the uplands into the basin have marked nick-points, and there is a nick-point in the Archer River where it leaves the basin.

The Coleman Plateau (Willmott et al., 1971) is a largely sand-covered undulating plateau formed on the granitic and metamorphic rocks of the Coen Inlier in HANN RIVER, EBAGOOLA and southern COEN.

Maximum elevation of the plateau is about 230 m near the Stewart River in the north, and in the south and west it drops to about 130 m. Local relief is generally less than 75 m, although several sharp strike ridges of metamorphic rock, mostly quartzite, rise up to 150 m above the plateau surface, and fringe it in places on its eastern and western sides. The extensive sand cover on the plateau is thought to be mainly colluvial (Czs).

The Kimba Plateau (Trail et al., 1968), locally known as 'The Desert' is a flat waterless forrested plateau of Mesozoic sediments overlain by Bulimba Formation, which connect the Laura and Carpentaria Basins over the Kimba Arch. Its maximum elevation is 360 m.

It is dissected along its eastern, souther, and northern margins, but merges with the Holroyd Plain in the southwest. The drainage pattern and contours suggest that the plateau is bounded by warps or faults.

The Deighton Tableland (Lucas & de Keyser, 1965) is a dissected area of Mesozoic sandstones flanking the southern end of the Kalpowar Plain, at the southern margin of the Laura Basin.

The Mulgrave Plain (Amos & de Keyser, 1964) is the gently undulating country formed on the granitic and metamorphic rocks of the Yambo Inlier in southeastern HANN RIVER. The plain is broken by a number of rugged quartzite strike ridges.

The eastern coastal plains and associated landforms

The Olive River Dunefield (Willmott et al., 1971; the Olive River Sand Dune Area of Trail et al., 1969) is composed of large northwest-trending longitudinal sand dunes. They have an average height of 30 m, but some are up to 90 m high. Many dunes are still active, advancing to the northwest under the influence of the prevailing southeast winds. Others have been stabilized by thick low brush. The dunes have probably resulted from the reworking of residual sand derived from the weathering of underlying Mesozoic sandstones.

The Olive-Pascoe Lowlands (new name; Trail et al., 1969 call this area 'Undulating Country') is a general term used to cover low lying areas (below 100 m) to the east of the Great Divide in CAPE WEYMOUTH. Topography ranges from low rounded hills to the north to more sharply incised regions of the Pascoe River valley in the south.

The Lockhart-Nesbitt Valley (Trail et al., 1969) is a north-trending corridor up to 12 km across in eastern COEN and south-eastern CAPE WEYMOUTH; it has probably formed along a fault zone. Thick deposits of clayey quartzose sandstone (the Lilyvale Beds, Czv) derived from the McIlwaith-Tozer Uplands to the west cover much of the valley floor; basement bedrock is exposed between the headwaters of the Lockhart and Nesbitt Rivers. The mouth of the Lockhart River which drains to the north has been drowned, but is filled by prograding mangrove swamps which extend for several kilometres inland from the coast.

The Coastal Range (Trail et al., 1969) is made up to the Heming, High, Chester, Meston, Adam, Howard, Macrossan, and Embley Ranges which are short steep granitic ridges up to 380 m high separated by low saddles. The peaks of the ridges are at an elevation similar to that of the McIlwraith-Tozer Uplands: hence it is thought that the Coastal Ranges might be a part of the McIlwraith-Tozer Uplands separated off by the downfaulting of the Lockhart-Nesbitt Valley.

The Kalpowar Plain embraces the Jack Peneplain and Normanby Sediplain of de Keyser and Lucas (1968).

The Kalpowar Plain may be divided into a number of sub-units.

To the west and north sand-covered and well vegetated interfluves between shallow stream valleys predominate. The interfluves are generally covered by loose residual sand which is derived from poorly consolidated Cainozoic sandstone and conglomerate (Lilyvale Beds, Czv) though metamorphics are exposed on some of the most westerly interfluves.

In EBAGOOLA several north-trending sandy rises up to 60 m high and carrying tall trees are probably underlain by Mesozoic sediments (Czs/JK).

At the southern end of Princess Charlotte Bay a flood plain mainly of heavy clay soils extends up to 80 km inland. The streams crossing the floodplain are braided; they form a distributory pattern in the west where Lilyvale Beds are close to the surface, and this may be controlled by Quaternary movements of the Palmerville Fault.

Coastal deposits consist of beach ridges, clay flats and saltpans, and grassed plains of black soil. They are equivalent to the Karumba Plain along the west coast of Cape York Peninsula and similarly, rivers take on a meandering habit within the zone. Willmott et al. (1971) claim that the

12

beach ridges indicate an emergence of about 3 m. Galloway et al. (1970) claim that there is no evidence that the sea was ever more than 'a few tens of feet' above its present level during the Pleistocene. However, photo interpretation suggests that a very old set of beach ridges extend up to 30 km south of the present coastline of Princess Charlotte Bay. They have almost been entirely eroded away and covered with flood plain sediment. According to BMR gravity station spot heights these ridges are at least 13 m above present sea level. Their age is unknown, and they may have been affected by Palmerville Fault movements.

The western plains

The Weipa Plateau (new name) is a partly dissected plateau of the Bulimba Formation (KTi) capped by resistant bauxite (Tw) or ferricrete (Tf) (see chapter on deep weathering). The plateau surface rises from an elevation of between 5 and 30 m in the west to as much as 140 m in the east. Local variations of 50 m in 10 km are not unusual on the plateau surface. The lowest areas affected by deep weathering generally coincide with major river valleys and may represent a pre-bauxite land surface. However, Evans (1959) has suggested that the bauxite surface has been gently uplifted and warped, and Maffi (pers. comm.) has photo-interpreted possible fold axes on the plateau (See Appendix 4).

A dendritic drainage pattern of sparsely distributed broad shallow stream beds predominates. Major river valleys have been drowned at the coast, indicating a recent rise in sea level.

In the interfluves subcircular depressions up to 1 km across filled with grey clay are common. They are described on the preliminary maps and appear as Plates with this Record as 'intermittent lakes with heavy clay floor'. They are similar to features in the Wyaaba Beds in MILLUNGERA and GILBERTON to the south. Valentin (1959) has tentatively suggested that the depressions are forms of an unusual 'tropical pseudo-karst' resulting from the solution of silica. They are most common near the coast.

In the south the Weipa Plateau merges with the Holroyd Plain which in AURUKUN and HOLROYD has a denser but similar drainage pattern. Computer-plotted form-lines based on helicopter gravity survey elevations show that the Holroyd Plain has a greater slope than the Weipa Plateau.

A scarp separates the Weipa Plateau from the Merluna Plain (new name) which is an undulating area developed on sediments of the Rolling Downs Group and the Bulimba Formation. A few small outliers of laterite thought to be equivalent to the bauxite on the Weipa Plateau have not been shown on Figure 1. The Plain is being created at the expense of the Plateau.

Broad swampy depressions and 'melon hole' (gilgai)- affected clay soils are common in lower areas of the plain. Hallsworth (1968) attributes the formation of gilgai to the forcing upwards of large blocks of soil in the wet season, possibly by the swelling of soil that had fallen down cracks when the soil was dry; however, Evans (1959, 1965) claims that the 'melon holes' result from leaching of sediments of the Rolling Downs Group. This origin seems unlikely as 'melon holes' in thick alluvium overlying the Bulimba Formation were observed during the 1972 field season.

The Holroyd Plain (Doutch et al., 1972) consists of low rounded sandy interfluves separating shallow swampy valleys. Local relief is less than 5 m. The streams crossing the plain are inactive and choked by detritus and the whole environment appears to be one of low energy. The drainage pattern is elongate dendritic with a dominant southwest trend over most of its area; it developed, and probably stagnated, before the recent erosional episode which is removing the Weipa Plateau to produce the Merluna Plain, and which has resulted in slight incision of a few streams in the plain.

The eastern margin of the Holroyd Plain is developed on the Bulimba Formation (KTi), but for the most part the plain consists of Wyaaba Beds (Czy).

The Alice Plain (Doutch et al., 1972) is primarily the flood plain of the Alice River. The river is incised into the plain, but relief rarely exceeds 2 m. The regional form-line pattern suggests that the Alice Plain is topographically lower than the Mitchell Fan, and erosion now dominates over deposition, as in the fan.

The Mottle Plain (Doutch et al., 1972) is similar to the Alice Plain, although more alluvium is probably being deposited than eroded, perhaps because its source area, the Holroyd Plain, is close to the coast here.

The Mitchell Fan (Doutch et al., 1972) lies below 55 m elevation and consists of Pleistocene to Holocene fluvial sand, silt, and clay. There are many active channels characterised by slight incision. 'Covered' plains (Twidale, 1966) associated with distributary drainage systems occur over the greater part of the fan.

The older sands of abandoned river channels (Qas) may in some places be older than flood-plain alluvium (Qa), in others contemporaneous or possibly younger. The younger sands (Qha) are mostly in short-lived deposits in active drainage channels.

The Karumba Plain (Twidale, 1956 a & b; Doutch et al. 1972; Needham & Doutch, in press) forms a continuous fringe up to 20 km wide along much of the west coast of Cape York Peninsula. Clay flats and saltplans (Qhp) and grassy plains of black soil (Qac), form swales between subparallel series of beach and sand ridges (Qm, Qml), which are thickly wooded inland and become scrubby towards the coast. The beach ridges rise 8-10 m above the pans and plains. The salt pans and associated mud flats are seasonally inundated by salty or brack sh waters, and halophytic plants commonly grow along their margins. Mangroves grow mostly along the lower parts of major rivers and are relatively sparse along the coast. Tidal megaripples parallel the shore in some places.

The most conspicuous feature of the coastal deposits of the Karumba Plain are the beach ridges (Qm, Qml). They represent episodes of coastal prograding related to sea level fluctuations in the Quaternary. Coastal accretion was and is mostly by the deposition of silty clay in the form of mud flats which are usually exposed at low tide. This sediment is supplied by large rivers such as the Archer and Mitchell, and re-distributed along the coast by current action. Winnowing in the inter-tidal zone and the accumulation of shell material has resulted in the building of beach ridges.

The older beach ridges (Qml) occur between 20-35 km inland and are subparallel to the present coastline. They consist of belts of sandy soil favoured by trees and have little relief. No abandoned river deposits (Qas) have been identified west of them. They appear to have been strands during the furthest transgression of Quaternary seas, when sea level was higher than at present.

Recent beach and sand ridges (Qm) occur as far inland as 10 km from the coast. They are made up of predominantly shelly, sandy deposits and have crests 4 to 6 m above present sea level. Beach ridges have been studied by Jackson (1902), Valentin (1959; 1961), Whitehouse (1963), and by Twidale (1956a, 1966) who reports a radiocarbon date of 3320 $\pm$ 125 years for a ridge near Karumba. Shells from ten beach ridge localities between Snake Creek in GALBRAITH and the Archer River in AURUKUN give radiocarbon dates between 470 & 5630 years BP. These and later samples will be discussed by Carpentaria Basin Party members in a later Record.

The swales between beach ridges are generally occupied by coastal alluvium. Auger holes drilled in swales between beach ridges near the Edward River Mission by Whitehouse (op. cit.) suggest that beach sand has been deposited as a continuous sheet over marine muds, and that high-energy waves from time to time have built up beach material to form ridges during arrested stages of shore progradation. Silty clays were deposited in the lagoons that formed in the swales when sea level dropped and the coastline advanced.

Black soil has commonly developed in the swales. In lower swales periodically inundated by salt water, salt pans develop (Qhp); salt pans also commonly border rivers and creeks. They contain up to 2mm of fibrous salt crystals over dark grey silty clay, peaty in appearance. The salt crystals are loosened and blown away by the wind, sometimes forming tiny 'dunes' at the margins of the pans and around obstacles such as branches lying on the surface of the pan. Jackson (op. cit.) reported on the distribution and occurrence of salt deposits.

Drainage originating in the plain is controlled by the characteristics of beach ridges and swales. Most rivers meander across the plain and a decrease in velocity on reaching the plain probably causes this. The decrease is due in part to tidal influences, in part to flatter slopes resulting from coastal processes. During the wet season each year the plain is inundated and this also shows rivers down when they enter it. When river velocity decreases relative to load, sediments are widely deposited in areas adjacent to river channels and in the sea along the coast; the latter sediments are removed by coastal currents. The relative increase in river volume and load in the wet seasons causes downstream migration of river channels by point-bar deposition of sediment along the lee of meanders, and erosion of the opposite bank.

The courses of smaller creeks are commonly deflected by beach ridges, whereas the larger rivers have disrupted and breached the ridges during downstream meander migration. In some cases beach ridges and river courses have developed together. The bars and spits at the mouths of many rivers and creeks are deflected by longshore currents.

Salt and clay pans are drained by radial gutters on the insides of meanders and by dendritic streams elsewhere (Twidale, 1966).

Development of physiography

Twidale (1966), has pointed out that the surface on which the Mesozoic sediments of the Carpentaria Basin were deposited has been exhumed to form part of the present land surface in the region a little to the south of the area covered in this Record. Similarly Willmott et al. (1971) recognized that three large plateaux of granitic rocks in EBAGOOLA, COEN, and CAPE WEYMOUTH - the Coleman Plateau (see previous descriptions in this chapter), the 'McIlwraith Plateau' (that part of the McIlwraith-Tozer Uplands south of about 13°5S), and the 'Pascoe River Plateau' which in this report is covered by the Pascoe Plateau and part of the McIlwraith-Tozer Uplands immediately surrounding it - are part of a modified peneplain on which Mesozoic sediments were deposited; they said that in HANN RIVER the surface corresponding to the Coleman Plateau is overlain by the Mesozoic sediments of the Kimba Plateau, and that in central COEN Mesozoic sediments lie at an elevation of about 350 m on a surface that is 'probably a dissected remnant of the McIlwraith Plateau'. In northernmost COEN and southern CAPE WEYMOUTH they also noted that several small outliers of Mesozoic sediments at an elevation of about 220 m sit on a flat-topped area of the McIlwraith-Tozer Uplands. These flat-topped areas may be remnants of a pre-Cretaceous surface, but the surface has been broken up into at least five major blocks of different elevations by post-Lower Cretaceous block-gaulting. It is probable that the Coleman Plateau is part of the pre-Cretaceous surface which has not been upfaulted as much as the uplands; there appears to have been only minor block-faulting within the plateau.

The block-faulting followed the deposition and lithification of the Lower Cretaceous sediments of the Carpentaria Basin and created the ancestral uplands of Cape York Peninsula. It was followed by erosion and the deposition of the Bulimba Formation (KTi) in the west, and the Yam Creek Beds (KTa) in a small intramontane basin.

Erosion of the Bulimba Formation followed, caused by a climatic change or drop in stream base level. This was followed by a stable period in which 'lateritization' took place. After this event a downwarp along the Alice-Palmer structure formed the Gilbert-Mitchell Trough in which the Wyaaba Beds were deposited on the eroded and 'lateritized' Bulimba Formation.

In the Uplands, faulting and erosion produced the Archer-Wenlock Basin and the scarp along the western edge of the Kalpowar Plain. The basin and plain were inundated with coarse unsorted detritus from the uplands, possibly at the same time as the Wyaaba Beds were being deposited.

After the deposition of the Wyaaba Beds there was a further period of deep weathering which upgraded the bauxite formed on the Bulimba Formation and moderately 'lateritized' the Wyaaba Beds and equivalent units.

Following this, a drop in sea level (probably as a result of the Pleistocene glaciation), and perhaps gentle uplift of the 'lateritized' surface in the central part of Cape York Peninsula, initiated a new period of erosion which began destroying the laterite/bauxite surface. Later, sea level rose causing the drowning of river valleys near the coast and increasing flood-plain deposition. A recent drop in sea level of 10 m or more has left behind the coastal beach ridge complexes.

MESOZOIC GEOLOGY

(K.G. Grimes
and B.S. Powell)

Chronostratigraphy

The Mesozoic stratigraphic nomenclature used by Smart et al. (1971, 1972) in the southern Carpentaria Basin is extended into the survey area, where some additional units have been recognized.

Two of these units occur at the base of the basin sequence in the north of the survey area, in CAPE WEYMOUTH: the Jurassic 'Wreath Sandstone', and its basal 'Wenlock Conglomerate Member'. These names are informal for the time being. Other equivalent units have been named further north (Zolnai et al., 1965). They are all probably time equivalents of the Eulo Queen Group of the southern part of the basin, but are not continuous with it.

Above them lie the Jurassic-earliest Cretaceous sandstones of the Gilbert River Formation. This unit is apparently continuous subsurface over the whole of the basin. It thins along the basin margin in the survey area and is overlapped in many places by the Wallumbilla Formation.

The Wallumbilla Formation mudstones cannot be differentiated from the Allaru Mudstone in the survey area because the Toolebuc Limestone, which separates them elsewhere in the basin, apparently pinches out to the south in the Staaten River Embayment, in WALSH and RUTLAND PLAINS. Nor can the overlying Normanton Formation, the youngest unit of the Carpentaria Basin sequence, be separated from the Allaru Mudstone in the survey area in most places.

The whole, apparently conformable, sequence above the Gilbert River Formation has therefore been mapped as a single unit, the early Cretaceous Rolling Downs Group, except for some outcrops which can reasonably be called Wallumbilla Formation.

Carpentaria Basin stratigraphic nomenclature can be extended in part into the Laura Basin, as the older rocks of the two basins are continuous over the Kimba Arch (see HANN RIVER, and Figs 2,3). Sandstone, which forms the lower part of the Battle Camp Formation of the Laura Basin (Lucas & de Keyser, 1965) is continuous with the Gilbert River Formation, and the mudstone of the upper part with the lower beds of the Wallumbilla Formation. However, because the upper beds of the Wallumbilla Formation are not present over the Kimba Arch the possibility cannot be ruled out that they may be of the same age as the lower part of the Wolena Claystone of the Laura Basin. However, foraminifera from one locality in the Wolena Claystone have an Albian age, the age of the Allaru Mudstone, which is younger than the Wallumbilla Formation by Superposition and palaeontology.

The Laura Basin Dalrymple Sandstone (de Keyser & Lucas, 1968) occurs in the survey area disconformably and unconformably underlying the Gilbert River Formation; it is not continuous into the Carpentaria Basin. It may be of the same age as the 'Wreath Sandstone' and the Eulo Queen Group.

19

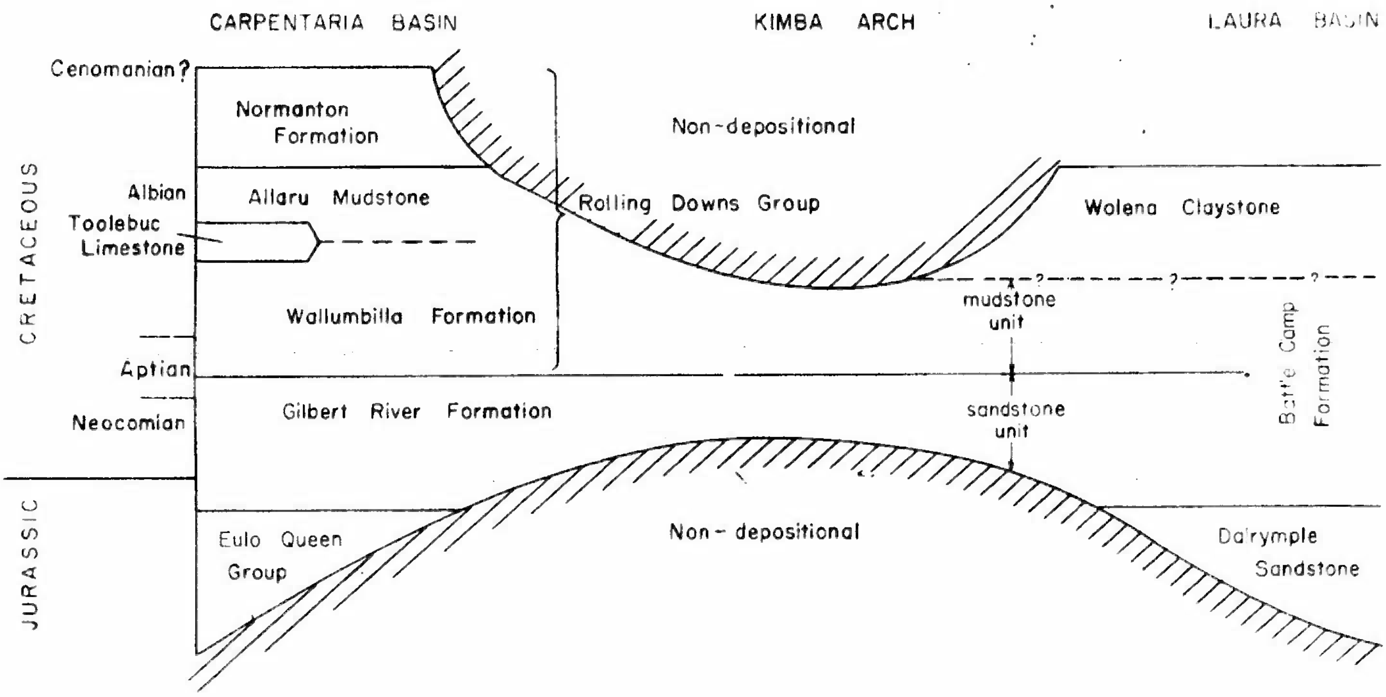

Fig. 2 Mesozoic correlations across the Kimba Arch

To accompany Record 1973/187

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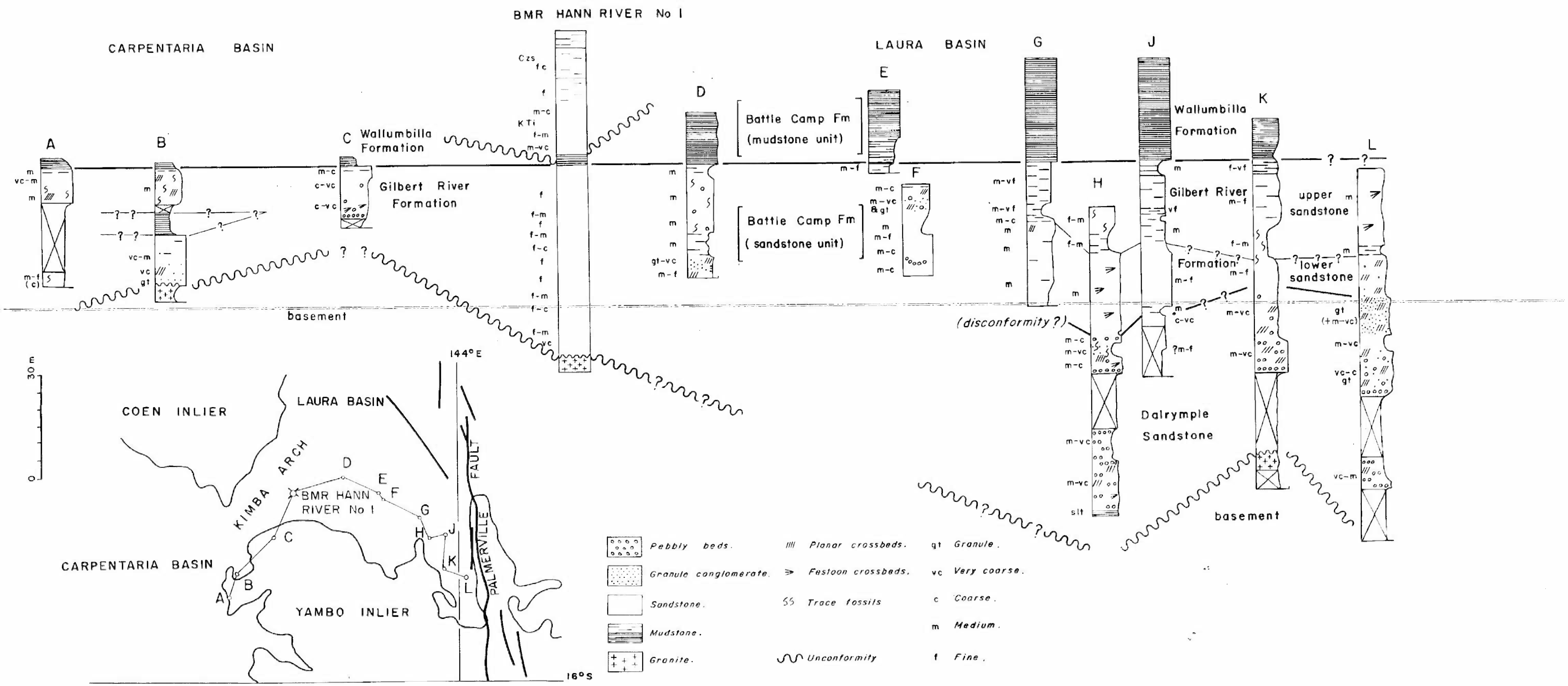

Fig. 3 Correlation of rock units between the Carpentaria and Laura Basins

To accompany Record 1973/187

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Mesozoic stratigraphy in the survey area is summarized in Table 1. A composite section of the succession in southeast HANN RIVER is shown in Fig. 4. Appendix 2 is a report on macrofossils collected in the survey area in 1972 by R.W. Day and D.W. Haig. Haig is currently examining foraminifera from the area. It appears that chronostratigraphic boundaries will eventually be recognized in the Weipa area, within the Rolling Downs Group at least.

Lithostratigraphy

The Jurassic sequence

In the Laura Basin, and in the Olive River Pascoe River area (CAPE WEYMOUTH), the Jurassic to Cretaceous Gilbert River Formation is underlain by older fluviatile Jurassic sandstones.

The Dalrymple Sandstone in the Laura Basin has been described adequately by de Keyser & Lucas (1968). A summary of the lithology is given in Table 1, and its general characteristics in outcrop shown in Fig. .

The 'Wreath Sandstone' (Zolnai et al., 1965) underlies the Gilbert River Formation with apparent conformity in the Olive River Basin area. The unit extends northwards from Garraway Creek, a tributary of the Pascoe River, to Double Point in Shelburne Bay. It may also be equivalent to other sandstone units seen during reconnaissances further north. Gibson interprets it as occurring in ZCL Weipa No. 1 (Fig. 2 of Appendix 1). By analogy with the Burketown, Canobie, and Millungera Depressions (Doutch et al., 1970) the area it occupies is called the Weipa Depression.

The formation consists of white to fawn clayey micaceous fine to medium-grained quartzose sandstone which is poorly to moderately sorted and has tabular crossbeds. There are minor conglomerates and some carbonaceous beds. The lithology is similar to the overlying Gilbert River Formation, but the 'Wreath Sandstone' is characterized by tabular crossbeds, a greater abundance of conglomerates, more clayey matrix, and it is micaceous.

