COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1963/65

THEGEOLOGY OF THE SOUTHERN HALF OF THE PROSERPINE 1:250,000 SHEET AREA.

by

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CONTENTS

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SUMMARY

Two thirds of the southern half of the Proserpine 1:250,000 Sheet area, on the coast of Queensland north of Mackay, are covered by sea dotted with small islands. The mainland is mountainous in the west, and low and swampy along the coast. Access on the mainland is good in dry weather.

The oldest rocks in the area are the Upper Devonian - Lower Carboniferous Campwyn Beds, which crop out on the coast and on the Repulse Islands. They are a sequence, about 10,000 feet thick, mainly of acid and intermediate volcanics, with interbedded marine, fossiliferous siltstone, sandstone, and oolitic limestone. The Lower Bowen Volcanics, composed mainly of intermediate volcanics and including some sediments, overlie the Campwyn Beds, with possible unconformity between the two units. Permian freshwater sediments and rhyolite overlie the Lower Bowen Volcanics conformably in the north, but with disconformity in the south-western part of the area. The Palaeozoic sequence is folded and faulted, and has been intruded by acid and intermediate plutonic rocks of the Urannah Complex.

A Tertiary sequence of acid and intermediate volcanics and freshwater sediments overlies unconformably the Palaeozoic units. It is 1,600 feet thick at Cape Hillsborough.

The only mines in the district, at Calen, produced 9,380 tons of coal between the years 1927 and 1939. Nearly 30,000 tons of clay have been taken from workings at Pindi Pindi. Two percussion bores at Cape Hillsborough, sunk in search of petroleum, encountered about 700 feet of Tertiary sediments and about 2,000 of Campwyn Beds, but no oil or gas. Traces of bitumen have been found along the coast.

INTRODUCTION

The southern half of the Proserpine 1:250,000 Sheet area, lies about 500 miles north of Brisbane, on the Queensland coast. The sea covers about two-thirds of the area, and the land, comprising the mainland, Cape Conway, and some small islands occupy just under a third.

The mainland was mapped by a joint Bureau of Mineral Resources - Queensland Geological Survey field party consisting of A.R.Jensen, C.M.Gregory, and V.R.Forbes, during 1962, as part of a programme of mapping the Bowen Basin. The scale of mapping was 1:85,000 (photoscale), using air photos taken by Adastra Airways Pty.Ltd., in 1960. Overlays of the geology of each photo were made, reduced, and assembled on a slotted template base supplied by the Division of National Mapping, to form the map presented with this report. Information on the geology of various islands, supplied by W.C.White and G.A.Brown of Ampol Exploration (Qld.) Ltd is gratefully acknowledged.

The climate of the Proserpine area is tropical with a hot summer and a cool winter. The annual average rainfall is 70 inches, most of the rain falling in summer. The district's most important product is sugar cane, mainly grown near the Bruce Highway; beef and dairy cattle are raised along the coast.

The Bruce Highway, for the most part a sealed road, runs through the area via the towns of Calen and Bloomsbury, and thence to Proserpine. Secondary roads, mainly unsealed, permit access from the Highway to most of the area, with the exception of the rugged Clark Range and Cape Conway, but mapping is impeded by long grass, tropical rain forest and, in some places, by sugar cane fields. The coastal railway passes through the area, ultimately linking it with Brisbane. Both Proserpine and Mackay have good aerodromes, and Mackay an artificial deepwater harbour.

Topography of the area varies from rugged mountains 3,000 feet above sea level, in the west, to tidal flats along the coast. The two most rugged areas are the south-west corner of the Sheet area, and Cape Conway. The south-west corner is occupied by the Clark Range whose general altitude is about 2,000 feet. Cape Conway, covered by dense rain forest, has peaks reaching 1,600 feet above sea level, and steep slopes.

The land between the Clark Range and the coast, in the southern part of the area, consists of river valleys and moderately steep hills up to 1,000 feet above sea level. Further to the north near Gunyarra the country is flat, and less than 100 feet above sea level. Creeks entering this plain from the west, flood out over the plain, and their courses become hard to define This plain, and Repulse Bay, are an extension of the Bowen-Proserpine Lowland or Corridor (Stanley 1927), a marked physiographic feature to the north. Extensive tidal flats and mangrove swamps extend for many miles along the coast. (Fig. 11).

PREVIOUS INVESTIGATIONS

First recorded geological observations in the area are those of Jack (1887), referring to the sandstone, coaly shale and coal between Constant Creek and St. Helens Creek. Maitland (1889b)noted volcanics in the sequence recorded by Jack and correlated the sequence on lithology with the 'Bowen River Beds', assigning a Permo-Carboniferous age to it. He also noted an interbedded sandstone and trachyte sequence which he called the Desert Sandstone, of Cretaceous age. Mapping in the area indicates that it is Tertiary.

While investigating the occurrence of coal in the district, Cameron (1903) recognized a sequence of tuff and volcanic conglomerate, underlying the interbedded sandstone and volcanics mapped by Maitland. Cameron regarded the tuff and conglomerate as 'equivalent to the lowest division of the Bowen River Beds, on the Bowen River Coal Fields, as described by Jack in 1879'. Ball (1910) reported that the geology of the area was more complicated than Maitland's or Cameron's maps would suggest, but he did not revise their maps. He noted in passing that 'Mounts Blackwood, Jukes, Ossa, and Pelion all belong to the same trachytic series'.