22

The 'Wreath Sandstone' contains the most productive aquifers known in this largely untapped northern part of the Great Artesian Basin (see section on Economic Geology).

In places there is a basal poorly sorted polymict conglomerate, with an abundant argillaceous matrix. This is the 'Wenlock Conglomerate Member', which fills hollows in the unconformable surface of basement rocks. It may be a time transgressive basal unit, as similar beds underlie the Gilbert River Formation at Wenlock, where coal beds and a lower Cretaceous flora are present.

In the Temple Bay area the 'Wreath Sandstone' appears to be represented by the 'Four Cliffs Member' of Zolnai et al. (op. cit.). In this sequence sandstones, which are similar to the 'Wreath Sandstone', though slightly feldspathic, are interbedded with dark grey silty and sandy shales, micaceous siltstones, and thin conglomerate beds. There is a basal polymict conglomerate which overlies a flat unconformity surface at the 'type' area (Red Cliffs, 649439y).

Further north, in Torres Strait, the 'Albany Pass Formation' (Zolnai et al., op. cit.) may also be an equivalent of the 'Wreath Sandstone'.

All these Jurassic units probably represent fluvial valley deposits which spread with time to form fluvial plains. They are overlapped by the more widespread Gilbert River Formation.

The Jurassic-Cretaceous sandstones

The Gilbert River Formation is a widespread unit extending throughout the Carpentaria Basin. In the survey area it is apparently conformable on the 'Wreath Sandstone'. In the Laura Basin, where it is the lower, sandstone, part of the Battle Camp Formation of Lucas & de Keyser (1965), it is disconformable on the Dalrymple Sandstone in the west, overlying it with angular unconformity further east (cf. de Keyser & Lucas, 1968).

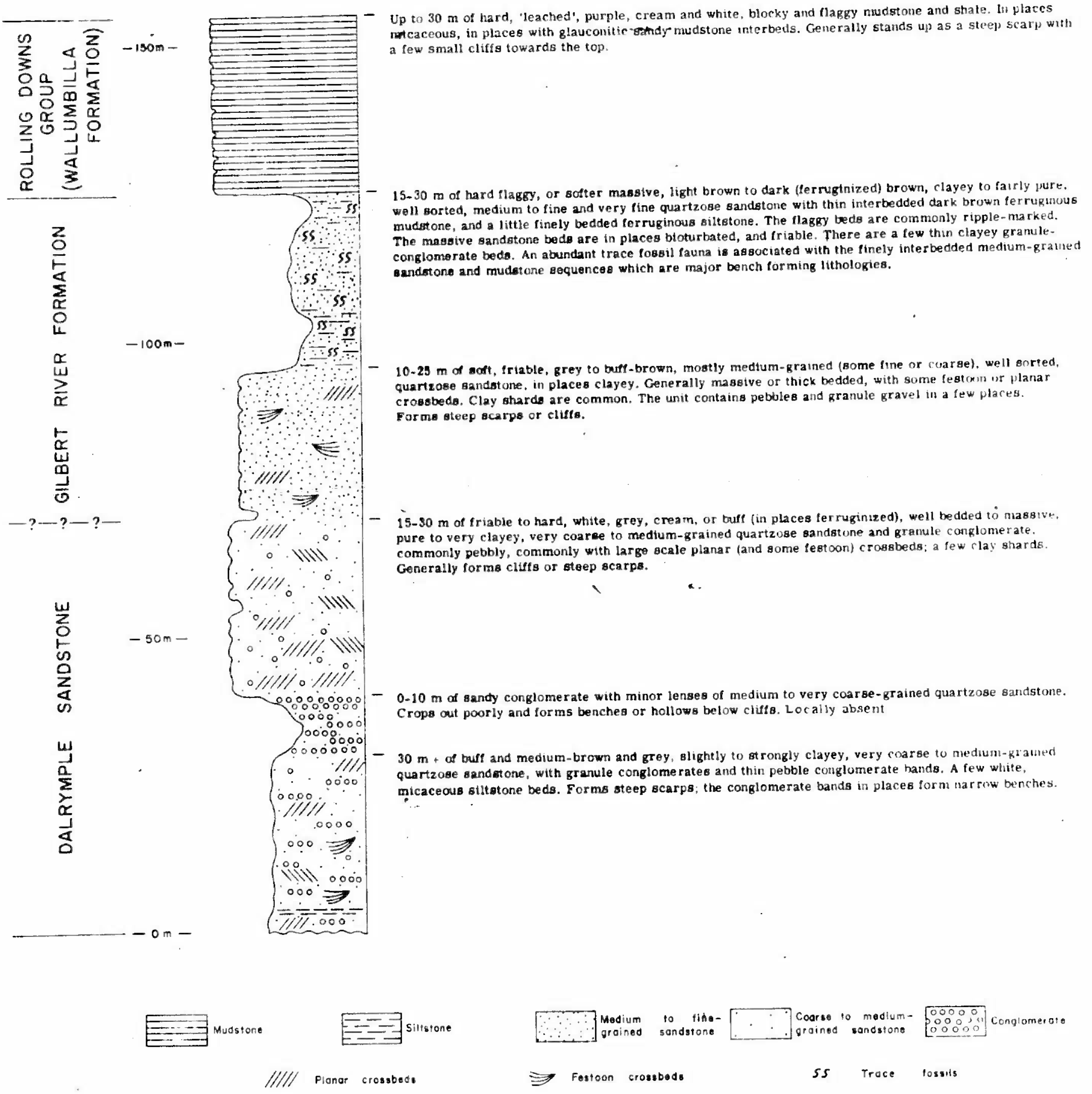

FIG. 4 COMPOSITE SECTION — MESOZOIC SUCCESSION — SOUTHEASTERN HANN RIVER SHEET

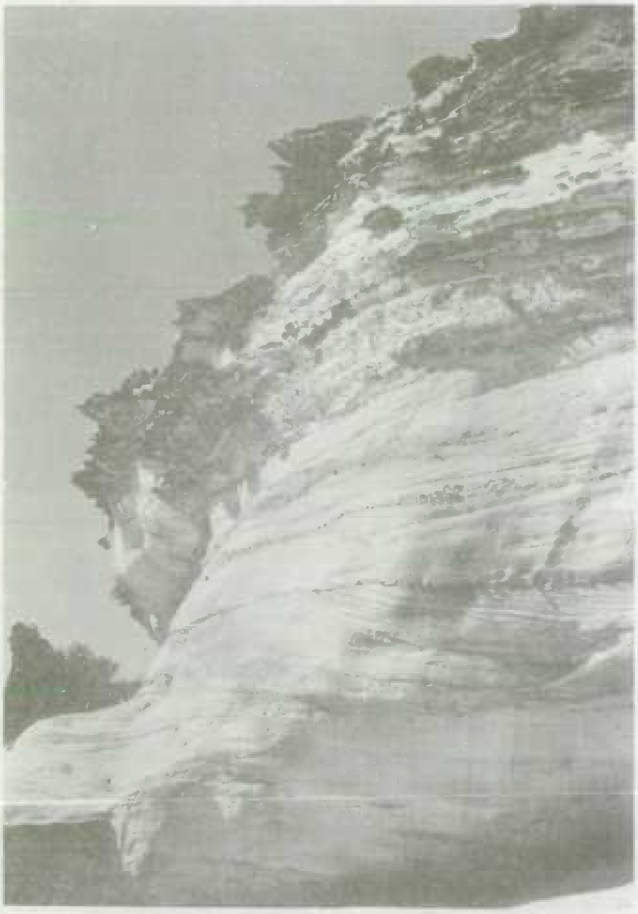

Fig. 5

Mesozoic Sandstone (JK), ferruginized at top. Cliff Islands, Princess Charlotte Bay. EBAGOOLA (Laura Basin)
Neg GA 8245

Mesozoic Sandstone sequence

Fig. 6

Gilbert River Formation (JKg), Glennie Tableland, COEN
Neg M 1520

The terms Gilbert River Formation (Laing & Power, 1959; Smart et al., 1971) and Wallumbilla Formation (Clarke, 1865; Vine et al., 1967), have precedence over the more recent term Battle Camp Formation (Lucas & de Keyser, 1965) and we have therefore used the Carpentaria Basin nomenclature in mapping the western parts of the Laura Basin in HANN RIVER and EBAGOOLA (Figs 2, 3, 4).

In the western Laura Basin the Gilbert River Formation is up to 50 m thick in outcrop around the basin margin (Figs 3, 4), but thickens subsurface to perhaps 200 m. It consists of a basal pebble or granule conglomerate, overlain by grey and brown massive or cross-bedded medium-grained quartzose sandstone, which becomes finer grained towards the top of the unit, where ripple marked, fine-grained sandstones occur closely interbedded with ferruginous mudstones. Trace fossils are common and include the forms Gyrochorte, Planolites, and a number of unidentified specimens (cf. Doutch et al., 1972). The upper fine-grained beds form benches which distinguish them from both the underlying cliff-forming coarser sandstone and the overlying cliffs of the leached and silicified mudstones of the Wallumbilla Formation (Fig. 4).

The Gilbert River Formation thins over the Kimba Arch and remains fairly thin (30 m or less) along the Carpentaria Basin margin in western HANN RIVER. In northwest HANN RIVER and EBAGOOLA the sandstone is not present in many places along the basin margin, and leached mudstones of the Wallumbilla Formation, Rolling Downs Group, lie directly on basement.

Further north Fig. 6 the unit thickens and in CAPE WEYMOUTH it exceeds 200 m. In this area it is composed of brown and grey poorly sorted fine to medium-grained sandstones with a few thin ferruginous shaly lenses and pebbly beds. The sandstone is porous and friable, massive or with sigmoidal to lenticular crossbeds, and cliff-forming. In the upper part of the formation the beds become less argillaceous, finer grained, better sorted, glauconitic, and contain trace fossils. The lithologies are similar to those of the underlying 'Wreath Sandstone' and the two units are in places difficult to distinguish. The Gilbert River Formation is less conglomeratic, has trace fossils and ferruginous shale beds, is glauconitic towards the top, and has sigmoidal to lenticular crossbeds (as distinct from the tabular crossbeds of the 'Wreath Sandstone').

26

In ORFORD BAY, JARDINE RIVER, and TORRES STRAIT the Gilbert River Formation is probably equivalent to the 'Wasp River Formation', and the 'Canal Creek Member' of Zolnai et al. (1965).

The only information on the formation in the west of the survey area, down dip within the Carpentaria Basin, comes from bores at Weipa. ZCL Weipa No. 1 penetrated 225 m of sandstone (Appendix 1, Fig. 2) but the lowest 89 m may be an equivalent of the 'Wreath Sandstone'; the next 83 m is interpreted as Gilbert River Formation, the remaining 53 m being the bottom of the Wallumbilla Formation. Several water-bores recently drilled in the Weipa area are discussed along with ZCL Weipa No. 1 in Appendix 1; the thickness of the sandstone in these bores varies, and there are numerous interbeds of finer sediments.

The Lower Cretaceous sequence

To the south of the survey area the Rolling Downs Group is divisible into a sequence of four units (Doutch et al., 1972): the Normanton Formation, the Allaru Mudstone, the Toolebuc Limestone, and the Wallumbilla Formation.

The Normanton Formation, which is overlain north of Normanton by the Cainozoic deposits of the Gilbert-Mitchell Trough, has lost much of its sandy character when next seen in outcrop in the Weipa area. There it consists of alternating labile sandstone and dark grey shale, with minor impure limestone (Fig. 7). Exposures are scattered and few in number and it has not been generally possible to recognize the base of the formation. It has been mapped as part of the undifferentiated Rolling Downs Group, together with the underlying Allaru and Wallumbilla equivalents. (The Toolebuc Limestone pinches out to the south of the present area (Doutch et al., op. cit.), and the marine mudstones of the Wallumbilla Formation and the Allaru Mudstone are lithologically indistinguishable from one another).

The basal mudstones of the Rolling Downs Group cropping out in western HANN RIVER can be traced through the Kimba Plateau area, over the Kimba Arch, and are continuous with the upper part of the Battle Camp Formation of the Laura Basin. In HANN RIVER the unit, which can be called the Wallumbilla Formation here, is almost universally leached and silicified in a deep weathering zone, which in the southeast commonly forms cliffs and hill cappings of purple and cream silicified siltstone and mudstone

27

Fig. 7. Calcareous concretions in Rolling Downs Group (Klr) muddy siltstone and sandstone. (Normanton Formation?). Tributary or Kurracoo Creek. Coen-Weipa telephone line. WEIPA
Neg M1515

Mesozoic 'mudstone' sequence

Fig. 8. Resistant hill capping of hard siltstone near base of Rolling Downs Group (Klr), in Wallumbilla Formation equivalent.
Grid reference 149011 yards, HANN RIVER
Neg M1524

Fig. 8. It is not clear whether more than one stratum of siltstone form the dissected duricrusted landsurface. The mudstones overlie the softer rocks of the upper part of the Gilbert River Formation. The only fresh outcrops seen in this Sheet area were at the head of the Hann River, where dark grey mudstone and limestone nodules are exposed near a fault. In the Koolburra homestead area some patches of black soil may be developed on mudstone.

Further east in COOKTOWN fresh rocks crop out poorly over an area near Fairview homestead, where they have been named the Wolena Claystone by de Keyser & Lucas (1968). This unit, which in places contains Albian fossils, is possibly partly (or wholly?) a time equivalent of the Allaru Mudstone. The foraminifera of the two units appear to represent two distinct assemblages (Haig, pers. comm.) and it appears that the sea had with drawn sufficiently for the Kimba Arch to become land in Allaru/Wolena times.

Further north in the Carpentaria Basin, in northern EBAGOOLA, Coen, etc., the overlying Cainozoic deposits have been removed (or may never have formed a thick cover), and there are large areas of outcrop of the Rolling Downs Group. These generally comprise hill cappings and plateaux of leached silicified pale cream, pink, and purple mudstone, or rolling downs of black soil with isolated stream-bed exposures of fresh grey mudstone and shale, with beds of labile glauconitic or quartzose sandstone, and nodules of limestone (calcilutite). The nodules contain Albian and Aptian fossils (Appendix 2). Towards the west the massive mudstones become less dominant and are replaced by harder fissile shales which generally crop out better than the softer mudstones. Still further west, near Weipa, calcareous labile sandstones become more common (Normanton Formation equivalent).

CAINOZOIC GEOLOGY

(J. Smart)

Only the formally named units are discussed here. Some sediments younger than the Wyaaba Beds have been discussed in Physiography. Figure 3 postulates time relations of Cainozoic units. Table 1 lists all Cainozoic units mapped. Soils have been classified and discussed by

Isbell et al., (1968) and Galloway et al., (1970).

Chronostratigraphy

A variety of names have been used for poorly consolidated clayey sandstone and sandy claystone beds which unconformably overlie the Lower Cretaceous Rolling Downs Group of the Carpentaria Basin. Time relations between them are uncertain. In the southern part of Cape York Peninsula, Smart et al. (1972) have defined two of the units, the Bulimba Formation and the Wyaaba Beds, which are separated by a major period of deep weathering.

The older unit, the Bulimba Formation, can be recognized along the western part of the peninsula as far north as Vrilya Point in JARDINE RIVER. (This is the unit underlying the bauxite in the Weipa-Aurukun area). Within the survey area, the younger overlying Wyaaba Beds are present only in the south, within the Gilbert-Mitchell Trough. The presence of both units offshore has been established by drilling (Zwigulis, 1971). East of longitude 142°30' E; the stratigraphic relations of the Bulimba Formation are not clear.

The Yam Creek Beds (Whitaker & Willmott, 1969), which occur in the Pascoe River area, show the development of a lateritic profile. They may be a time equivalent of the Bulimba Formation, but they are not continuous with it.

Further south in COEN, in the headwater basins of the Wenlock and Archer Rivers, the 'Falloch Beds' (this report), are similar to the Yam Creek Beds, but show only limited ferruginization and no development of a lateritic profile. In the Rokeby area, the 'Falloch Beds' appear to fill valleys cut in the lateritized plateau of Bulimba Formation. It therefore seems possible that these beds are younger than the Bulimba Formation and that they may be a Wyaaba Beds equivalent.

On the eastern side of Cape York Peninsula, in EBAGOOLA, Whitaker & Willmott (1968) defined the Lilyvale Beds. The unit can be traced northwards to the northeast part of COEN, into the Lockhart-Nesbitt Valley, and southwards into HANN RIVER and COOKTOWN, into the Kalpowar Plain, where it appears to be continuous with the Brixton Formation of Lucas (1962). This unit is lithologically similar to the Bulimba Formation and Yam Creek Beds, but only minor ferruginization has been noted so far. Its western boundary is the scarp up to the McIlwraith-Tozer Uplands and the Coleman Plateau. The scarp was probably a result of faulting. The Lilyvale Beds are detritus from the

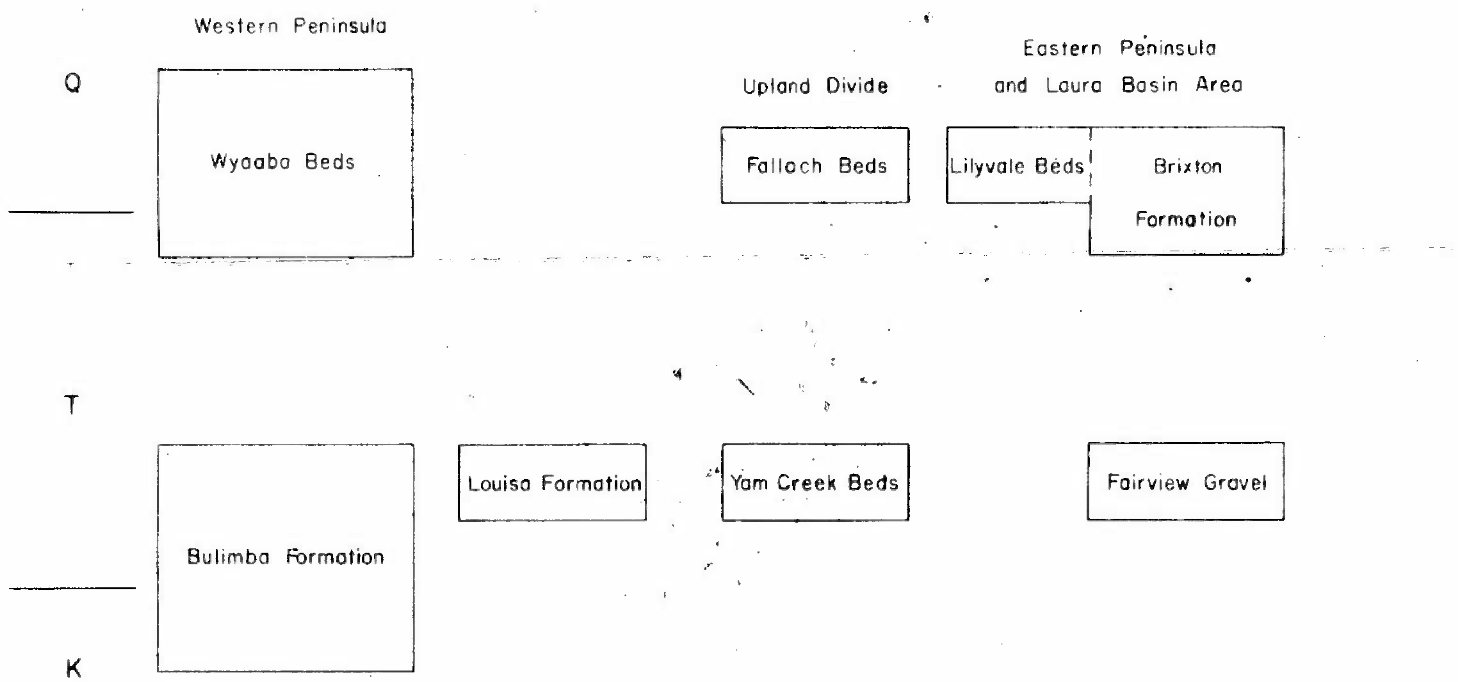

Fig. 9 Cainozoic correlations

To accompany Record 1973/187

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Fig. 10. Pretender Creek, EBAGOOLA. Column-forming joints in fine to coarse-grained clayey quartzose sandstone
Neg M1524

Bulimba Formation (KTi)

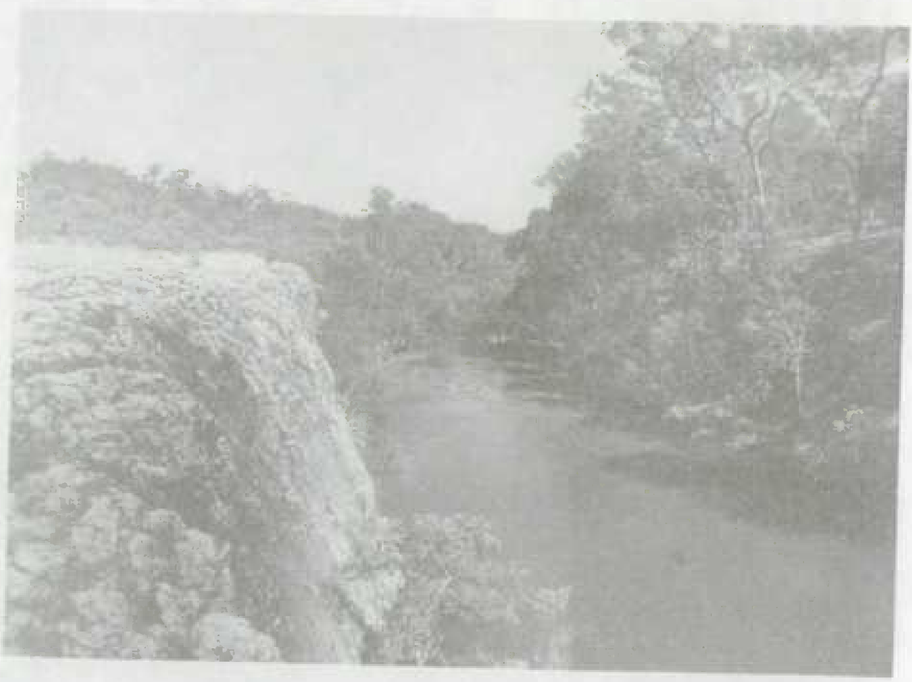

Fig. 11. Kendall River, HOLROYD. Clayey fine to medium-grained quartzose sandstone.
Neg M1524

erosion of the uplands and plateau, and are also younger than the tertiary igneous rocks of the area. Further south in the Carpentaria Basin, the Wyaaba Beds were deposited after an episode of block-faulting and volcanic activity, and the Lilyvale Beds may thus be of similar age.

The Brixton Formation (Lucas, 1962, 1964) was mapped (but not named) on COOKTOWN and CAPE MELVILLE. It is lithologically similar to the Bulimba Formation and other units, but overlies leached Mesozoic Wolena Claystone (de Keyser & Lucas, 1962). The leaching was probably contemporaneous with the deep weathering of the Bulimba Formation before deposition of the Wyaaba Beds, so the Brixton Formation is probably younger than the Bulimba Formation. Its upper part, at least, is continuous with the Lilyvale Beds. However, towards the east coast, there appears to be a division into an older mottled dominantly clayey unit and a younger less consolidated sandy unit (Lucas, 1964). The younger unit is most likely continuous with the Lilyvale Beds, while the older unit may be equivalent to the Bulimba Formation, with which it is possibly continuous through the Kimba Plateau area.

Lithostratigraphy

Within the survey area, the Bulimba Formation (Figs 10-11) is present on HANN RIVER, HOLROYD, AURUKUN, WEIPA, COEN, EBAGOOLA and to a limited extent on CAPE WEYMOUTH. It can be traced northwards as far as Vrilya Point on JARDINE RIVER. On HOLROYD it is mainly unexposed (but see Fig. 11), and on WEIPA and AURUKUN it is largely covered by bauxite and ferricrete. Offshore, the unit has been identified west of Duifken Point (see Appendix 4, Fig. 1) as far west as the Alice-Palmer structural zone. Its existence within the Gilbert-Mitchell Trough is uncertain in the offshore areas. It is absent off Pera Head and is absent on the 'Pine River High' (see Structure and Appendix 4, Fig. 1). North of the 'Pine River High', the Bulimba Formation is probably present offshore. Onshore, it is also present on GALBRAITH and RUTLAND PLAINS (Doutch et al., 1972).

The Bulimba Formation consists of quartzose sandy clay and claystone with interbedded clayey quartzose sand and sandstone, granule conglomerate and local pebble or cobble conglomerate. In the survey area it is noteworthy for its bauxite capping. In AURUKUN, WEIPA, and

33

JARDINE RIVER where the Bulimba Formation has been, or is at present, overlain by ferricrete and bauxite, exposures are iron-stained and mottled, in places as deeply as 15 m. The clayey beds exhibit numerous small fissures and vugs, up to 1 cm or more in size. This appears to be due to the loss of combined silica from feldspar clasts, as quartz grains are generally present.

Heavy mineral studies, and studies of quartz grains, (Edwards, 1957, 1958; Baker, 1958) show that the Bulimba Formation was originally arkosic (as used by Krynine 1948). The formation probably had high porosity and permeability prior to alteration, and these properties were probably of importance in the production of bauxite.

Within the formation at present, there are permeable intervals of limited extent which may be due to the preservation of old stream channels, filled with coarser and less argillaceous material (see Economic Geology). In the harbour at Weipa, dredging has brought up quartzose clasts up to cobble size from the level of the permeable zone in the area (12-15 m below land surface), whereas at Hey Point 6 km to the south, permeability in IWSC bores is variable and generally low.

The Bulimba Formation appears to have been deposited by an extensive alluvial fan system draining from the east. A provenance area of granitic character is required to yield detritus which was originally so dominantly arkosic. The present day exposed basement areas are predominantly granitic. A study of the Bulimba Formation in RED RIVER by W. Burgis is in progress.

The Yam Creek Beds (Figs 12, 13) are lithologically similar to the Bulimba Formation. They have been described by BHP (1962) - who named them informally the Browns Creek Grit - and by AAP (1965), Trail et al. (1969) and Willmott et al. (1971).

The Yam Creek Beds rest on basement, and locally on Mesozoic sandstone. In most places they are topographically lower than the latter, and appear to fill hollows erroded in it.

The Lilyvale Beds and Brixton Formation are also lithologically similar to the Bulimba Formation (Wyaaba Beds), although the Brixton Formation is more variable, in response to variations in provenance.

Fig. 12
Detail -
granule conglomerate,
sandstone and siltstone;
clayey, quartzose.
Neg GA 7962

Yam Creek Beds (KTa), vicinity of Garraway Ck,
CAPE WEYMOUTH

Fig. 13. Showing valley fill environment (Precambrian metamorphics in background). Black ferruginous layer tops the outcrop.
Neg GA 7967

The Lilyvale Beds (Fig. 15) were described by Trail et al. (1968), and Willmott et al. (1971). The Brixton Formation was described by Lucas (1962, 1964).

The 'Falloch Beds' were mapped by Trail et al. (1969) as Lilyvale Beds overlain by residual sand and alluvium (COEN). Because the Archer-Wenlock headwater basin sediments are not continuous with the Lilyvale Beds of the 'type' area, and because there are few clues to their age, they are renamed here informally. Their identity as a rock body is clear in terms of their position in the landscape. Further work on them is planned for the 1973 field season.

The Wyaaba Beds are present only in the southwest of the survey area, in HANN RIVER, HOLROYD, AURUKUN, and offshore in WEIPA. They are restricted to the Gilbert-Mitchell Trough (see Fig. 16) (and to the piedmont situation in CROYDON, MILLUNGERA and GILBERTON Doutch et al., 1970, 1972). Lithologically the unit is similar to the Bulimba Formation, but weathering effects are generally less marked and feldspars are commonly fresh. Exposures of Wyaaba Beds are generally partly ferruginized and in some areas ferricrete may be present.

Offshore, the Wyaaba Beds appear to be intercalated with a calcareous sandy clay bed (see Appendix 4, Fig. 1). The basal part of the unit contains pisolites and lateritic fragments, and may have been deposited consequent upon the drop in sea-level which caused the erosion of the lateritic material from the Weipa Plateau.

The original extent of the Wyaaba Beds in the survey area is uncertain. They may have been present northeast of the Alice-Palmer structural zone, on top of the Bulimba Formation and the overlying bauxite, or alternatively have been confined largely to their present distribution. This point is important in terms of bauxite genesis as discussed later (Appendix 4). However, the presence of lateritic material in the basal Wyaaba Beds suggests that a considerable area of the laterite on the Bulimba Formation was not covered by them.

26

WEATHERING AND ALTERATION

(J. Smart)

Deep weathering and chemical alteration are common to several rock units in the survey area. A major episode of lateritic weathering of probable Tertiary age can be interpreted. The lateritic surface partly or wholly produced by this episode is continuous with a similar surface further south in the Carpentaria Basin (Doutch et al., 1972). It is present on Bulimba Formation, Yam Creek Beds (Fig. 13) and Mesozoic rocks; the effects vary according to parent material, topographic situation (which affects drainage), groundwater conditions, and climate. On the Mesozoic sandstones it has partly or wholly caused extensive and intensive ferruginization, or local development of ferricrete. The effect on the Bulimba Formation is more difficult to judge as this unit was probably also affected by a younger bauxitic episode of deep weathering.

In the southern part of the Carpentaria Basin, the effects of this Tertiary lateritic episode appear to be restricted to sandstone and siltstone units, and little effect is noted on mudstone units (Doutch et al., 1970). This does not seem to apply in the survey area.

The land surface on which this Tertiary laterite developed consisted of Bulimba Formation in the west, Mesozoic sandstone in the east and Rolling Downs Group in the south. On HANN RIVER, in the south of the survey area, the Rolling Downs Group has been altered by kaolinization, silicification, and ferruginization, although no lateritic profiles are preserved.

Subsequent to this major episode of deep weathering and chemical alteration there has been extensive development of ferricrete, ferruginization, and ironstaining (Doutch et al., 1972; Smart et al., 1972), which has affected the Wyaaba Beds further south in Cape York Peninsula. The age of this event is probably Pleistocene. Within the survey area, this event is responsible for ferruginization of the Wyaaba Beds in HOLROYD, and may also be involved in the formation of the Weipa bauxite (see Appendix 4). There may also have been some effect on the Mesozoic sandstones in the east as reported from the central Carpentaria Basin by Doutch et al., (1972) and Smart et al., (1972). The ferruginization of the 'Falloch Beds' is probably of this age.

Fig. 14.
Development of clay filled pipes in ferruginized Mesozoic sandstone (JK), mouth of Gorge Creek
Neg GA/8242

Deep weathering. Gorge Creek, EBAGOOLA

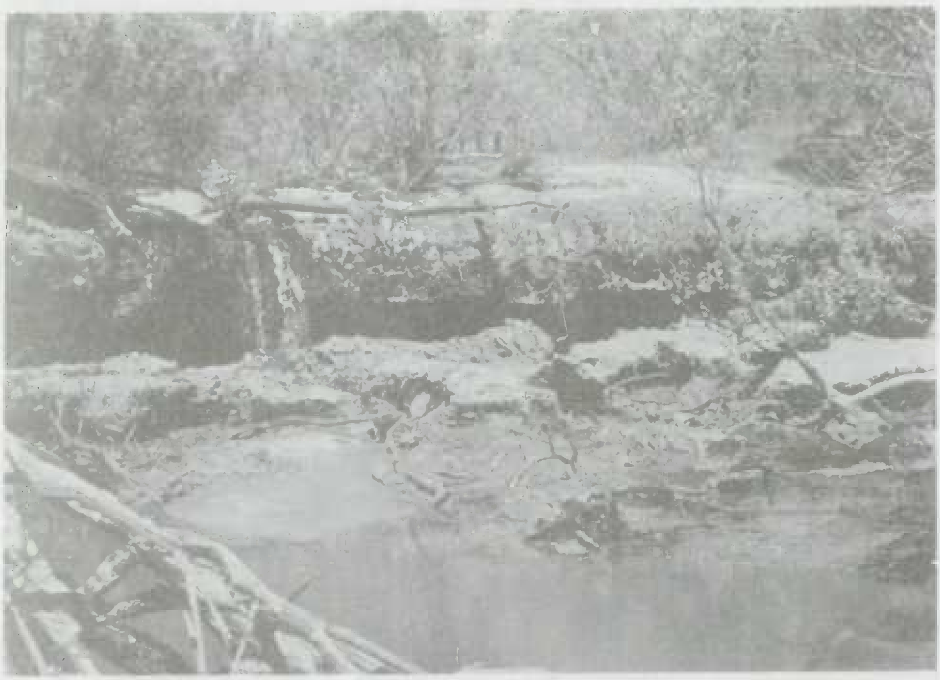

Fig. 15. Ferruginization and silicification of Lilyvale Beds (Czv). Tidal limit of Gorge Ck, 3 km upstream from mouth
Neg GA/8243

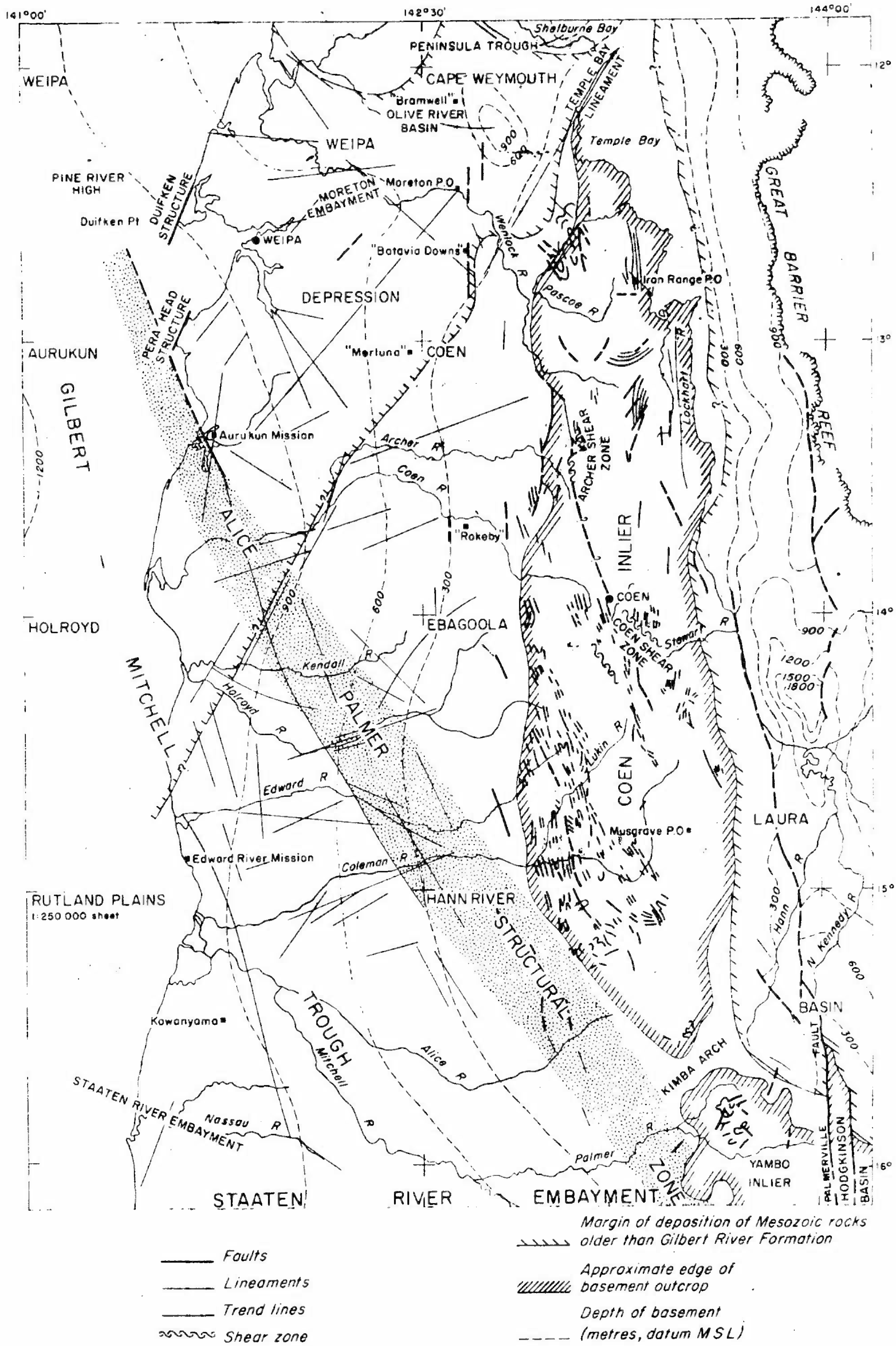

Fig. 16 Structural elements Cape York Peninsula

Q/A48

A third period of ferruginization and ferricrete development post-dates the dissection of the Weipa Plateau. It appears to be quite recent and in some places is continuing. This development includes the ferricrete in the soils of the Merluna Plain, various local ferricrete developments in creeks, and some mottling and iron staining. In the heavy clay soils of the Merluna Plain blocks of black ferricrete occur, and in the smaller creeks similar material is exposed. The ferricrete is 30-50 cm thick, glossy black, and generally has a nodular pisolitic or vermicular structure. Locally it contains iron stained and ferruginized fragments of Rolling Downs Group sandstone and siltstone. Within the area of the Merluna Plain, Isbell et al. (1968) recognized several soil units, all of which contain a ferricrete horizon at shallow depth.

Part of this youngest weathering period is the development of ferricrete in many creeks. Merkunga Creek in AURUKUN, at the road-crossing (lat. 13°12' S, long. 141°59' E) exposes a ferricrete bed 2.5 m thick in alluvium overlying Rolling Downs Group rocks. The river valley is cut through mottled white sandy clay of the Bulimba Formation.

The former extent of the Bulimba Formation may be reflected in the amount by which other units have been altered by deep weathering. Exposures of the Rolling Downs Group in the northern part of the area (WEIPA, AURUKUN) are quite fresh, possibly owing to the presence of Bulimba Formation on top during a weathering episode, and this suggests the eastward extension of the formation at least as far as the Coen-Bamaga raod; east of this, in CAPE WEYMOUTH and COEN, Rolling Downs Group siltstones are altered, iron stained, and silicified.

STRUCTURE AND TECTONICS

(S. Powell)

Structural elements in the survey area occur in two interrelated geologic domains (Fig. 16).

Firstly, the Yambo Inlier, Coen Inlier and Cape York-Oriomo Ridge represent the ancient foundation of the peninsula to which subsequent sedimentation and tectonism have given the present northerly oriented exposure. These areas have been described by Willmott et al. (1971), who conclude that a general northerly structural trend predominates. Discussion here is confined to their relations with sedimentary basin cover.

Secondly, the basement inliers are surrounded by sedimentary basins, the Carpentaria to the west and the Laura to the southeast. The two basins are connected across the Kimba Arch, consisting of shallow basement underlying the Kimba Plateau (see Physiography and Stratigraphy). This barrier was apparently low enough to be overlapped in earliest Cretaceous times, following the more restricted Jurassic continental sedimentation, but whether or not this may have resulted from downwarping is uncertain; the reason for disconformity between the Jurassic sediments of the Laura Basin and the overlapping Gilbert River Formation is unknown.

Overall, the Laura Basin owes it character to subsidence along the eastern side of the Palmerville Fault (de Keyser & Lucas, 1968). This is a complex structural zone consisting of dominantly north-striking en echelon faults, running along the western edge of the basin, and disappearing northwards below Princess Charlotte Bay. The Alice-Palmer structural zone of the Carpentaria Basin is a north-western branch of it. Movement probably began during late Carboniferous times and may still be continuing.

In the Carpentaria Basin the Mesozoic and younger formations show an overall westerly dip of a few degrees or less (cf. Appendix 1). The structural sketch (Fig. 16) shows lineaments determined from aerial photographs and mosaics, Earth Resources Technology Satellite (ERTS) imagery, topographic features, including drainage patterns and computer derived form-lines, field observation, and analysis of various reports.

South of latitude 14°S northwest-trending structural lineaments occur both in the Carpentaria Basin and Coen Inlier (in the latter as fold axes, metamorphic zones and faults). In addition there is an east-northeast set in the Carpentaria Basin.

The northwest trending lineaments in the northern part of the Gilbert-Mitchell Trough and in rocks of the southern part of the Coen Inlier, and finding out of Wyaaba Beds, are together the basis for postulating the Alice-Palmer structural zone.

Further north these directions persist, but strong north and northeast sets also occur. Structures are seldom more definite than this case of a lineament compounded of the east-facing scarp of the Embley Range and a 'fault' it lines up with to its north which is interpreted from seismic records. Faults around Rokeby station also have a northerly trend.

The northeasterly family of lineaments is exemplified by the Temple Bay Lineament and the Pera Head and Duifken Structure. The Duifken Structure affects the bauxite zone at Weipa with a small displacement downwards offshore and may represent recent faulting and/or monoclinal warping along a northeasterly line. Similar trends determine coastal morphology as far north as Torres Strait. This direction together with an easterly one has been proposed as outlining fault blocks in order to explain the en echelon arrangement of both coastlines of the Peninsula (AAP, 1965).

The Alice-Palmer structural zone (Fig. 16; Doutch et al. 1972) appears to be a northwest branch of the Palmerville Fault. The zone marks the northeast margin of the Mesozoic Staaten River Embayment (Meyers, 1969) and the Cainozoic modification to it, the Gilbert-Mitchell Trough. Cross-sections suggest that the southern part of the zone, in HANN RIVER, is a steep flexure or fault; further northwest the compound(?) structure is in effect a shallow warp, the lateritized Bulimba Formation and the oldest Wyaaba Beds having been flexed gently down to the southwest.

Structural control is probably responsible for the distribution of the Bulimba Formation offshore at Weipa, by warping similar to that along the Alice-Palmer structural zone to the southeast. The zone between these two areas coincides roughly with a northwest-trending break in slope suggested by computer form-lines and reflected in the geomorphological boundary between the Weipa Plateau and Holroyd Plain (see Physiography).

A group of structural features detected entirely by geophysical methods is present in CAPE WEYMOUTH and WEIPA: the Olive River Basin, the Peninsula Trough and the Moreton Embayment.

The term Olive River Basin was first used by the Compagnie Generale de Geophysique (1965) following seismic work for Australian Aquitaine Petroleum. A small basin had been disclosed by aeromagnetic survey flown by Adastra in 1964, but the seismic investigation was necessary to reveal its depth and general configuration.

As in the Pascoe River area to the south it was impossible to differentiate Palaeozoic and Mesozoic sediments so that the term was applied to the entire basin sequence in the basement depression. The Olive River Basin as used here is regarded as a Mesozoic feature; it includes part of the Weipa Depression (cf. Canobie and Millungera Depressions, Doutch et al. 1970). The basin is oval, and less than 30 km along its long axis, which trends northwest. The 1100 m-thick sedimentary sequence in it is thought to consist of Jurassic-Lower Cretaceous rocks. Below the basin some equivalents of the Upper Palaeozoic Pascoe River Beds may be reflected in the geophysical feature.

The basin is separated from the main Carpentaria Basin to the west by an area of probably upfaulted basement overlain by a thin but possibly complete succession of Mesozoic sandstones. These thicken to the southwest where seismic and magnetic data suggest an embayment in basement around Moreton - the Moreton Embayment - another aspect of the Weipa Depression. The margins of the Embayment can be taken to be coincident with a system of strong lineaments which run east, northeast, and southeast, suggesting movement along fault lines as a mode of formation. Extension of the northern margin westwards would join up with the 'Pine River High', an area off Duifken Point in which the Bulimba Formation and the Wyaaba Beds are absent.

The name Peninsula Trough was given to an offshore basin northeast of the Olive River Basin in a report for Tenneco (1967), but an earlier reference had been made to it by Mott in 1958. The trough may be up to 1000 m deep and has a northerly trend at its southern end, just north of the survey area. It is apparently separated from the Olive River Basin by shallow basement, the presence of which could explain differences in Mesozoic lithologies between the Olive River and Shelburne Bay. The eastern margin of both basin and trough may be a fault coincident with the Temple Bay lineament.

Summing up, there is no evidence to suggest large scale tectonism during the Mesozoic until an episode of re-activation of basement structures in the late Cretaceous (?), which was the precursor to widespread deposition of the Bulimba Formation and its equivalents.

Further uplift of the eastern highlands in the Pliocene(?) (Doutch et al. 1970) tilted the deeply weathered post-Bulimba land surface to the west, and downwarped it in the southwest along the hinge line of the Alice-Palmer structural zone to form the Gilbert-Mitchell Trough, in which the Wyaaba Beds accumulated. Small scale flexuring of the bauxite surface is suspected from photo-interpretation, and extensive lineaments cut across the bauxite plateaux in some areas. As bauxite development probably post-dates deposition of the Wyaaba Beds (see Cainozoic Stratigraphy and Economic Geology), this points to a recent period of adjustment along these lines which could be interpreted as a late Pleistocene rejuvenation of Pliocene or older structures.

The patterns of gravity anomalies in the survey area are most simply interpreted as representing alternating northerly-trending basement belts of granites and metamorphic or sedimentary rocks, as in the Coen Inlier.

ECONOMIC GEOLOGY

(J. Smart)

Bauxite

The bauxite on the west coast of Cape York Peninsula was first observed by Jackson in 1902, who described it as 'pisolitic iron ore'. The development of the deposit follows its recognition by H.J. Evans in 1955. A comprehensive discussion appears in Appendix 4.

At present, Comalco and Alcan hold bauxite mining leases. The former is the only producer at present and currently ships about 8 million tonnes per year from Weipa. Large reserves south of Weipa are held under an ATP by Aurukun Associates who are planning development.

Bauxite reserves in the area are considerable, and are probably over 3000 million tonnes of economic grade. In addition, there are large reserves of lower grade ore. The 'beneficiated' ore contains more than 55 percent total alumina and around 5 percent silica.

The bauxite is between 1 and 10 m thick, beneath about 1 m of sandy, clayey soil overburden. Generally the bauxite is poorly cemented or uncemented and mining is relatively easy. Locally, an iron-cemented zone at the top requires ripping. The underlying ferricrete (known locally as 'ironstone') is generally much harder and is the cut-off for mining. The matrix between the pisolites, although bauxitic, has a higher content of silica (up to 12% total silica), A.H. White, per.comm.) in the form of sand and silt-sized quartz. This is removed by wet screening to benef beneficiate the product. An account of mining methods at Weipa is given in Australian Mining (Anon. 1969).

Groundwater

Groundwater occurs in aquifers within the Gilbert River Formation and underlying Jurassic sandstones, in the Bulimba Formation, and in some younger deposits.

The Mesozoic artesian aquifers have been tested only at Weipa and at Aurukun Associates North Camp in AURUKUN. The thickness of Mesozoic sandstone in these areas ranges between 150 and 250 m, and much of it is argillaceous, so supplies are low in comparison with areas further south. Most of the water comes from the sandstone sequence under the Gilbert River Formation. ZCL Weipa No. 1 flowed at 26.6 litres per second and other artesian bores have similar yields. Water quality is not high, averaging 1000 parts per million total dissolved salts, and up to 15 parts per million fluorine; some of this water is used for processing at Weipa.

The Bulimba Formation provides the domestic water supply and part of the processing water used at Weipa. Elsewhere, test bores in the formation have yielded varied supplies. The formation as a whole is highly porous and much of the clay contains vugs. However, permeability is low and the successful production of water from the formation is dependent on intersecting a zone of above average permeability.

On the Weipa Peninsula extensive drilling has shown the existence of a relatively permeable zone 12-15 m below ground level. This is not everywhere of sufficiently high permeability to develop production bores. North of this area only a few bores have been sunk and all failed to encounter zones of suitable permeability. At Hey Point, 12 km south of Weipa township, IWSC sank 26 test bores 400 m apart in a rectangular grid pattern. Even in this distance the supplies varied greatly and some holes did not penetrate permeable material. Further south, towards Aurukun Mission, permeabilities are variable and water supplies unpredictable.

Permeability may be influenced by original deposits and conditions; e.g. buried stream channels would provide zones of high permeability. Thus the finding of water is difficult by drilling alone. Resistivity measures, using suitably high powered equipment to penetrate the highly resistive bauxite layer, may help in locating aquifers.

Hydrologically, the Bulimba Formation in this area is an unconfined aquifer system and much if not all of its water is taken in by vertical local recharge. Thus it is susceptible to drought conditions. In some coastal areas the permeable zone within the formation is in contact with sea water and over-pumping of bores could draw salt water into the aquifer system.

Minor water supplies are obtainable from beach ridges and sandy river channels; quality is generally good.

Construction materials

Quartz sand and gravel is obtainable in large quantities from the upper reaches of the larger rivers, but on the west coast the lower reaches of the rivers contain mud. Beach ridges contain considerable amounts of shell and so are unsuitable for concrete. At Weipa, building sand is obtained from a bed within the Bulimba Formation, and low grade bauxite is used for aggregate. High grade concrete aggregate has to be imported.

The west coast of Cape York Peninsula suffers from a dearth of conctruction stone, particularly in the Weipa-Aurukun area. The Rolling Downs Group contains no really hard rock. The nearest hard rocks are those of the Coen Inlier. Ballast for the railway at Weipa was imported from Townsville.

Petroleum

The Mesozoic and Cainozoic sequence is nowhere more than 900 m thick in this area, and even off shore is probably not more than 1500 m. Permeable beds are confined to the Gilbert River Formation and the underlying Jurassic sandstones, and where drilled are saturated with fresh or brackish water. The possibility of petroleum accumulation is slight.

Gibson (Appendix 1) discusses ZCL Weipa No. 1 and adjacent bores. No hydrocarbons were reported from the well.

Coal

Coal seams are present within the Pascoe River Beds, but they are generally thin, and exploitation is rendered difficult by the strong folding and faulting in the area (AAP, 1965; Trail et al., 1969). Carbonaceous material is present within the Jurassic sandstone sequence in the Weipa area (see Appendix 1) and has been reported from the same stratigraphic level elsewhere in the area, e.g. Gibson et al. (1973).

Heavy-mineral beach sands

Heavy-mineral beach sands are present on the east coast between Cape Sidmouth and Cape Direction (COEN and CAPE WEYMOUTH) (Trail et al., 1969; Zimmerman, 1969). The heavy minerals are present as thin seams, which are probably of limited lateral extent. The commonest mineral is ilmenite, with subordinate magnetite, rutile, and monazite.

On the west coast, a deposit of heavy mineral sands has been reported from the south side of Albatross Bay on WEIPA (Miller, 1957). Zircon and rutile are the main constituents, but the deposit is sub-economic at present.

Silica sand

The sand in the Olive River Dune Field (CAPE WEYMOUTH AND ORFORD BAY) is of very high silica content (over 99.8 percent), as reported by Trail et al. (1969).

Gold

In the Wenlock Goldfield, gold occurs in the base of the Gilbert River Formation, and is described by Morton (1930), and Trail et al. (1969).

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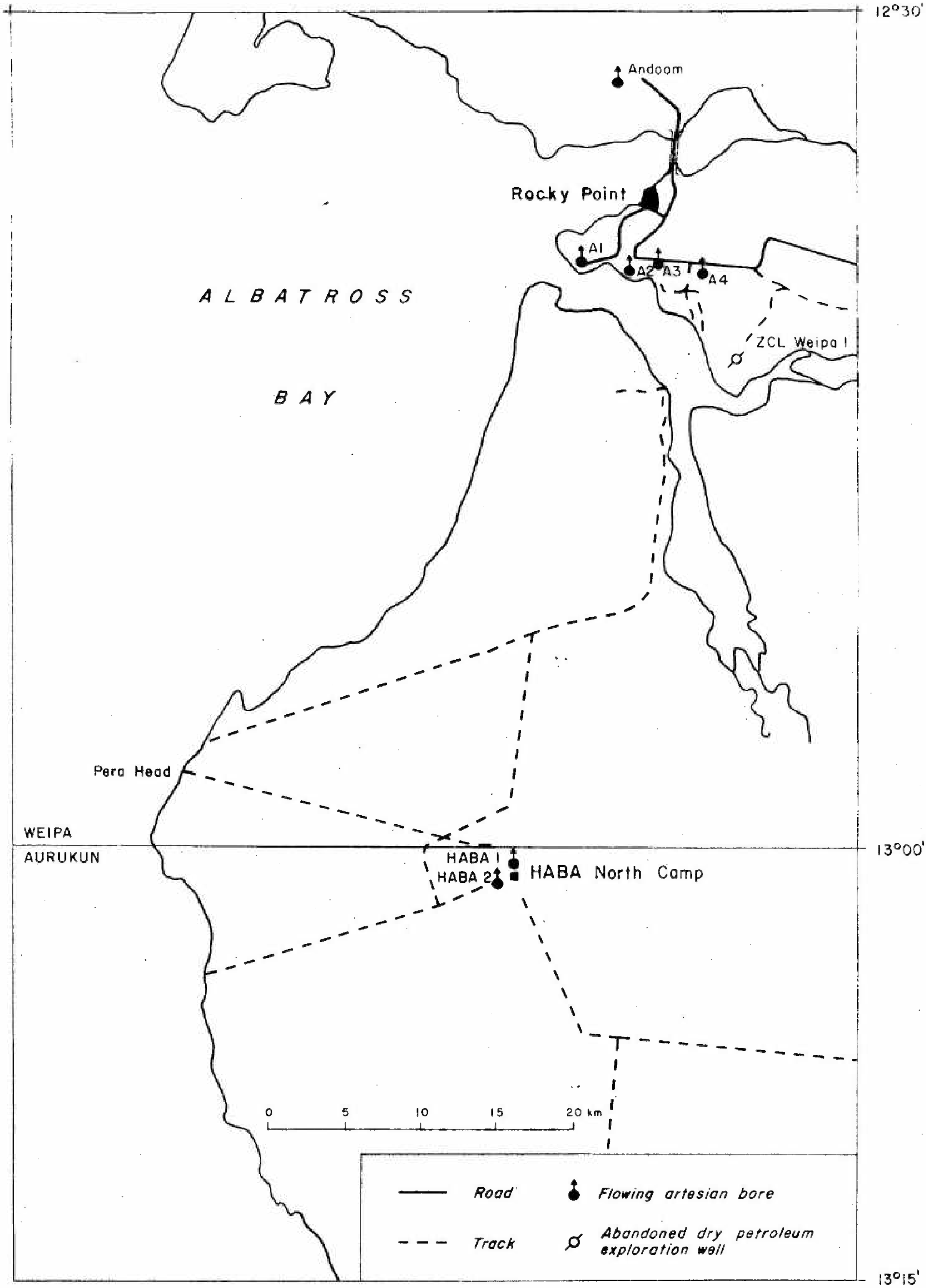

Appendix I, Fig. I Location of artesian bores on WEIPA, and northern AURUKUN sheets.

To accompany Record 1973/187

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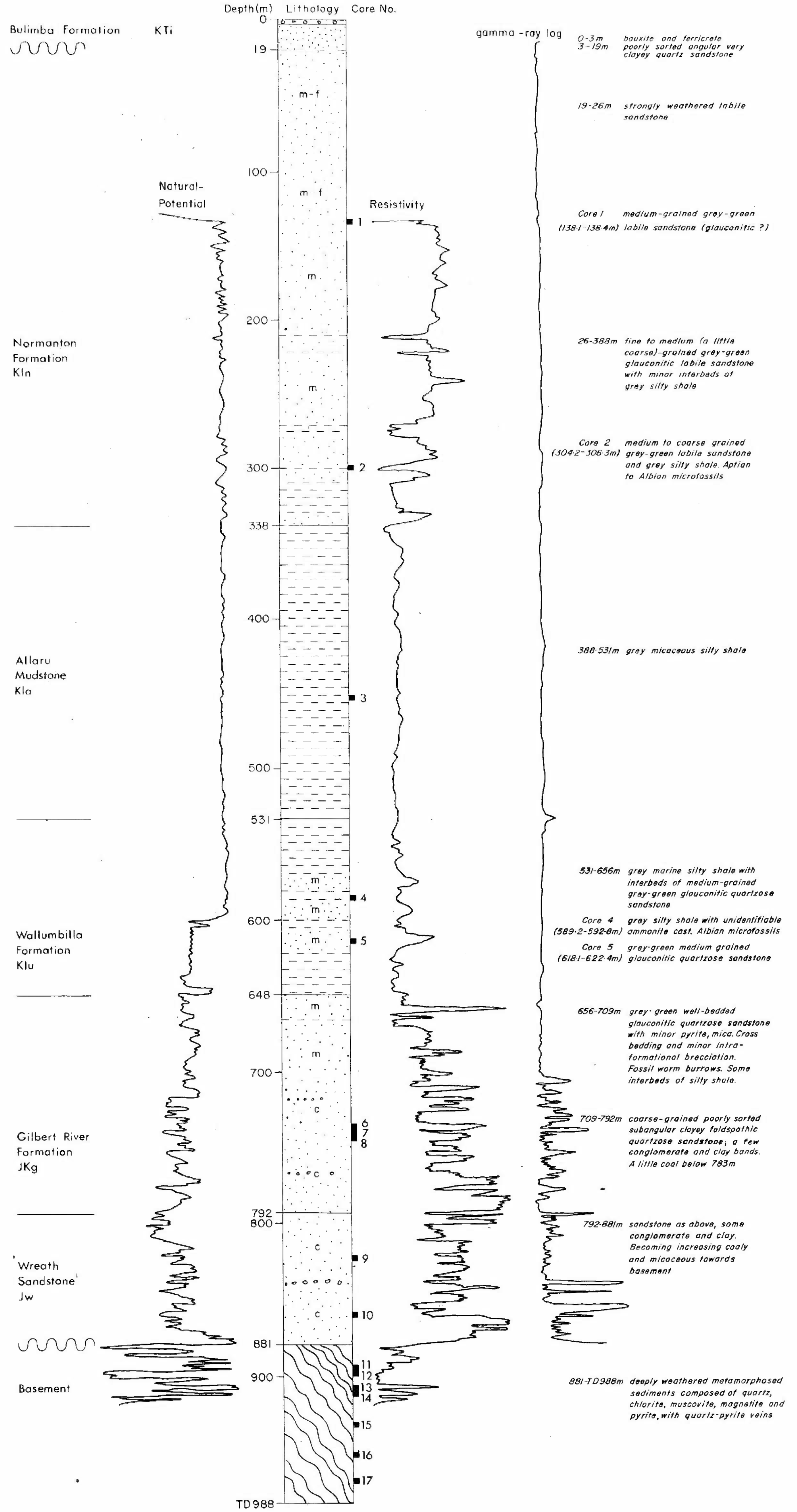
52

APPENDIX 1, FIGURE 2. ZCL WEIPA No 1 COMPOSITE LOG



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APPENDIX 1. MESOZOIC STRATIGRAPHY IN THE WEIPA AREA

(D.L. Gibson)

In the Weipa-Andoom area there are six artesian bores which penetrate both the Cainozoic succession and the whole of the local Mesozoic succession of the Carpentaria Basin. The Zinc Corporation Ltd petroleum exploration well, Weipa No. 1, was drilled in 1957, and the other five bores were drilled for Comalco in 1970-71. The locations of these bores are shown on Figure 1. For the record the localities of two artesian bores in northwest AURUKUN (HABA 1 and 2) drilled for HABA in 1970-71 are also shown on Figure 1, but the bores enter the discussion below only with respect to basement rocks and regional dips.

Wireline logs (gamma, resistivity, self-potential, and temperature) mostly run by BMR are available for all the bores at Weipa except Comalco's A_2 bore; some are of poor quality. A well completion report for Weipa No. 1 (Power & Lindhe, 1958) is held by the Queensland Mines Department; Figure 2, a composite log of the bore, is derived from the report. Drillers' logs for the other seven bores are held by IWSC in Brisbane. Cuttings from all the Weipa-Andoom bores and core fragments from Weipa No. 1 are stored at the BMR Core and Cuttings Laboratory, Canberra.

RESULTS

An examination of the cores, cuttings, logs, and reports available for the Weipa-Andoom bores has shown that:

a. The basement to the Carpentaria Basin in the vicinity of Weipa No. 1 consists of metamorphic rocks composed of quartz, chlorite, muscovite, magnetite, and pyrite (Power & Lindhe, op. cit.). However, drillers logs indicate that basement in bores A_2, A_3 and A_4 may be granitic. Drillers also report granitic basement in HABA 1.

b. The Carpentaria Basin succession consists of the following sequence (establishment of boundaries - and therefore of thicknesses - is discussed later in the Appendix):

(i) a coaly sandstone unit about 75 m thick at the base of the Mesozoic sequence. This is thought to be the 'Wreath Sandstone' which crops out along the basin margin in CAPE WEYMOUTH about 120 km to the east.

The 'Wreath Sandstone' is probably equivalent to the Jurassic Eulo Queen Group in the southern Carpentaria Basin, as both units conformably underlie the Gilbert River Formation (see Mesozoic Stratigraphy in this Record). At Weipa, as in CAPE WEYMOUTH, the 'Wreath Sandstone' is made up of sub-angular coarse-grained clayey quartzose sandstone with clayey and coaly interbeds. It contains a good aquifer at Weipa;

(ii) the sandstone overlying the 'Wreath Sandstone', the Gilbert River Formation. This is about 140 m thick, and has a similar lithology to the underlying 'Wreath Sandstone', except that the Gilbert River Formation has only very minor coal and is less permeable. The probable boundary between the two units is chosen from gamma ray logs (Fig. 3). The top 50 m of this unit consists mainly of medium to fine-grained glauconitic quartzose sandstone with some shaly interbeds; the remainder is made up of silty shale, commonly with sandstone interbeds;

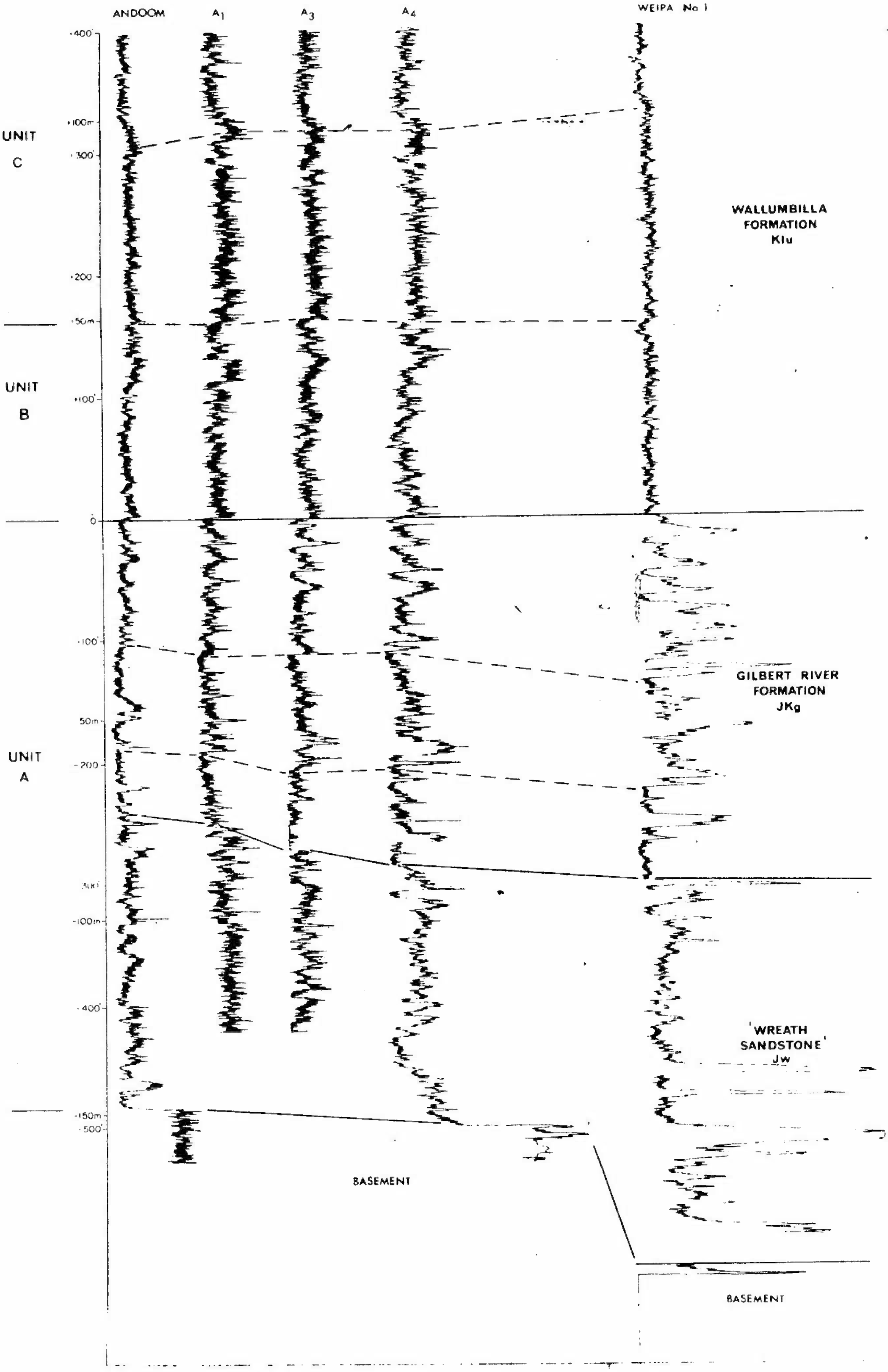
(iii) the grey silty shale with sandy interbeds, the Wallumbilla Formation, the bottom unit of the Rolling Downs Group, which overlies the Gilbert River Formation (Figs 3, 4). The Wallumbilla Formation is about 115 m thick in this area.

In the southern Carpentaria Basin this formation consists of mudstone with sandstone interbeds and is separated from the Allaru Mudstone by the Toolebuc Limestone. In this area it is differentiated from the Allaru Mudstone by having sandstone interbeds, the boundary being defined as the place corresponding to a peak on the gamma ray log about where the Toolebuc Limestone might be expected to occur (Fig. 2) (cf. Smart, 1972). The Toolebuc Limestone has not been recognised north of FBH Wyaaba No. 1, 400km to the south (Derrington, 1957);

(iv) the grey silty shale with rare sandy interbeds, the Allaru Mudstone of the Rolling Downs Group. It is about 200 m thick, which is slightly more than in the southern Carpentaria Basin, where it is made up of non-fissile mudstone rather than shale;

(v) the medium to fine-grained glauconitic labile sandstone and grey shale sequence which overlies the Allaru Mudstone, the Normanton Formation, the top unit of the Rolling Downs Group. The formation is up to 310 m thick; how much has been eroded away is not known. The shaley interbeds are most common towards the base of the formation where the character of the resistivity log changes (Fig. 2).

6. On the Carpentaria Basin succession rests the Cainozoic and/or Upper Cretaceous Bulimba Formation. This is less than 30 m thick in



APPENDIX 1. FIG 3 GAMMA RAY LOGS OF ARTESIAN BORES AT WEIPA, WITH PROPOSED CORRELATIONS

To accompany Record 1973/187

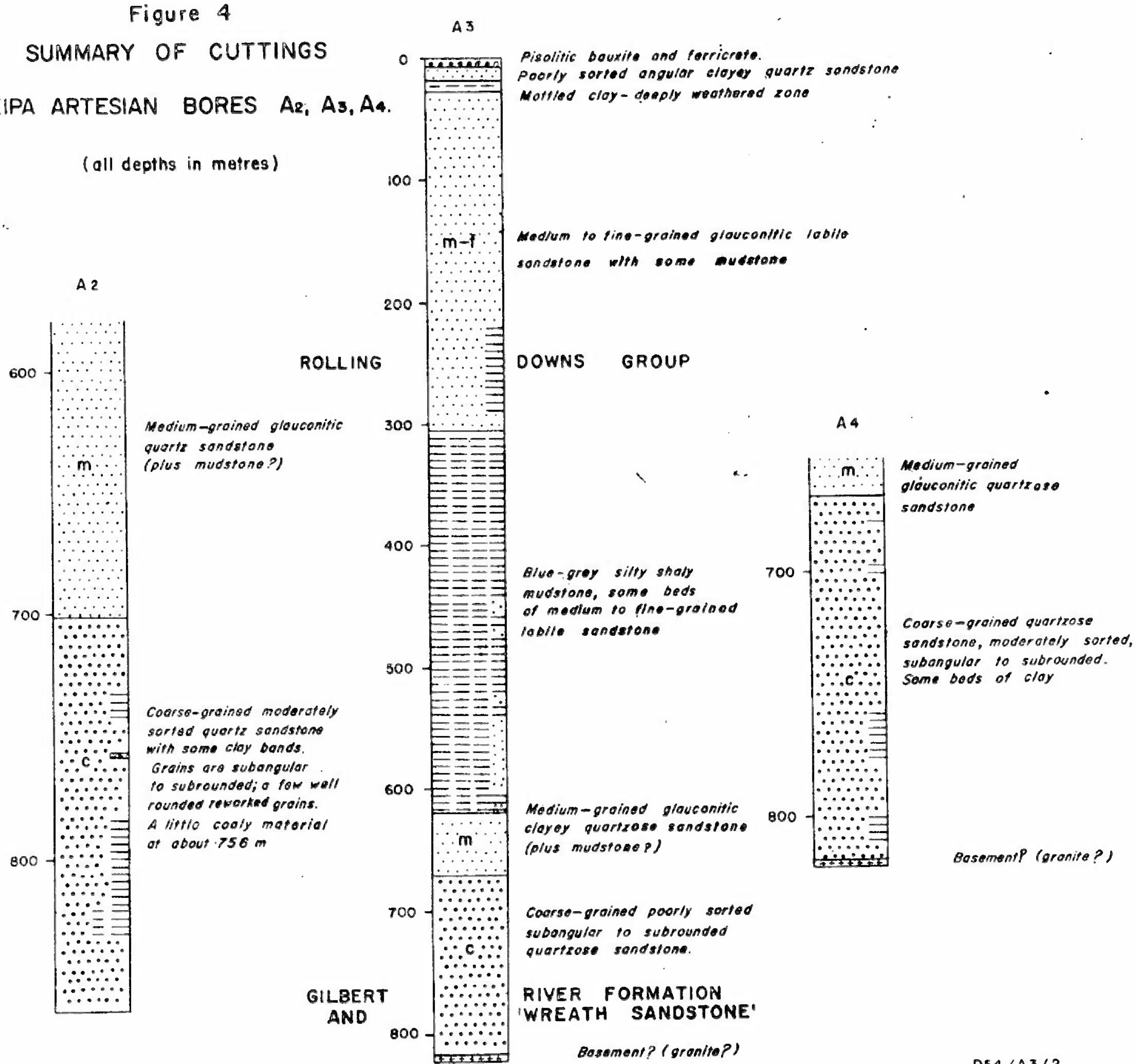
Appendix I,

Figure 4

SUMMARY OF CUTTINGS

WEIPA ARTESIAN BORES A_2, A_3, A_4.

(all depths in metres)



To accompany Record 1973/187

D54 / A3 / 2

57

the Weipa area and varies from kaolinitic clay to coarse-grained angular quartzose sandstone. The formation has been bauxitized; up to 10 m of the bauxite is preserved.

Description of cores

Power & Lindhe (1958) do not give descriptions of individual cores in the well completion report for Weipa No. 1. Some of the cores are stored in the BMR Cores and Cuttings Laboratory, Canberra.

Cores 1, 2, 4, and 5 are described in Figure 2. Cores No. 6 to 10 are represented by unlabelled fragments of coarse-grained poorly sorted subangular clayey quartzose sandstone collected by Smart in 1972 from a campsite used by personnel drilling the hole. The fragments are thought to be from the Gilbert River Formation and 'Wreath Sandstone'. Cores No. 11 to 17 are basement metamorphic rock composed of quartz, chlorite, muscovite, magnetite and pyrite, with veins containing quartz and pyrite.

Description of cuttings

All the cuttings available in Canberra for bore A_3 and cuttings downwards from depths of about 579 and 652 m from bores A_2 and A_4 respectively were studied. A summary of lithologies is given in Figure 4. Cavings of shale seriously contaminated cuttings from the sandstone sequences in these three bores: hence it is not known whether there is shale interbedded with the sandstones. In many samples of cuttings from the sandstones, sand grains and chips of shale are enclosed in khaki coloured clay, probably owing to breakdown of clay bands within the sandstone. The depths given in Figure 4 are not corrected for time lag.

Status of wireline logs

Gamma ray and temperature logs are available for bores A_1, A_3, A_4, Andoom and Weipa No. 1, and self-potential and/or resistivity logs for A_3, A_4, Andoom and Weipa No. 1. The gamma logs only are shown on Figure 3; temperature, self-potential, and resistivity logs are of poor quality. Further, only the bottom, most useful, parts of the five available gamma logs are shown on Figure 3 (partly because of the small horizontal scale on the original logs). Other features of the wireline logs are discussed below.

Regional dips

Depth data can be used to calculate regional dips. In the Weipa area this is less than ½°, towards the southwest. The average dip of the Carpentaria Basin between Weipa No. 1 and the basin margin in CAPE WEYMOUTH is also about ½°. The apparent dip of the basin between Weipa 1 and HABA 1 is less than 12' (depth to basement in HABA 1 is 3,300' according to the driller's log).

ESTABLISHMENT OF MESOZOIC STRATIGRAPHIC CORRELATIONS

If one compares the lithological log of bore A_3 on Figure 4, and of Weipa No. 1 (Fig. 2 and cf. Meyers, 1969), with the Mesozoic succession found in the south of the Carpentaria Basin (see Meyers, 1969 for several oil well log correlations, and Doutch et al. 1970, 1972), the broad similarity in the sequences is apparent: at the bottom quartzose sandstone and shale is overlain by shale or mudstone, and at the top medium to fine-grained lithic labile sandstone.

However, subdivision of the successions in the Weipa bores cannot be made based on outcrops eastwards of them: the Rolling Downs Group cannot be differentiated by reconnaissance mapping into a sequence of lithostratigraphic units, and the underlying Gilbert River Formation and older sandstone units are most easily defined in terms of their different physiographic appearances in reference areas. Nevertheless, as the introductory paragraphs to this Appendix indicate, from a study of cuttings, wireline logs and cores from the bores at Weipa, it is possible to sub-divide the Mesozoic succession in the bores and make fair correlations with the units defined in the southern part of the basin. Thus:

1. At the base of the succession, unit A is made up of 165 m of coarse-grained clayey quartzose sandstone with argillaceous interbeds throughout and coaly bands mainly in the bottom half. It is characterized on wireline logs by many large sudden variations in gamma intensity, resistivity, and self potential (Figs 2, 3).

2. Above unit A is about 50 m of medium to fine-grained glauconitic clayey quartzose sandstone with grey shale interbeds. These make up unit B. The rocks of this unit have generally lower resistivity and gamma intensity than unit A (Figs 2,3), but large sudden variations still occur. Self-potential is more positive than for unit A.

3. Unit B grades into unit C, (Figs 2, 3), which is made up of over 100 m of silty shale with sandstone interbeds which are similar in

lithology to the sandstone of unit B. Resistivity of unit C is generally low, but several broad peaks corresponding to as much as 15 m of section are present. Gamma intensity is low and fairly constant and self-potential tends to become increasingly positive towards the top of the unit, with few sudden changes.

4. Above this is unit D, which is made up of grey silty shale with very few sandy interbeds. This unit is characterized by fairly low constant gamma activity and resistivity, and constant high, positive, self-potential. It is about 215m thick. There is a small gamma peak at the boundary between unit C and unit D in some of the bores.

5. Above this, unit E is made up of fine to medium-grained glauconitic labile sandstone with some interbeds of grey silty shale, especially towards the base. This unit is up to 310 m thick in the Weipa area, and is characterized by low gamma activity, medium to high resistivity and high positive slightly variable self-potential.

Meyers (1969) showed a correlation of the succession in Weipa No. 1 with other petroleum exploration wells in the Carpentaria Basin. The 'Normanton Formation' of his correlations included both the Normanton Formation and Allaru Mudstone as revised by Smart et al. (1971). However, Meyer subdivided his 'Normanton Formation' into two parts which correspond in the Weipa Bores to units D and E, although he did not separate this Allaru Mudstone equivalent from his Wallumbilla Formation equivalent. He placed the boundary between the Wallumbilla (Blackdown) Formation and the Gilbert River Formation at about 50 m above the boundary between units B and C, a choice not supported by my analysis. He placed the boundary between the Gilbert River Formation and his 'Jurassic Sandstone' within unit A.

Taking all this into account, and comparing with similar analyses in the southern part of the basin (Doutch et al., 1970, 1972), it is proposed that:

1. Units A & B consist of both the Gilbert River Formation and the 'Wreath Sandstone'. It is proposed that, as in the southern Carpentaria Basin, the base of the Gilbert River Formation is at the bottom of a sandy interval characterized by low gamma activity and high resistivity. Coal is more abundant below this interval, than above it. There is also a rapid rise in water temperature below this interval, indicating that there are good aquifers and hence a change in the nature of the rock.

2. Unit C makes up the Wallumbilla Formation;

3. Unit D is the Allaru Mudstone, the small gamma peak at its base being thought to represent the anomaly characteristic of the Toolebuc Limestone of the southern part of the basin.

4. Unit E is the Normanton Formation.

The composite log for Weipa No. 1 (Fig. 2) shows the interpretation of stratigraphy and lithologies made in this study, and corresponding gamma, resistivity and self-potential logs.

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APPENDIX 2

PRELIMINARY REPORT ON LOWER CRETACEOUS MARINE FOSSILS FROM THE COEN AND CAPE WEYMOUTH 1:250 000 SHEET AREAS

(R.W. Day, G.S.Q.)

The localities in COEN Sheet area are shown on Plate 1, those in CAPE WEYMOUTH on Plate 2 (2nd edition Preliminary map, 1:250 000 series)

Neocomian or Aptian collections

Locality: GSQ L1317 - Ridge top on Cape York telegraph line, 5 miles (8km) north of turn-off to 'Bramwell'. Grid ref. 587446 (yd) Cape Weymouth 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 7.10.72

Lithology: Fine grained quartzose sandstone with some coarse to very coarse grained bands; leached and mottled in white, red-brown, and purple; well bedded and well sorted; possibly originally glauconitic; mud clasts common.

Mode of occurrence of fossils: Internal and external moulds of bivalves widely scattered on bedding planes.

Determinations: Bivalves - Meleagrinella sp.

Tancrediid ? Tancredia sp.

Tancrediid aff. Tatella maranoana (Etheridge Jnr)

Trace fossils - numerous sand filled, horizontal and inclined burrows

Age: Neocomian or Aptian

Locality: GSQ L1323 - Iron Range Road at top of major eastward facing scarp, about 2 miles (3.2 km) west of Wenlock River crossing. Grid ref. 627330 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 5.10.72

Lithology: Medium grained highly quartzose sandstone; mottled in white, red-brown, and purple; well sorted with little clayey matrix; bedding indistinct, defined in part by numerous mud clasts.

Mode of occurrence of fossils: Internal and external moulds of gastropods and bivalves widely scattered on bedding planes.

Determinations: Bivalves - Trigoniid

Indet. small bivalves

Gastropod - Naticoid aff. Neritopsis

Trace fossils - abundant horizontal burrows and some inclined forms.

Age: Neocomian or Aptian on stratigraphic grounds.

Aptian collections

Locality: GSQ 1326 - Ridge on western side of Cape York telegraph line 5.9 miles (9.4km) north from the turn-off to 'Batavia Downs'. Grid ref. 599394 (yd) Cape Weymouth 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 6.10.72

Lithology: Fine-grained quartzose, glauconitic sandstone; well sorted and massive; leached and mottled in white, pink, and deep maroon.

Mode of occurrence of fossils: External moulds of belemnites widely scattered on bedding planes.

Determinations: Belemnite - Peratobelus oxys (Tension Woods)
Trace fossils - inclined and irregularly branched burrows

Age: Aptian

Locality: GSQ L1325 - small creek where Cape York telegraph line crosses, 4 miles northwards from point where the telegraph line and road separate about 3.5 miles (5.6km) south-southeast of 'Batavia Downs'. Grid ref. 602378 (yd) Cape Weymouth 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 6.10.72

Lithology: Calcareous concretions and septaria in blue grey mudstone.

Mode of occurrence of fossils: Belemnites occur in abundance in lenses of conglomeratic limestone composed of belemnites and calcareous nodules in a calcareous matrix. These locally cemented areas, which are up to 1 ft (0.3 m) thick and 4 ft (1.2 m) across, have the appearance of large discoidal concretions. Ammonites occur in these conglomerates and within concretions.

Determinations: Ammonites - Australiceras aff. lamprum (Etheridge Jnr) or Tropaeum aff. imperator (Howchin & Whitehouse)

Belemnites - ? Peratobelus sp. ind.

Age: Aptian

Locality: CW 7 - Small creek near Cape York telegraph line about 4 miles (6.4km) south-southeast of 'Batavia Downs'. Close to locality GSQ L1325. Grid ref. 602377 (yd) Cape Weymouth 1:250 000 Sheet area.

Collectors: S. Powell & K.G. Grimes

Lithology: As for GSQ L1325

Mode of occurrence of fossils: As for GSQ L 1325

Determinations: Ammonites - Tropaeum leptum (Etheridge Jnr)
Belemnites - ? Peratobelus sp. ind.

Age: Aptian

Locality: LB 121 - 'Well 4 miles [6.4km] south of Batavia'. Cape Weymouth 1:250 000 Sheet area.

Collector: K.G. Lucas?

Mode of occurrence of fossils: External moulds of belemnites widely scattered on bedding planes.

Determinations: Belemnite - Peratobelus oxys (Tenison Woods)

Age: Aptian

Locality: GSQ L1325 - small creek where Cape York telegraph line crosses. 4 miles northwards from point where the telegraph line and road separate about 3.5 miles (5.6km) south-southeast of Batavia Downs. Grid ref. 602378 (yd) Cape Weymouth 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 6.10.72

Mode of occurrence of fossils: Apparently collected from mudstone spoil heap bedside well.

Determinations: Sanmartinoceras cf. olene? (Tension Woods)

Age: Aptian

Locality: GSQ L1314 - Roadside gully on eastern side of junction of new telegraph line to Weipa with the Cape York telegraph line. Grid ref. 613320 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 3.10.72

Lithology: Creamy white coloured leached mudstone; porcellanitic and silicified in part.

Mode of occurrence of fossils: Fossils occur as internal moulds widely scattered on bedding planes.

Determinations: Belemnites - Peratobelus oxys (Tenison Woods)

Trace fossils - Network of branching thin burrows

Age: Aptian

Locality: GSQ L 1315 Gully draining into Station Creek about 200 yards (182m) northwest of ruins of Mein telegraph station. Grid ref. 614317 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 4.10.72

Lithology: Blue grey mudstone with calcareous concretions and septaria, and stringers of olive glauconitic mudstone.

Mode of occurrence of fossils: Large ammonite fragments occur as internal moulds composed of argillaceous limestone. Small ammonite fragment found in mudstone retains its shelly material.

Determinations: Ammonites - ?Tropaeum leptum (Etheridge Jnr)
Indet. juvenile fragment of heteromorph

Age: Aptian

Locality: LB 92 - 'Mein' Coen 1:250 000 Sheet area

Collector: K.G. Lucas

Lithology: Calcareous concretions

Mode of occurrence of fossils: Fossils occur within the concretions and retain shelly material.

Determinations: Ammonites - Australiceras jacki (Etheridge Jnr)
Bivalves - Indet. Medium sized ? heterodonts

Age: Aptian

Locality: GSQ L1318 - Low ridge on old track from Coen to 'Rokeby' via 'New Yard' 0.5 miles (0.8km) north of crossing of Emu Creek. Grid ref. 616248 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day & D.W. Haig 11.10.72

Lithology: Fine grained glauconitic sandstone with ferruginous mottling in red-brown, cream, and pink; bedding largely ill-defined, extensively bioturbated with sandy and muddy material and some mud clasts intermixed.

Mode of occurrence of fossils: Fossils occur as scattered internal and external moulds; some bivalves preserved with closed valves; belemnites lie at various angles to the horizontal.

Determinations: Ammonites - ? Tropaeum leptum (Etheridge Jnr)
Belemnites - Peratobelus oxys (Tenison Woods)
Bivalves - Nototrigonia sp. ? Tancretella plana (Moore)
Maranoana etheridgei ? Day
Panopea sp.
Lucinoid

Age: Aptian

Locality: GSQ L1329 - Ridge on old track from Coen to 'Rokeby' via 'New Yard', about 2 miles (3.2km) north of 'New Yard'. Coen 1:250 000 Sheet area.

Collectors: R.W. Day and D.W. Haig 11.10.72

Lithology: As for GSQ L1318

Mode of occurrence of fossils: Single external mould

Determinations: Belemnite - Peratobelus oxys (Tenison Woods)

Age: Aptian

Possibly Aptian Collections

Locality: GSQ L1324 - Low ridge on southnside of track from Wenlock to Cape York telegraph line, 2.2 miles (3.5km) west from junction of Iron Range road, Grid ref. 619322 (yd), Coen 1:250 000 Sheet area.

Collectors: R.W. Day and D.W. Haig 6.10.72

Lithology: Interbedded hard pink and cream porcellanitic mudstone and leached and partly silicified buff - white and purplish siltstone.

Mode of occurrence of fossils: External moulds scattered on bedding planes.

Determinations: Belemnites ? Peratobelus oxys (Tenison Woods)

Age: Aptian ?

Locality: 72793005 - 100 metres south of track from Wenlock to Cape York telegraph line at jump up onto Geikie Range. Grid ref. 616319 (yd) Coen 1:250 000 Sheet area.

Collector: D. Gibson

Lithology: Pinkish coloured leached siltstone

Mode of occurrence of fossils: Single external mould

Determinations: Belemnite - ? Peratobelus oxys (Tenison Woods)

Age: Aptian ?

Locality: GSQ L1322 - High ridge on north side of Iron Range road about 5 miles (8km) northwards from junction of Iron Range road and Cape York telegraph line. Fossils from rubbly outcrop near base of ridge. Grid ref. 620316 (yd) Coen 1:250 000 Sheet area.

Collector: R.W. Day and D.W. Haig 5.10.72

Lithology: As for GSQ L1324

Mode of occurrence of fossils: External moulds scattered on bedding planes.

Determinations: Belemnite - ? Peratobelus oxys (Tenison Woods)
Trace fossils - Comparatively wide inclined burrows

Age: Aptian ?

Locality: GSQ L1316 - Mesa on eastern side of junction of Cape York telegraph line and road to Iron Range. Fossils from near base of northwestern slope of mesa. Grid ref. 619308 (yd) Coen 1:250 000 Sheet area.

Lithology: As for GSQ L1324

Mode of occurrence of fossils: Scattered external moulds of belemnites, some anomalously inclined to bedding planes with no evidence of bioturbation.

Determination: Belemnites - ? Peratobelus oxys (Tenison Woods)
Gastropod - Naticoid
Plants - flattened stemimpressions

Age: Aptian ?

Albian Collections

Locality: GSQ L1328 - Tributary of Pickaninny Creek, about 1 mile (1.6km) upstream (north) of point where old road from Cape York telegraph line to 'Merluna' crosses. Grid ref. 598324 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day and D.W. Haig 10.10.72

Lithology: Olive grey limestone concretions in olive coloured mudstone.

Mode of occurrence of fossils: Bivalves occur in concretions, belemnites found scattered in mudstone.

Determinations: Belemnites - Dimitobelus macgregori (Glaesner)
Dimitobelus diptychus (McCoy)
Bivalves - Inoceramus sp. ind.

Age: Albian (possibly upper Albian)

Locality: GSQ L1327 - Dry Creek 50 yards (45m) upstream from crossing of old road from 'Merluna' to Cape York telegraph line. Grid ref. 594325 (yd) Coen 1:250 000 Sheet area.

Collectors: R.W. Day and D.W. Haig 10.10.72

Lithology: As for GSQ L1328

Mode of occurrence of fossils: Limestone concretions

Determinations: bivalve - Aucellina cf hughendenensis (Etheridge Jnr)

Age: Albian

Remarks: Some of the collections from sandstones near the base of the marine Lower Cretaceous sequence, namely GSQ L1318, 1326, and 1329, contain Peratobelus oxys (Tenison Woods). They are therefore assigned an Aptian age. In the Eromanga and Surat Basins this belemnite is a diagnostic Aptian species (Day, 1969, tables 8:1, 8:3, 8:5).

Other collections from GSQ L1317 and 1323 contain assemblages which show a general resemblance to those from basal sandstones of Lower Cretaceous sequences in the Laura and Surat Basins. A collection reported by Fleming (1965) from the road about 19 miles (30.5km) north of Moreton Telegraph Station 587441.5 Cape Weymouth Sheet also belongs in this category. The occurrence of the bivalve genus Meleagrinella is particularly noteworthy (Day 1969, p. 154). These three collections could be Neocomian or Aptian in age. The lower part of Battle Camp Formation in the Laura Basin and the Nullawurt Member of the Bungil Formation in the Surat Basin are regarded as Neocomian, while the Minni Member of the latter formation is early Aptian.

The identifiable ammonites are all characteristic Aptian forms known from the Wrotham Park area of the Carpentaria Basin (Woods, 1961) and from the Eromanga and/or Surat Basins (Day, 1969). Specimens identified as ? Tropaeum leptum (Etheridge Jnr) have whorl sections and ribbing like that species, but are insufficiently preserved for positive generic determination. An incomplete specimen of Sanmartinoceras may belong to S. olene (Tenison Woods), a species found in abundance at Wrotham Park. Material from GSQ L1325 shows relationships with the large species Australiceras lamprum (Etheridge Jnr) and Tropaeum imperator.

Occurrences of Dimitobelus macgregori (Glaessner) at GSQ L1328 are particularly interesting as this belemnite has not been reported from Australia previously. The species was originally described from New Guinea by Glaessner (1945, p.160, Pl. 6, fig. 12). Subsequently, Glaessner (1958, p. 219, Pl. 26, figs 5a-b, 6; text fig. 5) redescribed the form, and Stevens (1965, p. 211, Pl. 24, figs 1-3) noted its presence in New Zealand. In New Guinea, Dimitobelus macgregori occurs with the upper Albian Myloceras - Labeceras ammonite fauna, so the mudstones at GSQ L1328 may also be upper Albian. At this locality it is accompanied by Dimitobelus diptychus (McCoy). This belemnite is very common in the Eromanga Basin where it ranges throughout the Albian succession.

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71

APPENDIX 3

Palaeontology and lithology, 90-93 m, Beefwood No. 1 Bore, Rutland Plains

The material described in this Appendix came from a bore drilled for water on Rutland Plains station, which is south of Kowanyama (Mitchell River Mission), RUTLAND PLAINS. The material apparently comes from the Wyaaba Beds.

The geology of RUTLAND PLAINS has been discussed by Doutch et al (1972), and Needham & Doutch (in press). This Appendix has been included partly as a convenient way of recording information acquired after the two reports were written, and partly because it deals with the first demonstration that some of the Wyaaba Beds were laid down in the sea.

Macrofossils from Beefwood No. 1 Bore, IWSC Licence No. 38472, Rutland Plains 1:250 000 Sheet Area

Locality: Beefwood No. 1 bore, IWSC Licence No. 38472; lat. 16°00', 28.5 miles (45.8km) north; long. 141°31', 14.5 miles (23.3km) east. From 295' - 305'.

Material: Rock fragments from percussion drilling operation.

Determinations:

Bivalves	Cardiid aff. *Vepricardium* ?
	Veneriid
	Arciid
	Pectinid ?
	Indet. elongate Myacean ? genus
	Indet. globose heterodont? genus

72

Gastropods	(Large turreted Muracean ? genus ((Several indet. diminutive genera
	Echinoid test, spines and spine bases Cellular base plate of barnacle Bryozoans ?

Age: Upper Cretaceous - Holocene

Remarks: These samples are highly fossiliferous, the fossils occurring as ill-sorted internal and external moulds preserved in a slightly re-crystallized lime mud matrix. Both the calcitic echinoid remains and the aragonitic shells of the other groups have been dissolved. None of the material is determinable at generic or specific level due to the fragmentary nature and limited size of these samples.

A cardiid offers most evidence for dating this material. It is represented by 7 internal moulds which range in height from 15 mm to 30mm, and 3 fragmentary external moulds. The shape and ribbing are comparable with those of the Vepricardium group which ranges from Upper Cretaceous to Holocene.

This macrofossil assemblage consists of shallow water (sub-littoral or inner neritic) benthos, which live at or just below the sediment - water interface. Taken in conjunction with observations on the foraminifera by Palmieri and on the sediment by Fleming in the accompanying reports, a low energy carbonate mud flat or lagoonal flat depositional environment is indicated.

R.W. Day - Principal Geologist, G.S.Q.
January 11 1973

73

Micropalaeontological analysis of samples from Beefwood No. 1 Bore, IWSC Licence No. 38472, Rutland Plains 1:250 000 Sheet area

Locality: Beefwood No. 1 bore, IWSC Licence No. 38472; lat. 16°00' 28.5 miles (45.8 km) north; long. 141°30', 14.5 miles (23.3km) east. From 295' - 305'.

Material: Rock chips from percussion drilling operation. The rock is a light grey or light cream limestone, vugular in aspect, and very fossiliferous. In thin section it appears as a partially recrystallized unsorted limy mud deposit.

Macrofauna:	Bivalves, Gastropods, Bryozoa?, Echinoderms, and small sized barnacle remains.
Microfauna:	Forams and Ostracods (some with ornamented carapace).
Plants:	Algal remains (fragments of Halimeda ?)

Foraminifera

Determinations:	
Miliolidae (common)	Triloculina, Quinqueloculina, Miliola
Rotaliidae (common)	Pseudorotalia, Pararotalia, Ammonia
Elphidiidae (common)	Elphidium, Cellanthus
Nodosaridae (frequent)	Nodosaria, Frondicularia, Plectofrondicularia

Soritidae (frequent): small Marginopora

74

Age: An upper Tertiary to Holocene age is indicated by the fauna; the genera Cellanthus and Pseudorotalia range from the Pliocene, and the genera Ammonia and Marginopora range from the Miocene.

Environment: A marine, shallow-water, near-shore shelf sea environment is suggested. In particular the microfauna might be indicative of a possible mud flat or lagoonal flat with hypersaline water.

Remarks: Lloyd (1968, p.95) has reported that a possible Miocene or Pliocene or Pleistocene marine transgression may have occurred in Northern Australia, and has indicated his preference for a Lower Miocene age for this event. Observations on the material failed to furnish proof of a Miocene or Pliocene or Pleistocene age for these samples. However, the occurrence of similar faunas in other parts of the northern and eastern Australian continental shelf and slope during the Pliocene suggests that similar lime mud flat or lagoonal flat environments were not uncommon then. Thus a Pliocene age might be inferred for these samples.

Reference: LLOYD, A.R., 1968 : Possible Miocene Marine transgression in Northern Australia. Bur. Miner. Resour. Aust. Bull. 80.

V. Palmieri - Geologist, G.S.Q.
January 11 1973

75

Sedimentary Petrology of sample from Beefwood No. 1 Bore, IWSC Licence No. 38472, Rutland Plains 1:250 000 Sheet area

Locality: Beefwood No. 1 bore, IWSC Licence No. 38472; lat. 16°00', 28.5 miles (45.8km) north; long. 141°30', 14.5 miles (23.3km) east. From 295' - 305'.

Material: Rock chips from percussion drilling operation.

Remarks: The sediment is sparse to packed biomicrite (Folk, 1962). The groundmass is carbonate mud, slightly recrystallized. Biogenic allochems are mostly dissolved and unidentifable. However, echinoderms, gastropods, bivalves, forams, and bryozoa? are represented. Allochems are angular and unsorted. Where grain support exists, carbonate mud is not washed from interstices, and most of the sediment is mud-supported.

Depositional conditions therefore were very low energy.

Reference:

FOLK, R.L., 1962: Spectral subdivision of limestone types. In HAM, W.E., ed. Classification of carbonate rocks. Mem. Am. Assoc. Petrol. Geol., 1, 62-84.

P.J.G. Fleming - Geologist, G.S.Q.
January 11 1973

76

Setting of the fossils and biomicrite

(H.F. Doutch)

1. Their marine origin

The level of the biomicrite in the Wyaaba Beds is unknown, but is probably low. What proportion of the Beds is marine is unknown, but to the east of the bore the equivalent strata of the Wyaaba Beds to the biomicrite may be continental - to the south, in CROYDON, MILLUNGERA and GILBERTON, the upper parts, at least, of the unit are continental.

Alternatively: Sea level and climate variations during the Pleistocene should have resulted both in variations in base levels for rivers and variations in the types of sediments carried by them; lime muds (e.g., biomicrite) have been found in the Wyaaba Beds only in this bore and offshore from Weipa; elsewhere the unit is composed of claystone, sandstone and granule conglomerate, all kaolinitic and quartzose; therefore the low energy conditions reflected by the biomicrite may be represented by a so-far unrecognized non-depositional 'disconformity' in the continental facies.

K.R. Warner (1968) suggested that saline groundwater in what appears to be Wyaaba Beds reflects deposition of them in the sea, the groundwater being sea water originally trapped in the sediments.

2. The history of the Gulf of Carpentaria

The depth of the material in the bore was about 79 m below present sea level. The deepest part of the Gulf of Carpentaria is about 65 m. If the material from the bore came from the depth at which it was originally deposited, then at that time the coastline is likely to have been much further east than it is now, but perhaps not if subsequent sinking brought the materal to its present depth from a shallower near-shore locale.

As the bore locality is within the Gilbert-Mitchell Trough, sinking is a possibility (wherefore correlation of the biomicrite with lime muds offshore near Weipa is uncertain). As it is possible that the Gulf of Carpentaria is a structural depression, the depth and occurrence of the fossils and biomicrite may be as much a consequence of the formation of the Gulf as of the Trough, which may well be penecontemporaneous events, possibly Pliocene or younger (Doutch et al. 1972).

77

There is no evidence yet for the sea being present in the area between Early Cretaceous times and the time represented by the fossils. It is possible that the Gulf began forming as early as Miocene times, its present depth being in part a result of infilling by sediments, including Wyaaba Beds, delivered by rivers such as the Gilbert and Mitchell and their ancestors, sometimes as continental deposits during Pleistocene episodes of low sea level, sometimes as marine, when sea levels had risen.

Because tectonic sinking cannot be ruled out, the overall setting of the material from the bore does not help narrow down its age, while the likely age range of the fossils does not improve on previous estimates of the age of the Gulf and Trough (e.g., Doutch, 1972).

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78

APPENDIX 4

(J. Smart)

Bauxite

The red cliffs of the western side of Cape York were noted by Asschens, in the 'Buijs', in 1756, and by Matthew Flinders in 1802 (Jack, 1922), but the first mention in the geological literature was by Jackson (1902) who described the rock type as 'pisolitic iron ore'. Several samples were analysed between 1902 and 1955, and Owen (1954) mentioned the bauxite potential of the area. The investigation and development of the deposit followed recognition of its potential by H.J. Evans in 1955. Until now, in the absence of regional geological mapping, studies of the bauxite have been on local detail and have concentrated on its chemistry and mineralogy. Evans (1959, 1965) provided an outline of the regional geology as then known, and discussed the chemistry and probable origin of the bauxite. Edwards (1957, 1958) and Baker (1958) investigated the heavy minerals of the bauxite and underlying beds (now called the Bulimba Formation), and studied the quartz grains present in both units. Loughnan & Bayliss (1961) described the mineralogy and possible origin of the bauxite. Grubb (1971) discussed its genesis on the basis of mineralogy and heavy mineral content. Plumb & Gostin (1973) described the petrology of the bauxite and made comparisions with the deposits at Gove and Mitchell Plateau. MacGeehan (1972) presented the most complete account to date of the petrology of the bauxite and its probable genesis, but his account considered only the Aurukun area.

The main area of bauxite in Cape York is on the west coast, between Vrilya Point in the north and the Archer River mouth in the south. The bauxite surface extends inland for up to 100 km in southeast AURUKUN, but it is generally within 50 km of the coast. Bauxite is also present on the east coast, in the Escape River area (TORRES STRAIT & ORFORD BAY).

The unit mapped as Tw on the preliminary 1:250 000 geological maps is not everywhere economic bauxite. The presence of bauxite offshore in the Gulf of Carpentaria is uncertain. West of Weipa, drilling by Canadian Superior and Ocean Resources in 1971 (Zwigulis, 1971) showed the bauxite to be absent, and the underlying Bulimba Formation thinning seaward and absent in many areas (Fig. 1). The offshore part of JARDINE RIVER has also been drilled for bauxite by BHP in 1970 and 1972 but results are still confidential. However, the ATP has been relinquished.

79

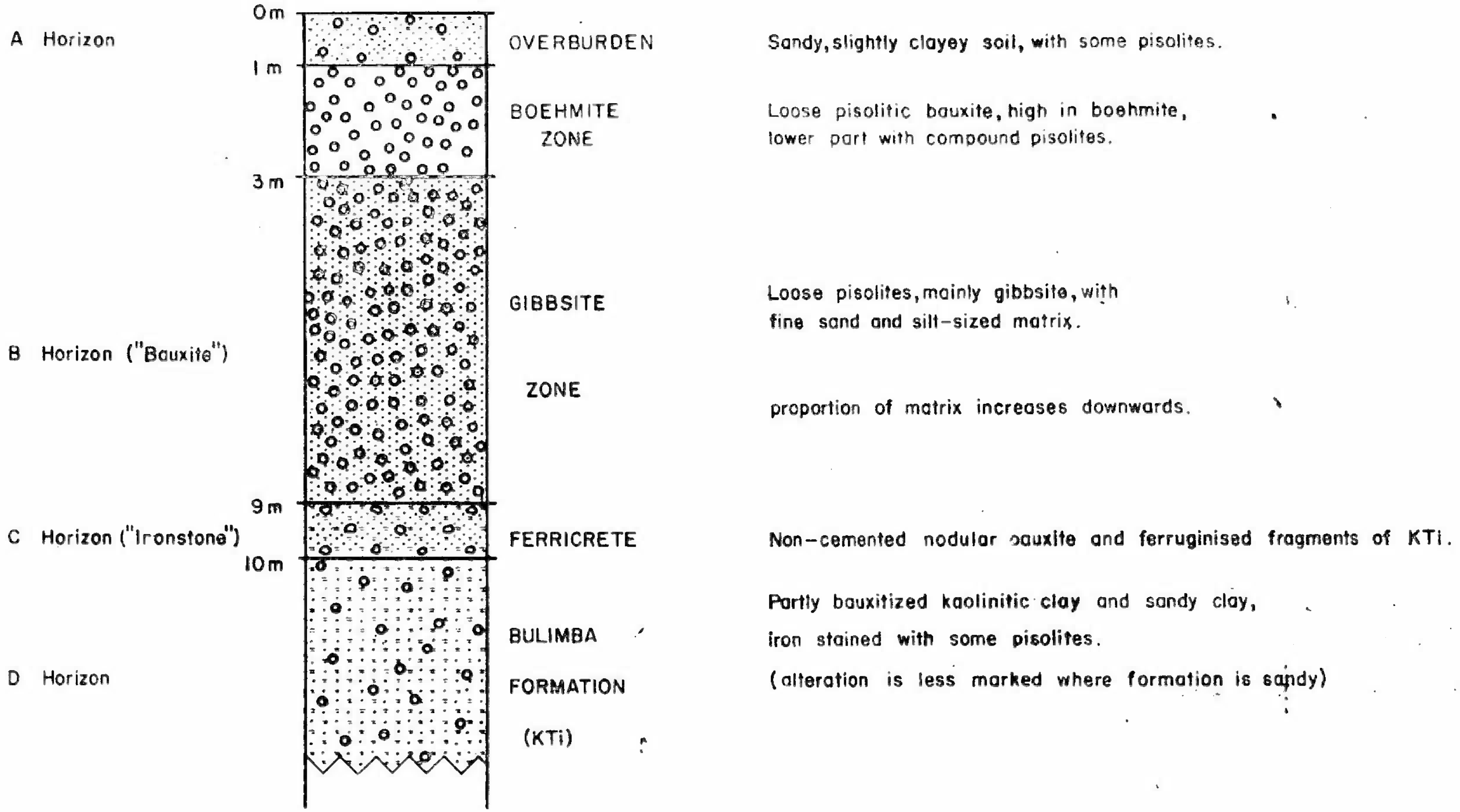
APPENDIX 4, FIGURE I

Detailed offshore sections based on 1971 drilling of Canadian Superior and Ocean Resources (Zwigulis, 1971).

To accompany Record 1973/187

Aus 6/90

30



APPENDIX 4,
FIGURE 2

GENERALISED SECTION THROUGH THE WEATHERING PROFILE IN THE WEIPA AREA, BASED ON EVANS (1965) AND MacGEEHAN (1972).

The bauxite surface in the Weipa-Aurukun area shows considerable topographic variation, from less than 10 m above sea level over most of the Andoom area in WEIPA, to over 130 m in Southeast AURUKUN. In general there is a westward dip, but it is impossible to quote a meaningful average figure because of topographic irregularities. Computer contour plots (at 5 m interval) of elevations derived from BMR gravity spot heights have thrown some light on the topography of the surface. (In some places, the density of data points is too low to give meaningful results and in others erroneous elevations have resulted in large artificial anomalies). The 20-30 km-wide low plateau fringing the coast is generally below 10 m in elevation. To the east of this the land rises relatively steeply to 50 m or so above sea level, and then more gradually to the highest part of the land surface in the Southeast. This upland area is considerably modified by the major river valleys which, within the bauxite areas, are less than 30 m above sea level, and generally much lower.

The bauxite surface is more or less continuous in the coastal plateau area. Inland it is present on both interfluves (where it is partly dissected) and in river valleys. The latter have a considerable amount of Rolling Downs Group exposed, and the Bulimba Formation underlying the bauxite in the valleys appears to be thinner than on the interfluves and coastal plateau. MacGeehan (1972) states that the bauxite is thicker and of higher grade on the interfluves, and therefore the major river valleys existed before bauxitization. In addition, a general proposition can be made that as the economic bauxite is within 50 km of the sea and areas inland of this are of lower grade, that bauxitization of the inland areas has been incomplete.

A generalized section of the bauxite based on Evans (1965) and MacGeehan (1972) is shown in Fig. 2. The bauxite is unusual in being pisolitic throughout, and no massive or earthy bauxites are present. The upper part of the bauxite proper (B Horizon) consists of the monohydrate of alumina, boehmite, and the lower part consists of the trihydrate, gibbsite. The junction is commonly interpreted (Evans, op. cit.; MacGeehan, op.cit.) as representing the wet season water-table during bauxite formation. The 'ironstone' unit (C Horizon) appears to be an iron pan formed at the level of the dry season water-table. Within the boehmite layer, the lowermost part consists of gibbsite pisolites coated and partly cemented together by boehmite. This seems to reflect a regional drop in groundwater levels as noted by Evans (op.cit.) and MacGeehan (op.cit.), and is probably consequent on the dissection of the Weipa Plateau. This waterlevel is generally above that of the present day, but in some areas such as Andoom, even the dry season water-table is above the ironstone horizon, which suggests downwarping of the bauxite surface.

82

The generally accepted pre-requisites for the formation of bauxite include suitable high alumina parent material, in situ weathering under stable conditions, and a tropical or sub-tropical climate, with a heavy, but seasonal, rainfall. At present, the Weipa-Aurukun area fulfills all these conditions and bauxite is probably forming in some areas at present, as suggested by Evans (op.cit.) and MacGeehan (op.cit.). The climate is ideal, with an annual average maximum temperature of 35° C, and a minimum of 21° C. Rainfall is over 1500 mm per annum in coastal areas, decreasing inland, and falls between December and March. The feldspathic Bulimba Formation forms an ideal parent rock, and in areas near the coast is not being eroded or covered with superficial sediments at present. Orthoclase contains about 15% alumina, so no arkose can contain more than this and less than 10% would be likely for most arkoses. Kaolinite contains about 21% alumina. Four samples of Bulimba Formation from the Weipa area analysed in 1957, have alumina contents ranging from 7.3 to 22.0% and total silca contents from 69.5 to 89.2% (J.R. Beevers, writt. comm.*). The alumina is probably present in clay minerals.

The other factor in bauxite formation is topography and its effect on surface and subsurface drainage, and on the water-table. MacGeehan (op.cit.) has pointed out that the bauxite is thickest and of best grade on the interfluves, where there is a considerable fluctuation of groundwater level between wet and dry seasons. In the river valleys, fluctuations will obviously be less or perhaps even absent. This reasoning is valid in the Aurukun area, and as far north as the Weipa Peninsula, but in the Andoom area, the situation is different. Most of this area is of low elevation, much of it less than 10 m, and is poorly drained, swamps persisting in the lower parts well into the dry season. Despite this the area contains thick bauxite (up to 10 m) of economic grade. However, the groundwater conditions mentioned earlier suggest that the Andoom area was originally at a higher level.

Evans (1959) first mentioned warping of the bauxite surface in the Weipa area. However, he did not provide any specific details. C. Maffi of BMR, while preparing photogeological maps of WEIPA and AURUKUN, recognized apparent anticlinal and synclinal structures and some minor faulting. Some of these can be explained as topographic features of the land surface on which the bauxite formed, while others appear to be of tectonic origin. The groundwater situation in the Andoom area, where the present water-table appears to be above that existing during bauxitization, is best explained by tectonic movement. Other areas also have anomalous water-tables, well above or below what would be expected if the present topography was inherited entirely from that existing at the time of bauxitization. The details of the warping of the bauxite surface could be worked out from a study of present day water-tables and past water-tables revealed by the 'ironstone' horizon and the boehmite/gibbsite boundary. The warping of the bauxite surface is probably contemporaneous with the regional uplift, warping and faulting in the late Cainozoic.

* BMR Technical File SD/54-3

Summary of points relevant to the origin of the bauxite. The following aspects of the bauxite areas are important in considering its origin:

1. The theory that it formed under stable geological conditions, with the water-table subject only to seasonal fluctuations.
2. The subsequent apparent drop in water-table in most areas.
3. The relations of the bauxite to topography, suggesting bauxitization is younger than the development of the major river system.
4. Restriction of bauxite to near coastal areas, and general absence offshore.
5. Warping of the bauxite surface after formation of the bauxite.

Regional geological points that are relevant to the origin and distribution of the bauxite are:

1. The origins of the Bulimba Formation.
2. The regional lateritic weathering in the Tertiary.
3. The considerable variations in sea levels during the Pleistocene.
4. The uplift, faulting and warping in Cape York Peninsula in Pleistocene times.
5. Limited distribution of the Bulimba Formation offshore, which implies sub-aerial erosion when the Gulf floor was higher than present, or marine erosion, in both cases before Wyaaba Beds deposition.
6. The absence of the Bulimba Formation offshore in the Gilbert-Mitchell Trough in the Weipa-Arukun area.
7. The lateritic material in the basal Wyaaba Beds offshore in the Weipa-Aurukun area.

A possible history of the bauxite is as follows:

TERTIARY	1.	Lateritic weathering of the arkosic Bulimba Formation to form aluminous laterite or low grade bauxite.
	2.	Development of present major river system.
MIOCENE?-PLIOCENE	3.	Erosion of much of the Bulimba Formation within the area of the present Gulf of Carpentaria.
	4.	Initiation of the Gilbert-Mitchell Trough, by downwarping southwest of the Alice-Palmer structural zone.
PLEISTOCENE	5.	Deposition of the Wyaaba Beds in the Trough onshore on Bulimba Formation and Rolling Downs Group.
	6.	Lateritization of the Bulimba-Wyaaba land surface, with bauxitization of the previously lateritized Bulimba Formation. Groundwater level higher than present.
	7.	Change in base level owing to sea level drop (glacial episode), uplift of main axis of Cape York Peninsula and bauxite area inland of the coastal plateau (20-30 km from present coast), and warping of the bauxite surface. Consequent drop in groundwater level and change in level of the boehmite/gibbsite boundary. Dissection of bauxite surface was most pronounced inland, the effects decreasing seaward, being minimal in the coastal plateau.
RECENT	8.	Rise in sea level in the present interglacial period giving drowned river valleys and very slow erosion rate in the coastal areas. Bauzitization continuing?

86

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TABLE 2. GEOLOGICAL HISTORY

AGE	EVENTS IN SEQUENCE	REMARKS
Late Permian to Mid Jurassic	Erosion of Precambrian and Palaeozoic 'basement' rocks	Formation of Weipa and Peninsula Trough Depressions
Late Jurassic to earliest Cretaceous	Fluvial, finally marine, deposition of quartzose sandstone, siltstone	Depressions filled by 'Wreath Sandstone' and equivalents; after this the Gilbert River Formation blanketed most of the area.
Early Cretaceous (Aptian-Albian)	Marine transgressions and regression; deposition of mudstone and labile sandstone.	Deposition of the Rolling Downs Group.
	Block faulting) Pene-	Creation of ancestral Great Dividing Range.
	Erosion) contem-	Ancestors of present rivers initiated.
	Continental deposition) poraneous	Bulimba Formation; Yam Creek Beds in ancestral basin of Pascoe River.
	Erosion and deep weathering	Ferruginization and lateritization, especially of Bulimba Formation and Yam Creek Beds.
Pliocene?	Warping	Creation of scarp facing east coast. Downwarp of Gilbert-Mitchell Trough. Olivine nephelinite emplacement?
Pleistocene	Erosion and deposition; latter continental and marine	Erosion of higher parts of Bulimba Formation. Deposition of Waaba Beds (part marine), Lilyvale and Falloch Beds, and younger (if not all of the) Brixton Formation.
	Erosion and deep weathering	Ferruginization and bauxitization
	Uplift and warping, during sea level low	Uplifts in Great Dividing Range; warping of bauxitized surface, followed by dissection of it.
	Sea level rise	Valley drowning in Weipa area.
	Sea level retreat	Beach ridge and delta-fan development. Continuing bauxitization?

QUATERNARY	Riverine plain deposits (Qa)	Quartzose sand and silt, some clay	10	River flood plains	Contemporaneous with Qac, Qd, younger Czs	Plains along rivers	Along most rivers
	River channel deposits (Qas)	Quartzose sand	5	Abandoned river channels	Contemporaneous with older Qa, younger Czs	Low ridges on river plains	Edward River, HOLROYD
	Colluvial clay (Ql)	Heavy clay	10 ?	Weathered bedrock?	Could be as old as Czy, Czv	Clay plains	HANN RIVER, EBAGOOLA
CAINOZOIC	Colluvial sand (Czs)	Quartzose sand, minor silt	10	Weathered bedrock	Could be as old as Czy, Czv	Sand plains	Most sheet areas
	Wyaaba Beds (Czy)	Clayey quartzose sand and granule gravel, pebbly in parts; interbedded sandy clay	Up to 80	Part marine, part continental	Contemporaneous with Czv, Falloch Beds, and younger Czx	Piedmont plain and Gulf floor	HOLROYD, EBAGOOLA, HANN RIVER, AURUKUN
	Lilyvale Beds (Czv)	Clayey quartzose sand, gravel; interbedded sandy clay	Up to 50	Continental, possibly part marine	Contemporaneous with Czy, Falloch Beds, and younger Czx	Piedmont sheets	EBAGOOLA
	Falloch Beds (Czh)	Clayey quartzose sand, gravel; interbedded sandy clay	Up to 30	Continental	Contemporaneous with Czy, Czv, younger Czx	Piedmont sheets filling valleys	COEN
	Brixton Formation (Czx)	Clayey quartzose sand, gravel; interbedded sandy clay	Up to 50?	Continental	Contemporaneous with Czv, Czy, Falloch Beds	Piedmont sheets	HANN RIVER, EBAGOOLA
	(Czn)	Olivine nephelinite		Plug?	Older than Lilyvale Beds?	Low hill	COEN

MESOZOIC	JURASSIC	'Wreath Sandstone' (Jw)	m - f quartzose sandstone. Minor conglomerate.	0 - 100	Fluvial	Unconformable on basement (rocks of Peninsula Ridge). Equivalent to the 'Four Cliffs Member' and the 'Albany Pass Formation'. (Zolnai et al. 1965)	Cliffs and hill country	Olive River Basin.
		'Wenlock conglomerate member'	polymictic conglomerate, some coal beds.	0 - 30				
		Dalrymple Sandstone (Jd)	quartzose, sandstone, conglomerate, minor silt, shale and coal.	0 - 600	Fluvial	Unconformable on basement. (the rocks of the Hodgkinson Basin)	Cliffs and rough ranges	Laura Basin

TABLE 1. STRATIGRAPHY

AGE	ROCK UNIT	LITHOLOGY	THICKNESS metres	DEPOSITIONAL ENVIRONMENT	STRATIGRAPHIC RELATIONS AND CORRELATIONS	PHYSIOGRAPHY	DISTRIBUTION OF OUTCROPS
CAINOZOIC, QUATERNARY, HOLOCENE	Stream bed deposits (Qha)	Quartzose sand, minor silt and clay	5	Present day river beds	Contemporaneous with youngest beds of Qhe, Qhp, Qd, Qac, Qa, Czs	River bottoms	Most sheet areas Majority not mapped.
CAINOZOIC, QUATERNARY, HOLOCENE	Meander belt deposits (Qhe)	Clay, silt and sand	5	Coastal plain-point bar deposits	Contemporaneous with Qha, Qhp, Qd, Qac, Qa, Czs	Plains fringing major rivers	North Kennedy River EBAGOOLA
CAINOZOIC, QUATERNARY, HOLOCENE	Salt pan deposits (Qhp)	Silty clay and salt	2	Coastal plain-tidal	Contemporaneous with Qha, Qhe, Qd, Qac, Qa, Czs	Lowest parts of coastal plains	Along coasts developed in Cainozoic deposits.
CAINOZOIC, QUATERNARY	Gulf bed deposits (Qc)	Shelly mud over calcareous clay and limestone	10	Shallow marine	Contemporaneous with Qa, Qac	Present sea floor off Weipa	Floor of Gulf of Carpentaria generally?
CAINOZOIC, QUATERNARY	Dune sands (Qd)	Quartzose sand	Dunes to 90 m high	East coast sandstone areas	Contemporaneous with Qa, Qac, Qm, younger? Czs	Longitudinal sand dunes	Coast in ORFORD BAY, CAPE WEYMOUTH
CAINOZOIC, QUATERNARY	Beach ridge (Qm) sands	Calcarenite, shelly quartzose sand	5	Coastal plain	Contemporaneous with Qa, Qac, Qd, younger	Subparallel ridges along coasts.)	Along coasts developed in Cainozoic deposits.
CAINOZOIC, QUATERNARY	(Qm_1)	Quartzose sand	5	Coastal plain	Czs (older beach ridges)	Up to 15km inland)	
CAINOZOIC, QUATERNARY	Coastal deposits (Qac)	Silt, clay and minor sand	10	Coastal plain	Contemporaneous with Qhp, Qm, Qd, Qa, younger Czs	Plains surrounding and between Qm	Along coasts developed in Cainozoic deposits

		Deep weathering zone phenomenon (Czf)	Ferruginized lithified gravel	5	Weathered bedrock	Contemporaneous with Tw, Tf?	Low plateau	CAPE WEYMOUTH
CAINOZOIC	TERTIARY	Deep weathering zone phenomena (Tw)	Bauxite and ferricrete	10	Weathered bedrock	Younger than Bulimba Formation	Low plateaux, mainly	WEIPA, AURUKUN, HOLROYD, EBAGOOLA
		Deep weathering zone phenomena (Tf)	Ferricrete, minor bauxite bauxite	10	Weathered bedrock	Younger than Bulimba Formation	Low plateaux, some valley floors	WEIPA, AURUKUN CAPE WEYMOUTH HANN RIVER, EBAGOOLA
		Deep weathering Zone phenomena	Kaolinized, silicified and ferruginized sediments	10	Weathered Bedrock	Younger than Bulimba Formation	Low plateaux	EBAGOOLA, HANN RIVER, CAPE WEYMOUTH
	LATE CRETACEOUS OR TERTIARY	Bulimba Formation (KTi)	Clayey quartzose sandstone and granule conglomerate, locally pebbly; interbedded sandy claystone	Up to 80	Continental, possibly part marine	Underlies Wyaaba Beds; overlies Rolling Downs	Plateaux scarps and valley floors	WEIPA, AURUKUN, CAPE WEYMOUTH, EBAGOOLA
		Yam Creek Beds (KTa) (Cza on First Edition maps)	Clayey quartzose sandstone and granule conglomerate, locally pebbly; interbedded sandy claystone	Up to 60	Continental	Contemperaneous KTi?	Dissected valley floor	CAPE WEYMOUTH

MESOZOIC							
EARLY CRETACEOUS	Rolling Downs Group (Klr)	Mudstone, shale, siltstone; minor labile and glauconitic sandstones; minor limestone concretions	Up to 700	Marine, shallow marine paludal	Includes the Normanton Formation, Allaru Mudstone, Toolebuc Limestone, and Wallumbilla Formation. Lower part equivalent to the Woleand Claystone and the upper part of the Battle Camp Formation. Conformably overlies and overlaps the Gilbert River Formation. Unconformable on Basement.	Rolling Downs', or plateaux and mesas where deep weathering zone developed	Carpentaria Basin; Laura Basin outcrops of Wallumbilla Formation
JURASSIC TO EARLY CRETACEOUS	Gilbert River Formation (JKg)	c - fg, quartzose Sandstone; minor conglomerate interbeds of mudstone in upper part. Trace fossils	0-200	Fluvial in lower part, shallow marine above	Conformable on 'Wreath Sandstone'. Unconformable on basement rocks and on Dalrymple Sandstone. Equivalent to the 'Canal Creek Members' and the 'Wasp River Formation' (Zolnai et al. 1965) and to the lower part of the Battle Camp Formation.	Scarps and hill country	Olive River Basin and the margins of the Carpentaria and Laura Basins.

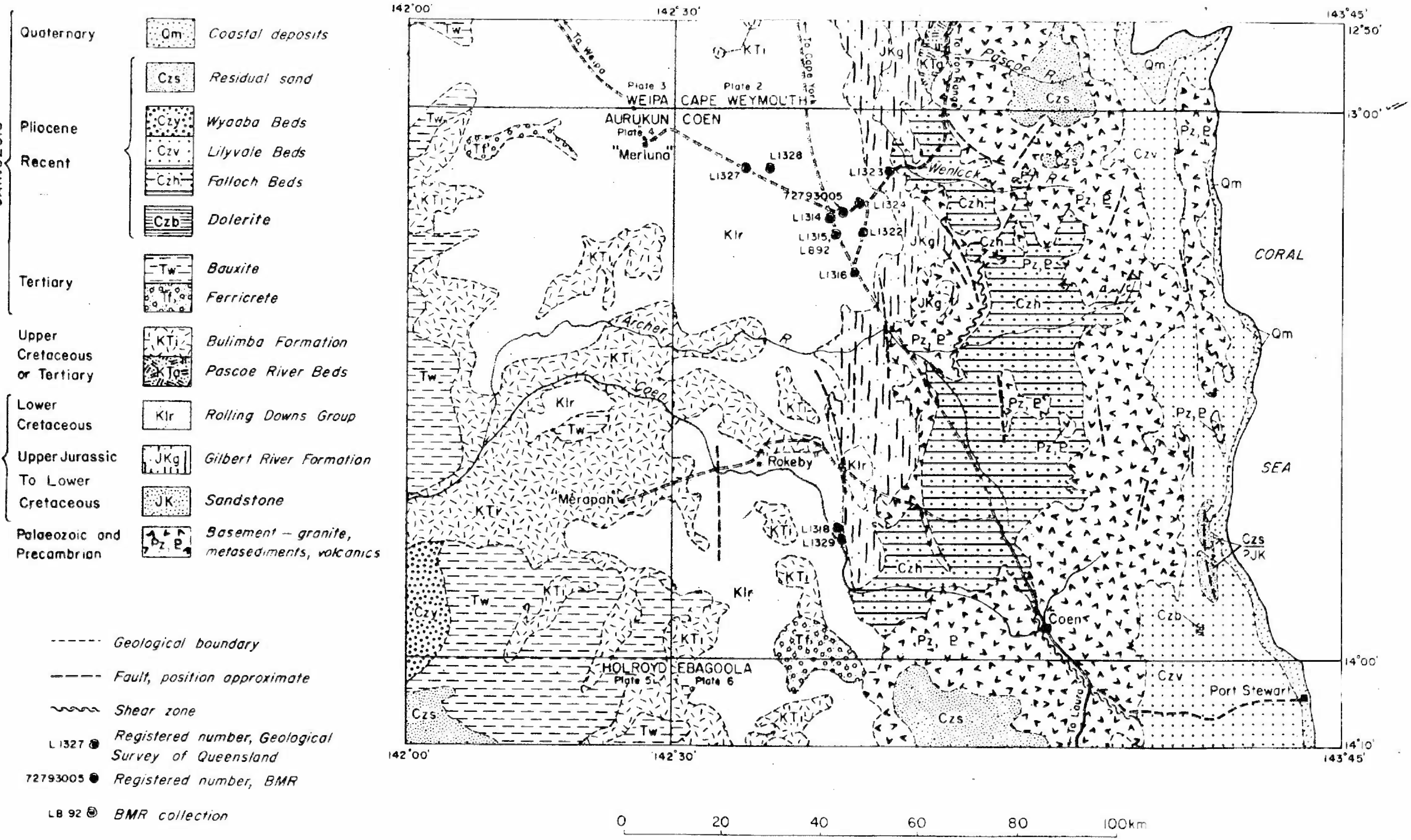


Plate I Generalised geology of part of COEN and surrounding sheets

(Qs, Qa omitted)

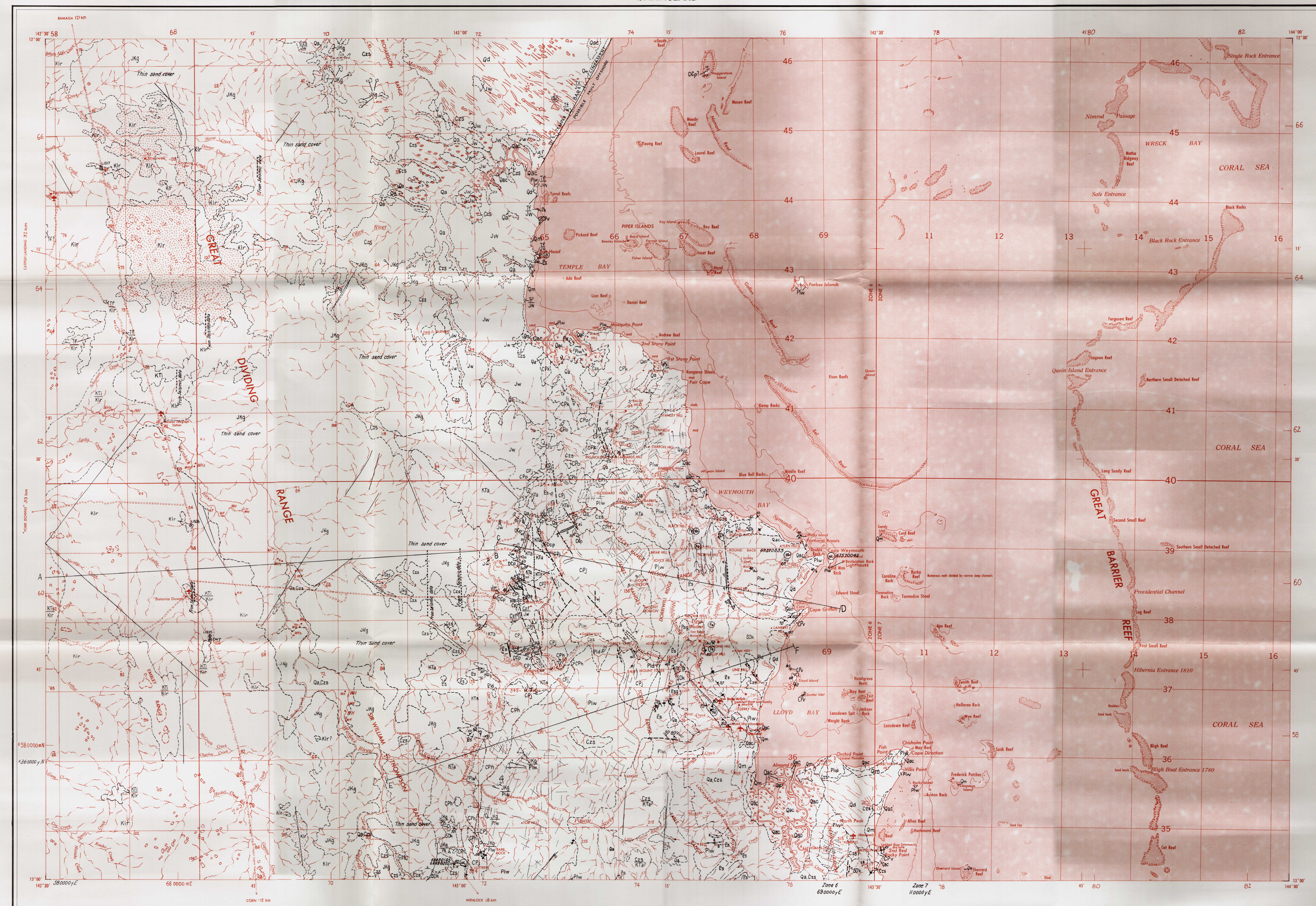
D 54/A/8

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

CAPE WEYMOUTH

QUEENSLAND

SHEET SD 54-4



Reference

CAINOZOIC	QUATERNARY		Qac	Silt, clay, minor sand:	coastal alluvium } Coastal plain deposits
			Qm	Coquina, calcarenite, shelly quartzose sand:	beach ridges } Coastal plain deposits
			Qd	Quartzose sand:	dune deposits
			Qa	Sand, silt and clay:	stream channel and floodout alluvia including minor outwash deposits
			Czs	Quartzose sand and gravel:	colluvial and outwash deposits
			Czf	Ferruginous lithified gravel	
	TERTIARY		Tf	Ferricrete; minor bauxite	
				Kaolinized, silicified and ferruginized rock in deep weathering zone	
	UPPER CRETACEOUS OR TERTIARY	Bulimba Formation	KTi	Poorly sorted, clayey quartzose sandstone and granule conglomerate, pebbly in places; interbedded sandy claystone	
		Yam Creek Beds	KTa		
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group	Klr	Shale, siltstone, calcareous in part, minor labile glauconitic sandstone	
	UPPER JURASSIC TO LOWER CRETACEOUS	Gilbert River Formation	JKg	Clayey quartzose sandstone and siltstone, minor conglomerate; glauconitic in part	
	JURASSIC	*Wreath Sandstone	Jw	Clayey micaceous quartzose sandstone, conglomerate; carbonaceous in places	
PALAEOZOIC	LOWER PERMIAN	Weymouth Granite	Plw	Biotite granite and adamellite commonly porphyritic	
			Pld	Biotite-hornblende diorite and tonalite	
	CARBONIFEROUS TO LOWER PERMIAN		CPh	Granophyric and hybrid adamellite granodiorite and granite	
			CPo	Dolerite	
		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 minor volcanic breccia, agglomerate, hornfels	
			CPv	Acid welded tuff and agglomerate, andesite, metabasalt, intrusive acid porphyry	
	UPPER DEVONIAN TO CARBONIFEROUS	Pascoe River Beds	DCp	Sandstone, arkose, greywacke, siltstone, shale; minor chert, tuff, coal, conglomerate	
	UPPER SILURIAN TO LOWER DEVONIAN	Cape York Peninsula Batholith Kintore Adamellite	SDk	Muscovite-biotite adamellite, muscovite granite	
PROTEROZOIC		Sefton Metamorphics	Ps	Muscovite-quartz schist, hematite—quartz schist, quartzite, magnetite quartzite, calc-silicate rocks, limestone	
			Psg	Greenstone	

*Name not yet approved

- Geological boundary
- Anticline
- Syncline
- Fault

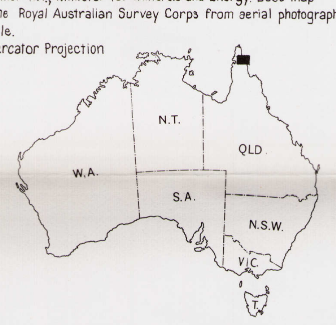
Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted; faults are shown by short dashes

- Strike and dip of strata
- Strike and dip of strata, unmeasured
- Horizontal strata
- Vertical strata
- Dip < 15° } Airphoto interpretation
- Dip 15-45° } Airphoto interpretation
- Trend line } Airphoto interpretation
- Joint pattern } Airphoto interpretation
- Lineament } Airphoto interpretation
- Strike and dip of foliation
- Vertical foliation
- Foliation with plunge of lineation
- Vertical joint
- L1317 Macrofossil locality with text reference number
- Plant fossil locality
- Fossil wood locality
- Sample locality for age determination with reference number
- Dyke: a-acid, b-basic, i-intermediate, q-quartz
- Mine
- Abandoned mine
- Abandoned alluvial workings

- Unworked mineral deposits
- Au Gold
- Fe Iron
- Ls Limestone
- Mn Manganese
- Si Silica
- Sn Tin
- W Tungsten (wolfram)

- Windpump
- WH Waterhole
- Intermittent lake
- Intermittent lake with heavy clay floor
- Swamp
- Mangroves
- Reef
- Rock, submerged; bare or awash
- 18 Bathymetric contour, depth in metres, approximate
- Sand dunes
- Beach ridge crest
- Road
- Vehicle track
- Landing ground
- "Bramwell" Homestead
- Building
- Yd Yard
- Telephone line
- Trigonometrical station
- Astronomical station
- 315 Elevation in metres, approximate

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of Minerals and Energy. Issued under the authority of the Hon. R.F.X. Connor M.P., Minister for Minerals and Energy. Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50 000 scale.
Transverse Mercator Projection



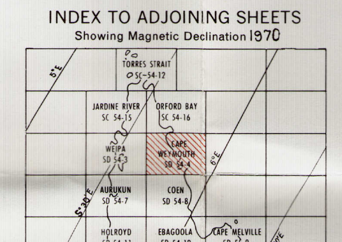
NOTE ON GRID COORDINATES

Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10 000 yard grid, Zone 6,7 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered ticks (with larger upright numbers), inside the neatline are 20 000 metre intervals of the superimposed Australian Map Grid, Zone 54 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970



Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

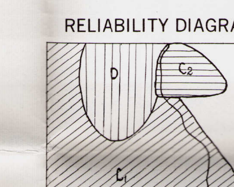
5 0 5 10 MILES

Sections

Cainozoic sediments omitted

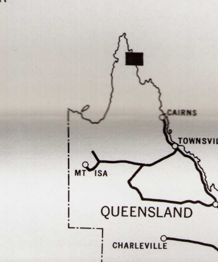
Depth in metres

RELIABILITY DIAGRAM

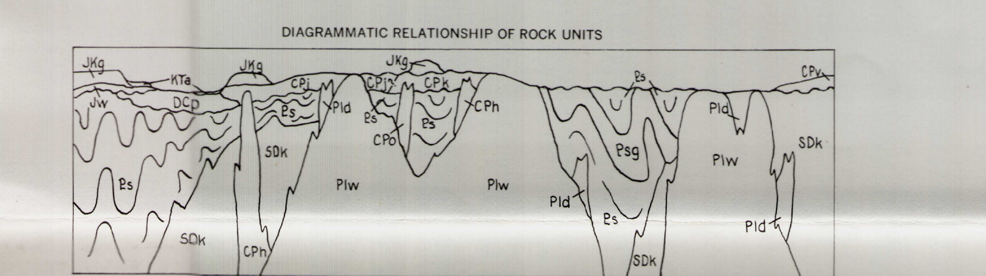


Geology
C1 General reconnaissance: many traverses and airphoto interpretation
C2 General reconnaissance: few traverses and airphoto interpretation
D Airphoto interpretation

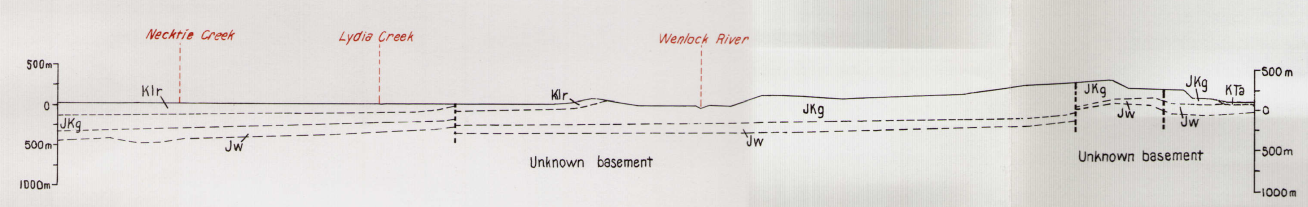
Geology 1967-68 by W.F. Willmott, W.D. Palfreyman, R.F. Spark, D.S. Trail (B.M.R.), W.G. Whitaker (G.S.Q.), with information supplied by Broken Hill Pty. Co. Ltd., and Australian Aquitaine Petroleum
Geology 1973 by S. Powell
Compiled 1968 by R.F. Spark, A.S. Mikolajczak
1973 by S. Powell, F. MacLean
Cartography by Geological Branch, BMR
Drawn by F. MacLean

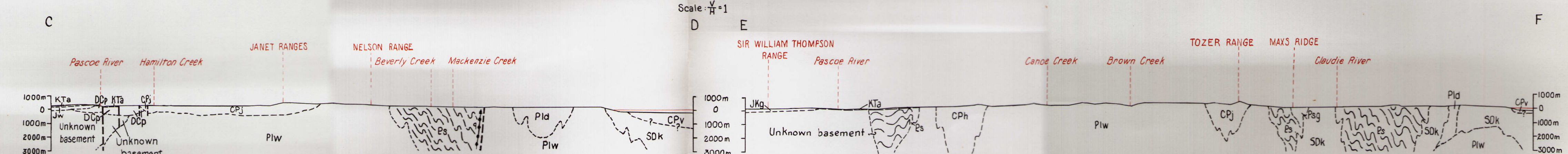


DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity
Time relation unknown





SECOND PRELIMINARY EDITION 1973

SUBJECT TO AMENDMENT

CAPE WEYMOUTH

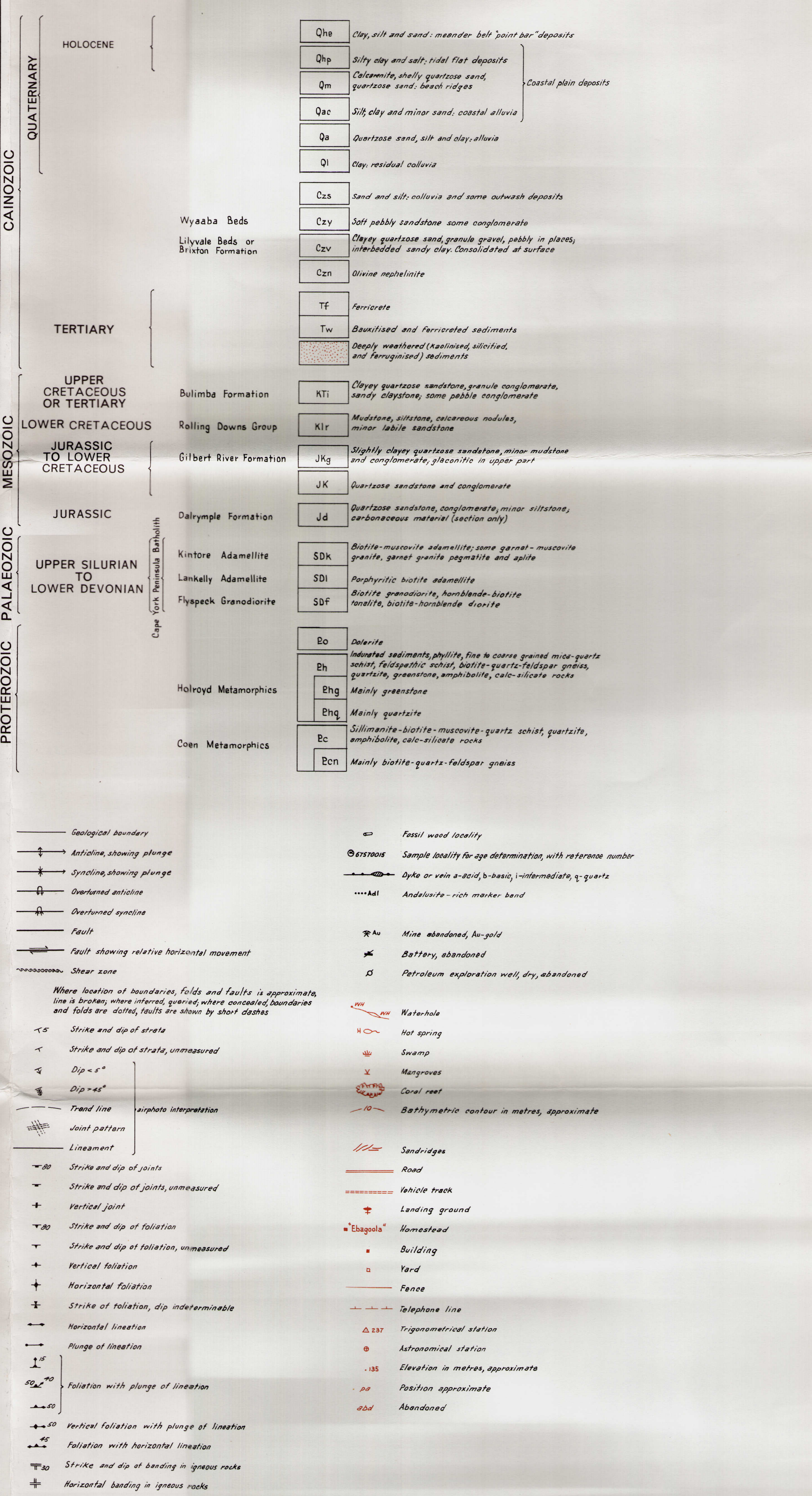
SHEET SD 54-4

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

EBAGOOLA

QUEENSLAND

SHEET SD 54-12



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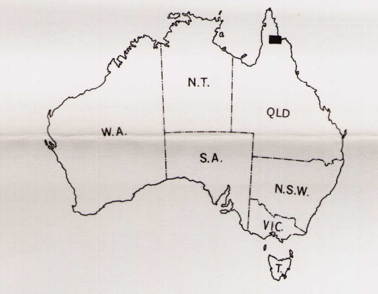
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50,000 scale.
Transverse Mercator Projection



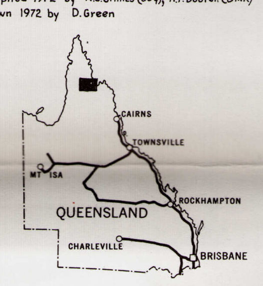
INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970

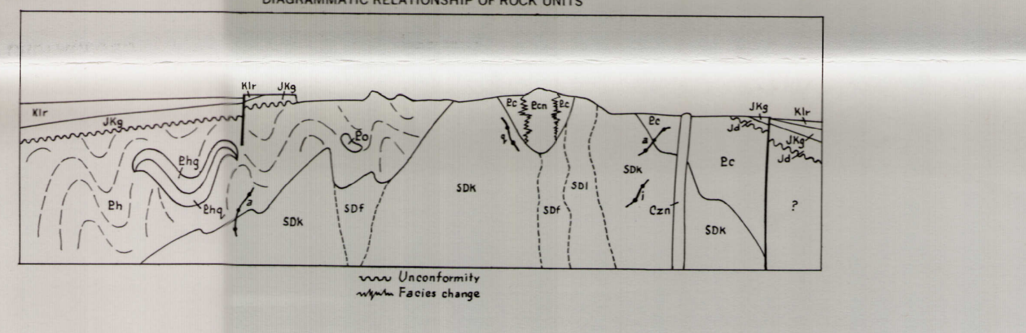
Scale 1:250 000

RELIABILITY DIAGRAM

Geology 1963 by K.G. Lucas
1966 by D.S. Trail, I.R. Pontifex, W.O. Palfreyman W.F. Willmott (BMR); W.G. Whitaker (GSQ)
1972 by K.G. Grimes (GSQ); H.F. Doutch (BMR)
Compiled 1972 by K.G. Grimes (GSQ); H.F. Doutch (BMR)
Drawn 1972 by D. Green



DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



NOTE ON GRID COORDINATES

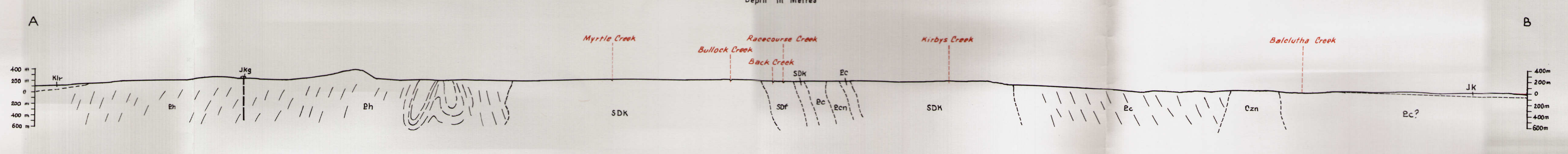
Brown ticks with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 20,000 yard intervals of the Australian National Grid, Zone 6,7 (Australian Series), CLARKE 1858 SPHEROID, Transverse Mercator Projection

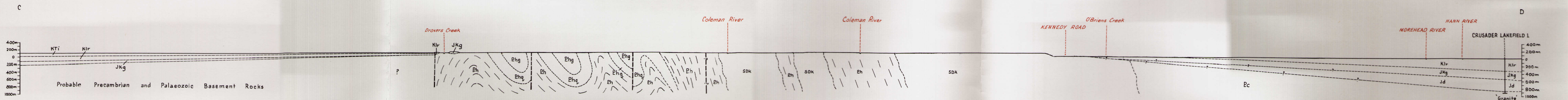
Brown numbered lines (with larger upright numbers), indicate the 20,000 metre intervals of the superimposed Australian Map Grid Zone 54, AUSTRALIAN NATIONAL SPHEROID Transverse Mercator Projection

Section

Superficial Cainozoic sediments omitted

Depth in Metres





SECOND PRELIMINARY EDITION 1973

SUBJECT TO AMENDMENT

EBAGOOLA

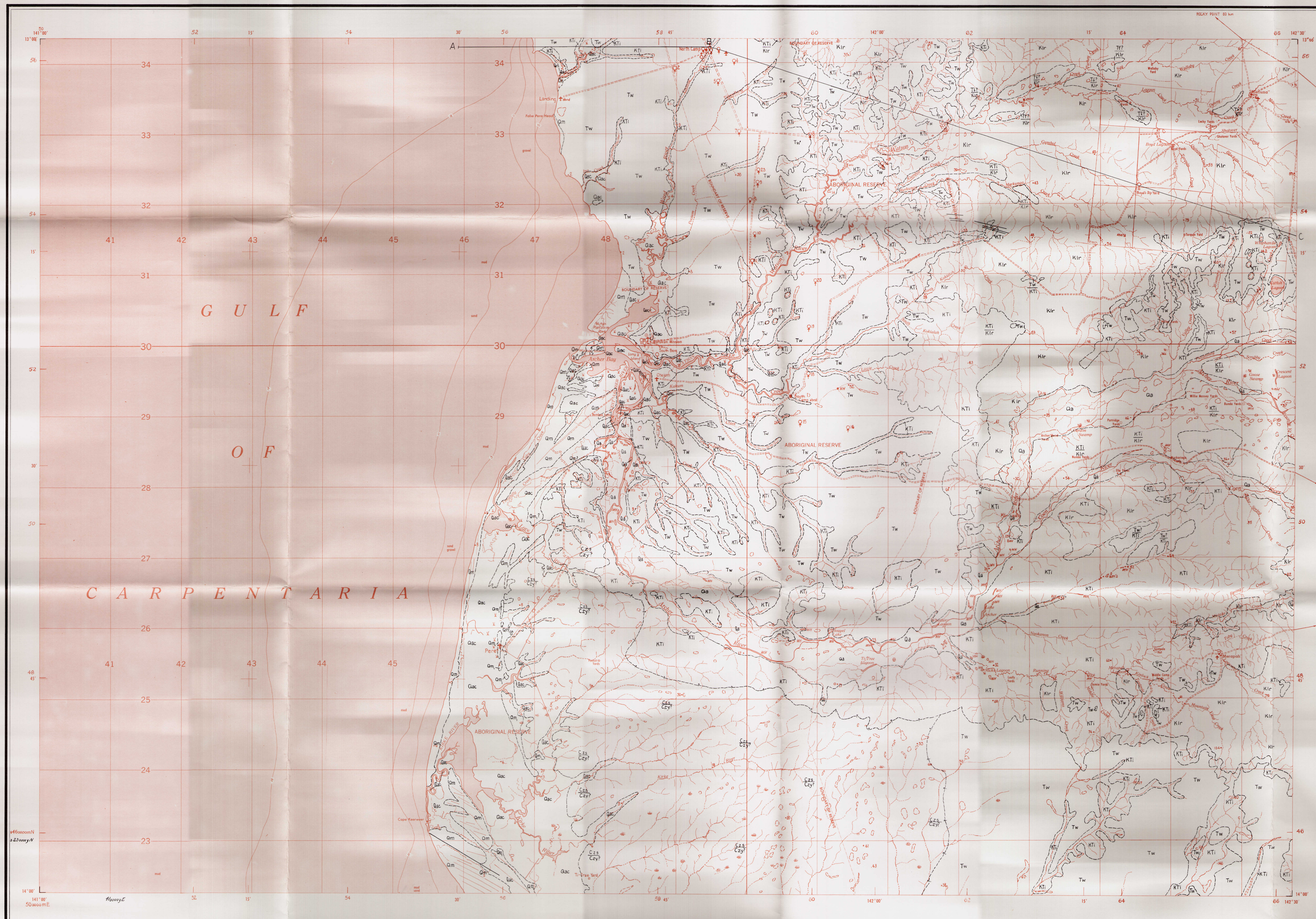
SHEET SD 54-12

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

AURUKUN

QUEENSLAND

SHEET SD 54-7



Reference

CAINOZOIC	QUATERNARY		Qac	Silt, clay, minor sand	: coastal alluvium
			Qm	Coquina, calcarenite, shelly quartzose sand	: younger beach ridges
			Qm_1	Quartzose sand	: older beach ridges
			Qa	Quartzose sand and silt, some clay	: river alluvium
			Czs	Sand, minor silt	: colluvial deposits
	PLIOCENE ? TO HOLOCENE	Wyaaba Beds	Czy	Clayey quartzose sand, with granules and pebbles in places; interbedded sandy clay	
	TERTIARY		Tw	Bauxite and ferricrete ('ironstone')	
			Tf	Ferricrete, minor bauxite	
	UPPER CRETACEOUS OR TERTIARY	Bulimba Formation	KTi	Clayey quartzose sand, pebbly in places, interbedded sandy clay	
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group	Klr	Shale, siltstone, some mudstone, calcareous in part; labile glauconitic sandstone	
	UPPER JURASSIC TO LOWER CRETACEOUS	Gilbert River Formation	JKg	Slightly clayey quartzose sandstone interbedded with shale and siltstone	Section only
	JURASSIC		Jw	Clayey micaceous quartzose sandstone, conglomerate; in places carbonaceous	Section only
PREMESOZOIC			pM	Basement rocks; granitic in HABA North Camp bore	Section only

- Geological boundary, position approximate
- Geological boundary, inferred
- Lineament : airphoto interpretation
- Abandoned bore
- Artesian bore, pre-Klr aquifer system
- Subartesian bore, post-Klr aquifer system
- 5 Bore reference number of HA Bauxiet Australie N.V. (HABA)
- WH Waterhole
- Swamp
- Mangrove
- Intermittent lake with heavy clay floor
- 5 Bathymetric contour, depth in metres
- Beach ridge crest
- Vehicle track
- Landing ground
- "Merluna" Homestead
- Building
- Yd Yard
- Fence
- Telephone line
- Astronomical station
- .76 Elevation in metres, approximate
- abnd Abandoned

NOTE ON GRID COORDINATES

Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10,000 yard grid, Zone 6 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered ticks (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 54 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

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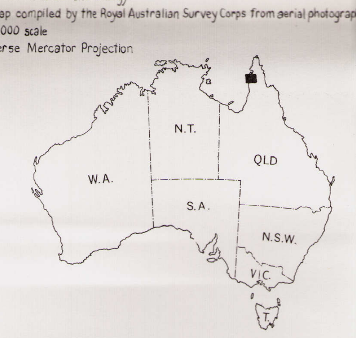
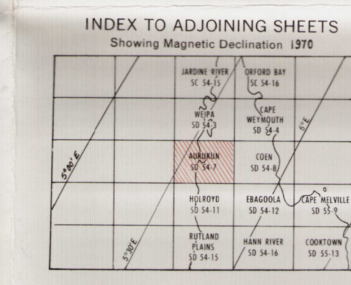
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50,000 scale
Transverse Mercator Projection

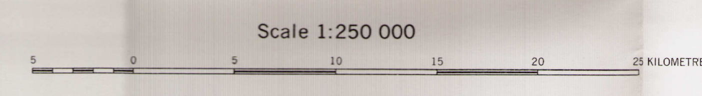


INDEX TO ADJOINING SHEETS

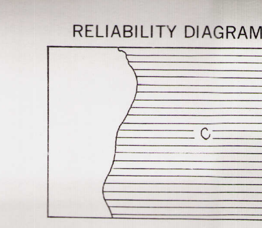
Showing Magnetic Declination 1970



Scale 1:250 000



RELIABILITY DIAGRAM



Geology C General reconnaissance : many traverses, mainly airphoto interpretation

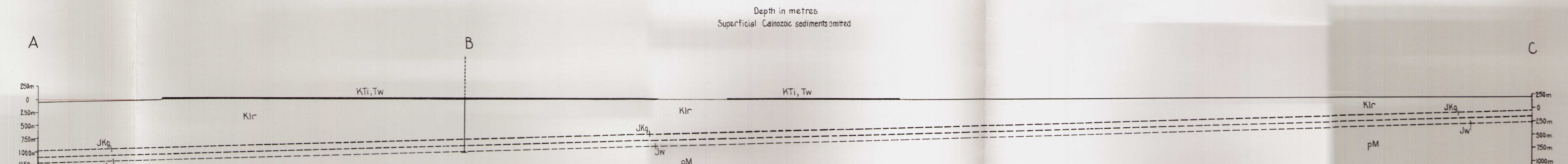
Geology 1972 by J. Smart
Compiled 1973 by J. Smart, P. McKinnon
Cartography by Geological Branch, BMR
Drawn by P. McKinnon, S. Hellier

Section

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

Depth in metres

Superficial Cainozoic sediments omitted



PRELIMINARY EDITION 1973
SUBJECT TO AMENDMENT

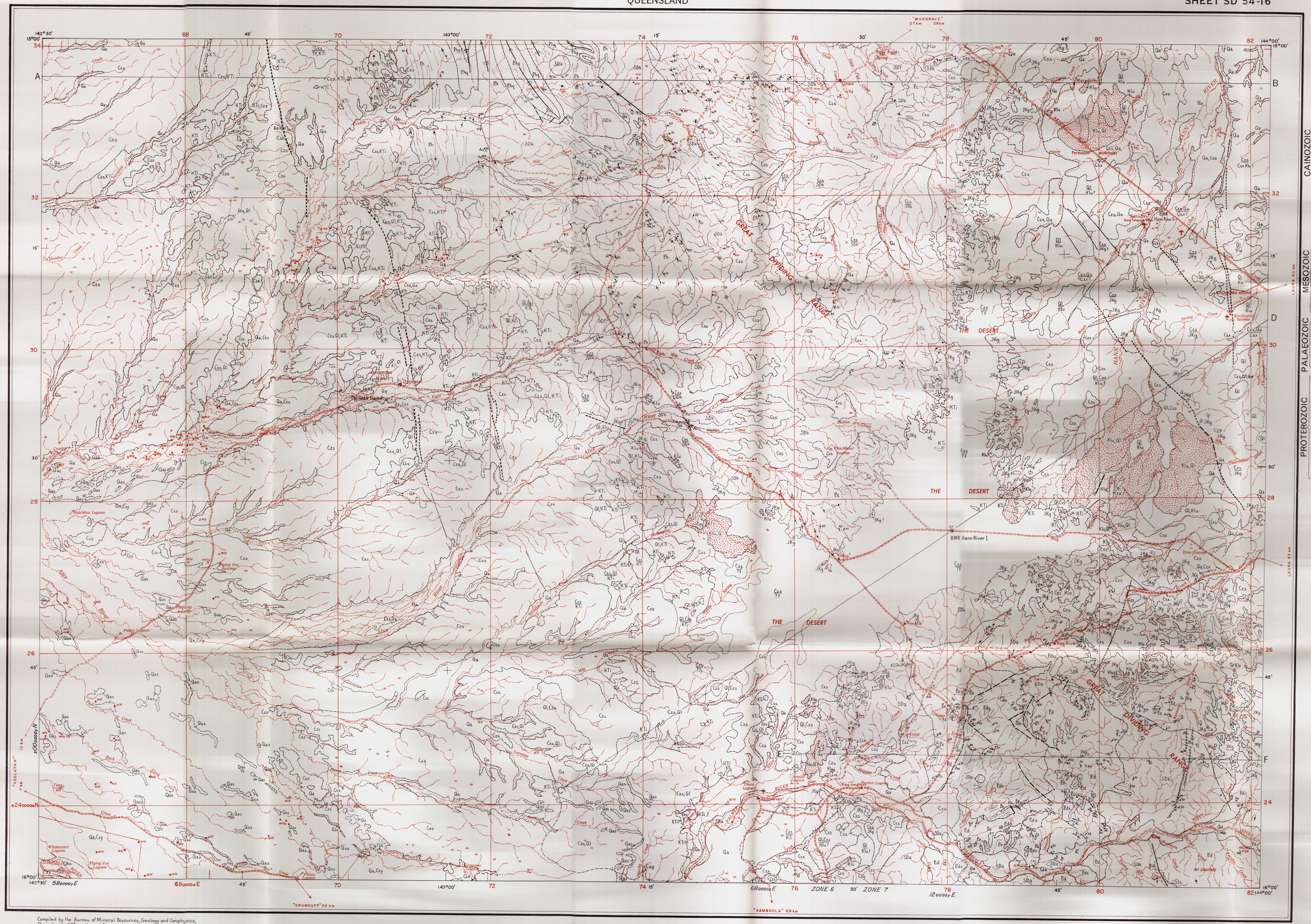
AURUKUN
SHEET SD 54-7

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

HANN RIVER

QUEENSLAND

SHEET SD 54-16



Reference *

CAINOZOIC — QUATERNARY	HOLOCENE		Qha	Quartzose sand, minor silt and clay: stream bed sediment
			Qas	Quartzose sand: abandoned stream channels
			Qa	Quartzose sand, silt and clay: alluvium
			Ql	Clay: residual colluvium
			Czs	Sand and silt: colluvium and some outwash deposits
		Brixton Formation	Czx	Clayey quartzose sand, granule gravel; pebbly in places interbedded sandy clay
		Wyaaba Beds	Czy	Clayey quartzose sand, granule gravel; pebbly in places interbedded sandy clay
	TERTIARY		Tf	Ferricrete
				Deeply weathered (kaolinized, silicified and ferruginized) sediments
	UPPER CRETACEOUS OR TERTIARY	Bulimba Formation	KTi	Clayey quartzose sandstone, granule conglomerate and sandy claystone; minor pebble conglomerate
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group	Klr	Siltstone, mudstone, calcareous in part labile glauconitic sandstone } section only
		Wallumbilla Formation	Klu	Mudstone, siltstone, calcareous nodules
	JURASSIC	Gilbert River Formation	JKg	Slighty clayey quartzose sandstone; minor conglomerate and siltstone; glauconitic in upper part
		Dalrymple Formation	Jd	Quartzose sandstone, conglomerate; minor siltstone, carbonaceous material
PALAEOZOIC	UPPER SILURIAN TO LOWER DEVONIAN	Cape York Peninsula Batholith — Kintore Adamellite	SDk	Biotite-muscovite adamellite, minor garnet-muscovite granite, garnet-muscovite granite pegmatite
		Aralba Adamellite	SDa	Porphyritic biotite-muscovite adamellite
		Flyspeck Granodiorite	SDf	Biotite granodiorite, hornblende-biotite tonalite
PROTEROZOIC			Po	Dolerite,
		Holroyd Metamorphics	Ph	Indurated sediments, phyllite, fine-grained mica quartz schist, coarse-grained mica-quartz schist, biotite-quartz feldspar gneiss, quartzite amphibolite, calc silicate rocks
			Phg	Mainly greenstone
			Phq	Mainly quartzite
		Coen Metamorphics	Pc	Muscovite-biotite-quartz-feldspar gneiss and schist, minor sillimanite-muscovite quartz schist, amphibolite, calc silicate rocks
		Dargalong Metamorphics	Pd	Biotite-plagioclase-quartz gneiss, leucocratic gneiss, quartzite, amphibolite, plagioclase-muscovite-biotite-quartz schist
			Pds	Mainly sillimanite-muscovite-quartz schist, quartzite

* Where two or more stratigraphic units cannot be mapped separately from one another the presence of the subsidiary unit is indicated by writing its symbol after the letter symbol of the predominant unit.

- Geological boundary
- Overturned anticline, showing direction of plunge
- Overturned syncline, showing direction of plunge
- Fault

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

- Shear-zone
- Strike and dip of strata (50)
- Strike and dip of strata, unmeasured
- Horizontal strata
- Strike and dip of foreset beds (10)
- Trend line } airphoto interpretation
- Lineament } airphoto interpretation
- Strike and dip of foliation (30)
- Strike and dip of foliation, unmeasured
- Vertical foliation
- Horizontal foliation
- Strike of foliation, dip indeterminable
- Horizontal lineation
- Direction and plunge of lineation
- Foliation with plunge of lineation
- Strike and dip of banding in igneous rock (80)
- Horizontal banding in igneous rock
- Dyke, a-acid, b-basic, q-quartz
- Mine-minor
- Au Gold
- St BMR stratigraphic hole
- Windpump
- Dam
- WH Waterhole
- Spring
- Swamp
- Road
- Vehicle track
- Fence
- Telephone line
- Landing ground
- "Kimba" Homestead
- Yd Yard

NOTE ON GRID COORDINATES

Brown ticks with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 20 000 yard intervals of the Australian National Grid, Zones 6,7 (Australian Series), CLARKE 1858 SPHÈROID, Transverse Mercator Projection

Brown numbered lines (with larger upright numbers), indicate the 20 000 metre intervals of the superimposed Australian Map Grid Zone 54 , AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

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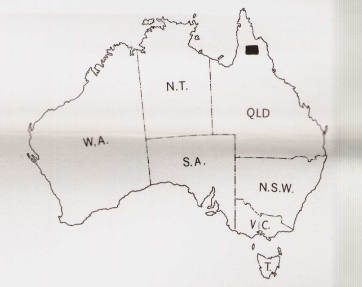
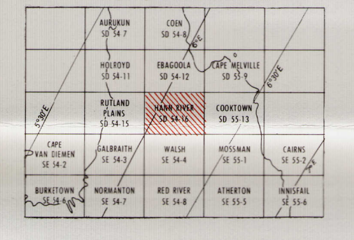
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50,000 scale
Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970

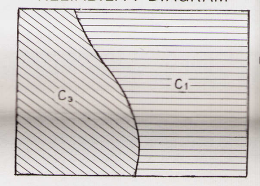


Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

5 0 5 10 MILES

RELIABILITY DIAGRAM

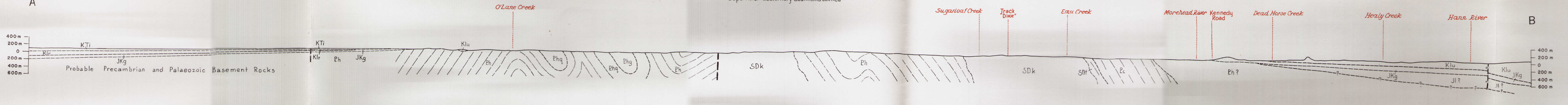


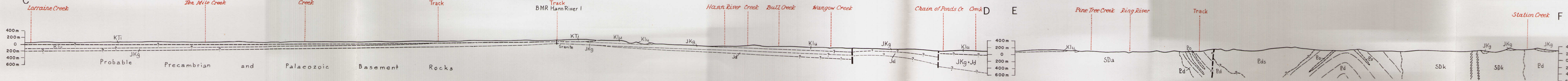
Geology C1 General reconnaissance: many traverses, and airphoto interpretation
C3 General reconnaissance: few traverses, and airphoto interpretation

Geology 1963 by K.G. Lucas
1966 by D.S. Trail, I.R. Pontifex, W.D. Palfreyman W.F. Willmott, (B.M.R.); W.G. Whitaker (G.S.Q.)
1972 by K.G. Grimes
Compiled 1973 by K.G. Grimes and J. Kopras
Drawn 1973 by J. Kopras

Sections

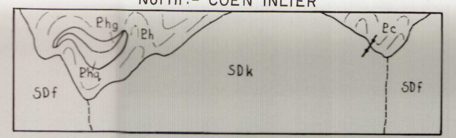
Scale: V/H = 4
Depth in metres
Superficial Quaternary Sediments omitted



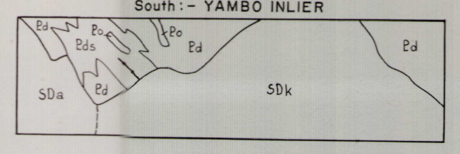


DIAGRAMMATIC RELATIONSHIP OF PRE-MESOZOIC ROCK UNITS

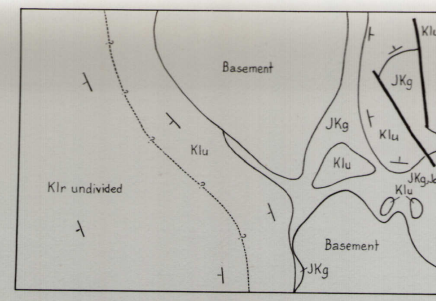
North:- COEN INLIER



South:- YAMBO INLIER



SOLID GEOLOGY (SUB-CAINOZOIC)



SECOND PRELIMINARY EDITION 1973

SUBJECT TO AMENDMENT

HANN RIVER

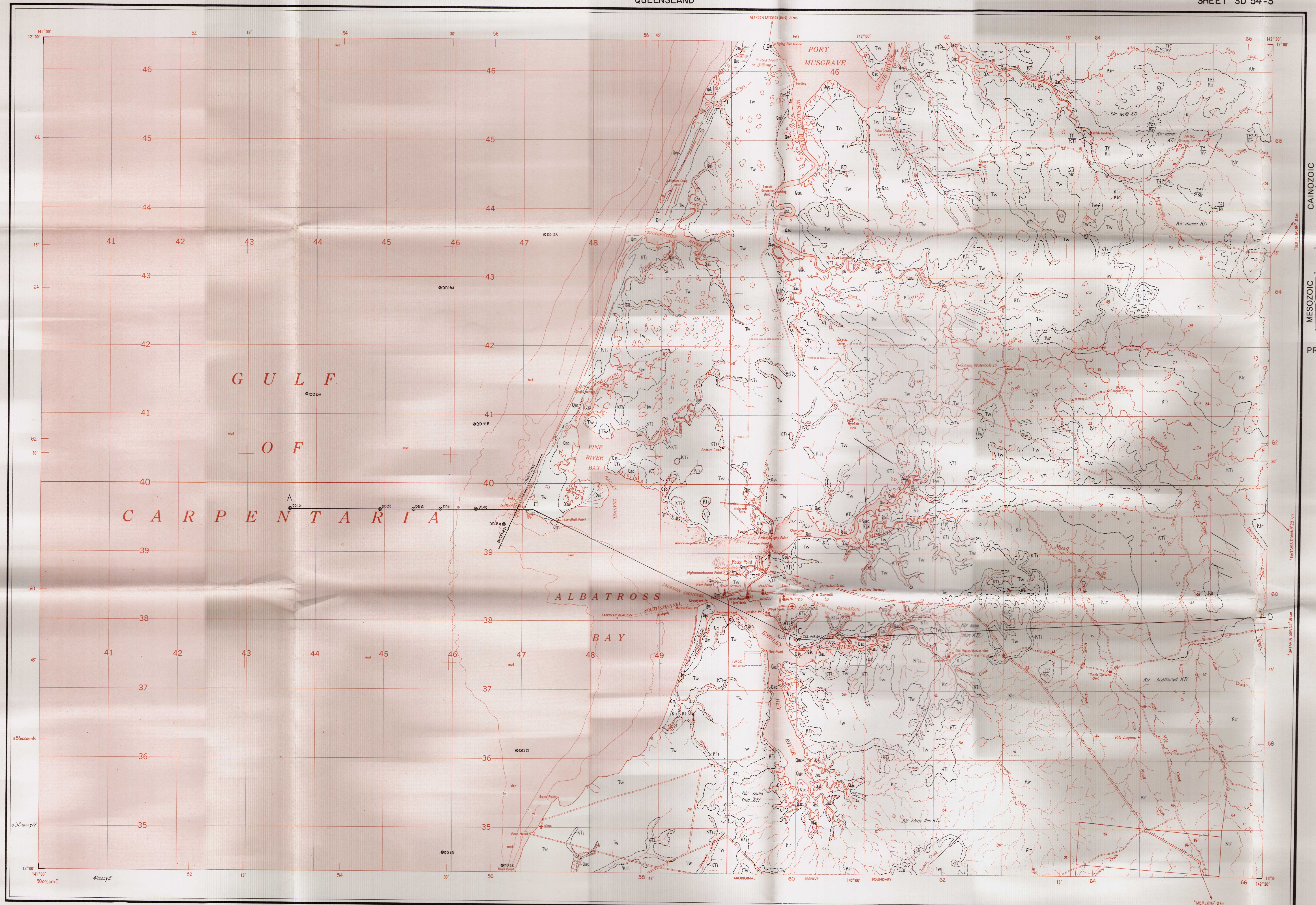
SHEET SD 54-16

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

WEIPA

QUEENSLAND

SHEET SD 54-3



Reference

CAINOZOIC	QUATERNARY		Qc	Marine calcareous clay and limestone, and overlying soft shelly mud	Section only
			Qac	Silt, clay, minor sand: coastal alluvium	
			Qm	Coquina, calcarenite, shelly quartzose sand: beach ridges	
	PLIOCENE ? TO HOLOCENE	Wyaaba Beds	Czy	Clayey, quartzose sand and granules, pebbly in places, interbedded sandy clay; Calcareous marine sandy clay	Section only
	TERTIARY		Tw	Bauxite and ferricrete ('ironstone')	
			Tf	Ferricrete, minor bauxite	
	UPPER CRETACEOUS OR TERTIARY	Bulimba Formation	KTi	Poorly sorted clayey quartzose sandstone and granule conglomerate, pebbly in places; interbedded sandy claystone	
MESOZOIC	LOWER CRETACEOUS	Rolling Downs Group	Klr	Upper part: labile glauconitic sandstone and siltstone, some shale; calcareous in part. Lower part: shale and siltstone, calcareous in part, minor labile glauconitic sandstone	
	UPPER JURASSIC TO LOWER CRETACEOUS	Gilbert River Formation	JKg	Slightly clayey quartzose sandstone and siltstone, minor conglomerate; glauconitic in upper part	Section only
	JURASSIC		Jw	Clayey micaceous quartzose sandstone, conglomerate; in places carbonaceous	Section only
PREMESOZOIC			pM	Basement rocks, metamorphic in ZCL Wiepa 1	Section only

- Geological boundary, position approximate
- Fault; concealed and inferred
- Lineament } airphoto interpretation
- Joint pattern } airphoto interpretation
- W — Oil exploration well; dry, abandoned; W indicates completed as water bore (Zinc Corporation Ltd.)
- DD 21 — Diamond drill hole (Canadian Superior Mining and Ocean Resources, 1971)
- A3 — Artesian bore, flowing from pre Rolling Downs aquifer system, with Comalco reference number
- WH — Waterhole
- Swamp
- Mangrove
- Mud
- Intermittent lake with heavy clay floor
- Reef
- Rocks, submerged
- Bathymetric contour, depth in metres
- Beach ridge crests
- Road
- Vehicle track
- Railway
- Airport
- Landing ground
- "York Downs" — Homestead
- Building
- Yd — Yard
- Fence
- Town
- Telephone line
- Trigonometrical station
- Astronomical Station
- 37 — Elevation in metres, approximate
- abnd — Abandoned
- pa — Position approximate

NOTE ON GRID COORDINATES

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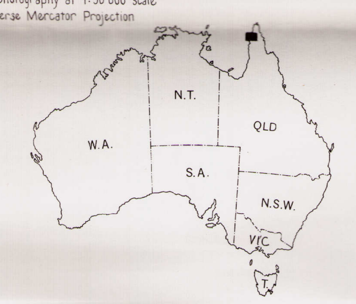
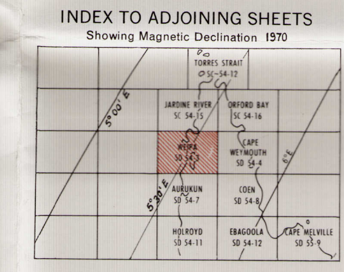
Transverse Mercator Projection



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970

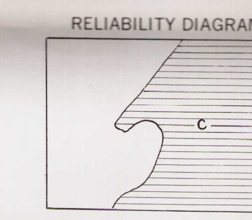


Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

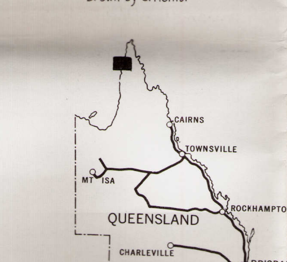
5 0 5 10 MILES

RELIABILITY DIAGRAM



Geology C General reconnaissance: many traverses, mainly airphoto interpretation

Geology 1972 by J. Smart
Compiled 1973 by J. Smart, S. Hellier
Cartography by Geological Branch, B M R
Drawn by S. Hellier

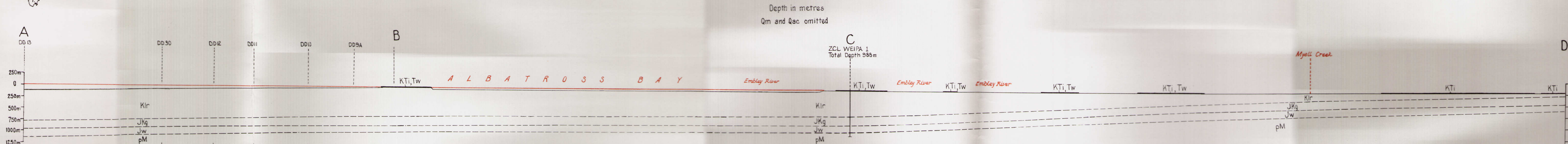


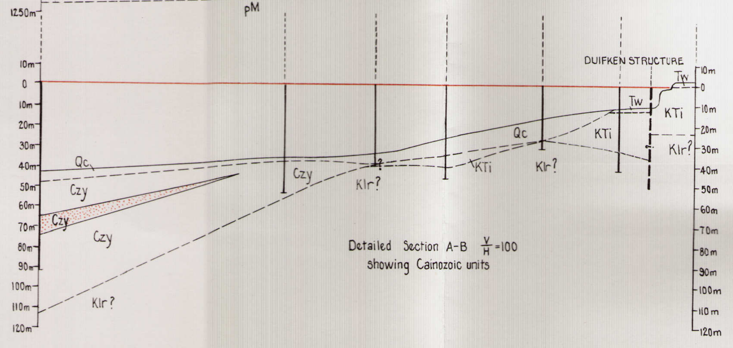
Section

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

Depth in metres

Qm and Qac omitted





Detailed Section A-B $\frac{V}{H} = 100$ showing Cainozoic units

PRELIMINARY EDITION 1973

SUBJECT TO AMENDMENT

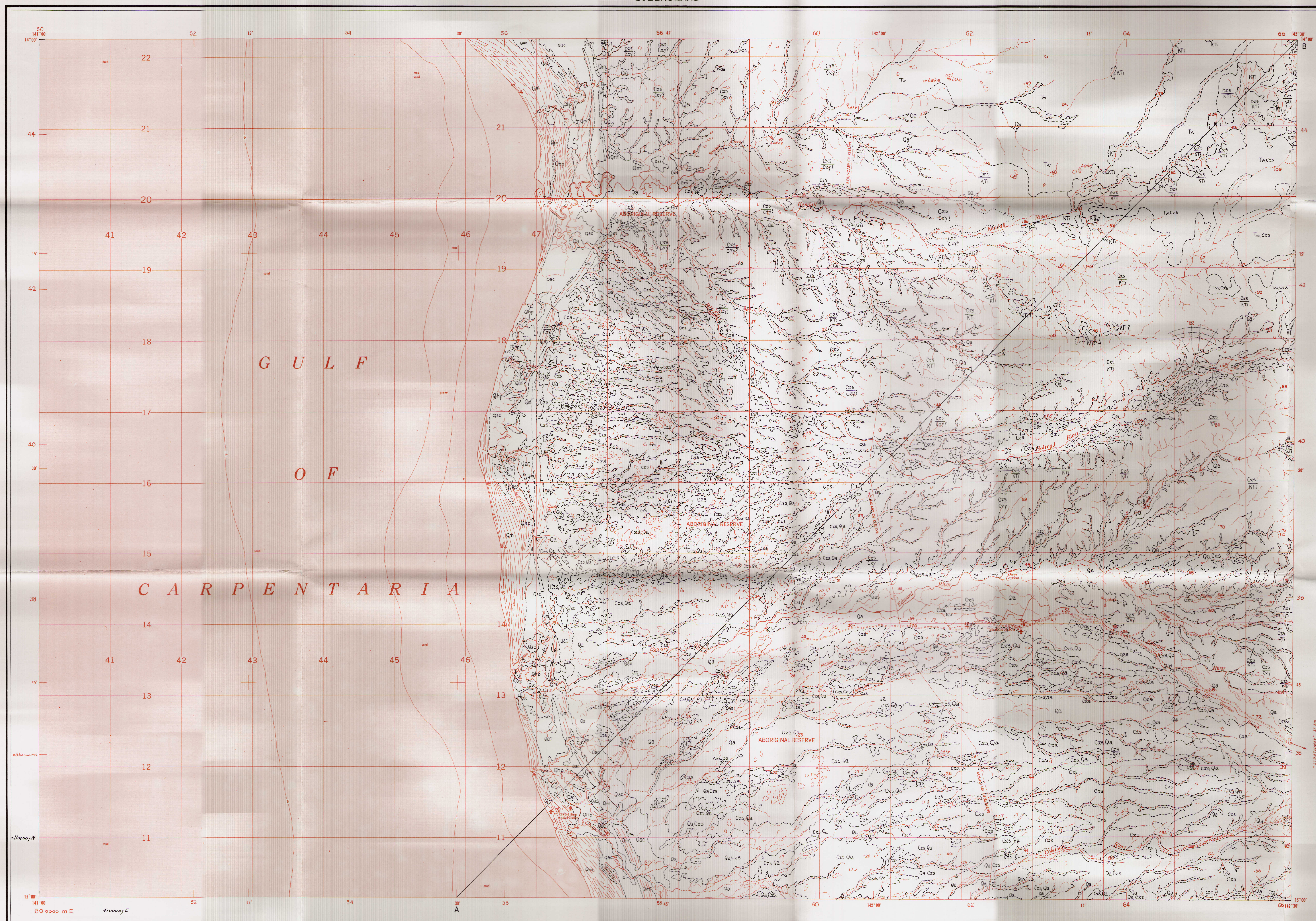
WEIPA

SHEET SD 54-3

AUSTRALIA 1:250 000 GEOLOGICAL SERIES

HOLROYD
QUEENSLAND

SHEET SD 54-11



Reference*

CAINOZOIC	QUATERNARY	HOLOCENE		Qhp	Silty clay and salt:	tidal flat deposits	Coastal plain deposits
				Qm	Calcarenite, shelly quartzose sand, quartzose sand:	beach ridges	Coastal plain deposits
				Qac	Silt, clay and minor sand:	coastal alluvium	Coastal plain deposits
				Qa	Quartzose sand and silt, some clay:	valley alluvium	Alluvial plain deposits
				Qas	Quartzose sand:	abandoned stream channels	Alluvial plain deposits
				Czs	Quartzose sand and minor silt:	colluvial and fluvial deposits	
		PLIOCENE TO HOLOCENE	Wyaaba Beds	Czy	Clayey quartzose sand and granule gravel, pebbly in parts; interbedded sandy clay		Subsurface only
		TERTIARY		Tw	Bauxitised and ferricreted sediments		
MESOZOIC		UPPER CRETACEOUS OR TERTIARY	Bulimba Formation	KTi	Clayey quartzose sandstone, granule conglomerate, sandy claystone; some pebbles		
		LOWER CRETACEOUS	Rolling Downs Group	Klr	Shale, siltstone, some mudstone, calcareous in part; labile glauconitic sandstone		
		JURASSIC TO LOWER CRETACEOUS	Gilbert River Formation	JKg	Probably slightly clayey quartzose sandstone and siltstone		Section only

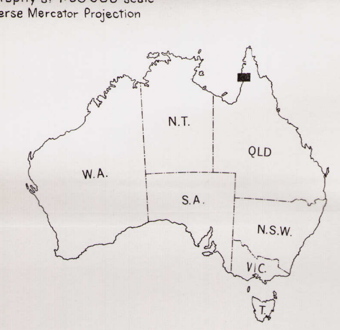
* Where two or more stratigraphic units cannot be shown separately at the scale of this map, subsidiary units are indicated by the second and following letter symbol groups eg. Czs, KTi (Czs with smaller areas of KTi)
Czs/KTi (Czs overlying KTi)

- Geological boundary, position approximate
- Geological boundary, concealed and inferred
- Joint pattern, airphoto interpretation
- Intermittent lake with heavy clay floor
- Bathymetric contour, depth in metres, approximate
- Former strand lines
- Vehicle track
- Landing ground
- "Strathgordon" Homestead
- Building
- Fence
- Astronomical station
- ·61 Elevation in metres, approximate

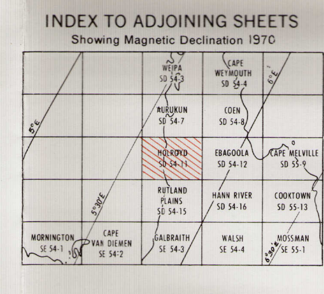
NOTE ON GRID COORDINATES
Brown lines with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 10,000 yard grid, Zone 6 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered ticks (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 54 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of Minerals and Energy. Issued under the authority of the Hon. R.F.X. Connor, M.P., Minister for Minerals and Energy.
Base map compiled by the Royal Australian Survey Corps from aerial photography at 1:50 000 scale
Transverse Mercator Projection



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination 1970

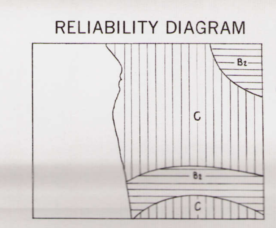


Scale 1:250 000

KILOMETRES

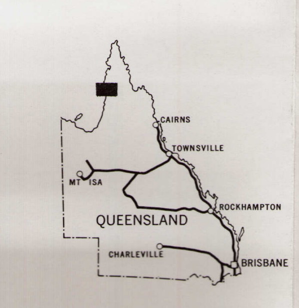
MILES

RELIABILITY DIAGRAM

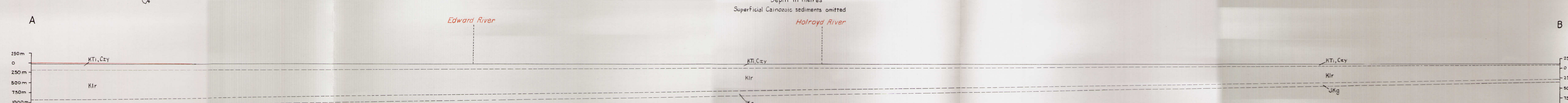


Geology A General reconnaissance; few traverses, mainly airphoto interpretation
C Airphoto interpretation

Geology 1972 by K. Grimes, (GSQ)
Compiled 1972 by K. Grimes, F. MacLean
Cartography by Geological Branch, B M R
Drawn 1973 by F. MacLean



Section
Depth in metres
Superficial Cainozoic sediments omitted



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SHEET SD 54-11