The investigation of the occurrence of coal was again the cause for the visit of a geologist to the area, this time in 1924. On this occasion it was J.H. Reid who wrote in his report (1924b) 'while no detail geological work has been done in the district between Mackay and Proserpine, sufficient information is available to leave little doubt that the coal measures here belong to the Middle Bowen Formation of Permo-Carboniferous age, and are regarded as equivalent of the Collinsville coal measures'. Later (Reid 1929a) he recorded that the basis of this correlation was the thickness of coal and the lithological similarity of the associated sandstone and conglomerate beds. The freshwater sequence with interbedded volcanics, underlying the coal measures, Reid thought to be equivalent to the Lower Bowen Volcanics - thereby agreeing with Cameron. However, he suggested that the basal part of the sequence could be of 'Gympie' age, because it appeared to be conformable with the underlying Rockhampton Series, and because of the absence of Glossopteris.

The year 1956 saw the drilling of two bores (referred to as MOPS Nos. 4 and 5) in search of oil, at Cape Hillsborough, by the Mackay Oil Prospecting Syndicate. Number 4 was drilled to 303 feet and number 5 to 2,405 feet. The geology of the district was discussed in an unpublished report by the consultant geologist to the company, (Lawrence, 1956).

Fossils were collected in the area by students of the University of Queensland, in 1957, and localities and identifications are given in Appendix A.

Various islands in the area have been visited by members of the Geological Survey of Queensland (Simmonds and Tucker 1960; and Simmonds 1961), and by geologists of Ampol Exploration Limited(Qld) (White and Brown 1963).

STRATIGRAPHY

A summary of the stratigraphy is given in Table I.

(a) Devonian - Carboniferous

On the southern half of the Proserpine 1:250,000 Sheet area Devonian-Carboniferous rocks are confined to the coastal areas of the mainland, the western part of Cape Conway, Rabbit and Newry Islands, and the Repulse Islands. Reid (1924a) correlated these rocks with the Rockhampton Series. Hill and Denmead (1960) referred them to the Rockhampton Group, which, at Rockhampton, contains chert, subgreywacke, and limestone. As the rocks in the Proserpine district are not lithologically similar to those at Rockhampton, the name 'Rockhampton Group' is not perpetuated in this report: instead, the new name the 'Campwyn Beds' (Jensen, Gregory and Forbes 1963) is preferred.

The Campwyn Beds are mainly flows and pyroclastics of both acid and intermediate composition, interbedded with minor sedimentary rocks. The most common rock type is red and green rhyolitic tuff, consisting of fine grained siliceous lithic fragments; quartz, and feldspar, in a groundmass of quartz, feldspar, chlorite and clay minerals. The red colouration is produced by concentrations of iron oxide in some of the lithic fragments, the green colour is caused by chlorite. Variation of the size of the fragments gives rise to volcanic breccia, lapilli tuff, and tuff. Rhyolite is also common, being generally a dark colour - red, purple, or brown; it is often amygdaloidal. Trachytic and andesitic flows and pyroclastics are present but minor.

The volcanic sequence is well exposed at Midgeton and on Red Cliff Islands. The northern promontory at Midgeton is composed of about 2,000 feet of thin flows and pyroclastics, well exposed at low tide.

Sedimentary rocks in the sequence include mudstone, siltstone, sandstone, and oolitic limestone. The mudstone is generally thin bedded and dark grey to black, weathering deep red. Near Mount Springcliff it exhibits small scale graded

TABLE I

SUMMARY OF STRATIGRAPHY

PERIOD	UNIT	THICKNESS	LITHOLOGY	FOSSILS	RELATIONSHIPS
Quaternary		?	Soil, and alluvium.		
Tertiary		1,600 ft. at Cape Hillsborough	Rhyolite, rhyolitic agglomerate, trachyte, conglomerate, shale, sandstone.	cf. <u>Sigaretus</u> Dicotyledenous leaves	Unconformable on all Palaeozoic units.
Lower Permian to Upper Carboniferous	Undivided fresh-water beds	abt. 10,000 ft.	Shale, siltstone, chert, sandstone, coal, rhyolite	<u>Noeggerathiopsis hislopi</u> <u>Glossopteris indica</u> <u>Vertebraria indica</u>	Overlies Lower Bowen Volcanics, disconformity evident in south-west part of the area.
	Lower Bowen Volcanics	20,000 ft. ?	Andesitic flows and pyroclastics, acid tuff, minor basalt & rhyolite, shale, siltstone, sandstone, conglomerate	<u>Noeggerathiopsis hislopi</u> <u>Vertebraria indica</u> <u>Samaropsis dawsoni</u> <u>Glossopteris</u> fragments	Overlies the Campwyn Beds, with possible unconformity
Lower Carboniferous	Campwyn Beds	10,000 ft. ?	Acid and intermediate flows and pyroclastics, mudstone, siltstone, sandstone, oolitic limestone.	<u>Cyrtospirifer</u> sp. <u>Stenosia</u> sp. <u>Aviculopecten</u> sp. <u>Syringopora</u> sp. <u>Alveolites</u> sp. <u>Macgeea</u> sp. <u>Lepidodendron veltheimianum</u> <u>Prospira striatoconvoluta</u> <u>Camarotoechia</u> sp. <u>Spirifer</u> sp. <u>Leptophloeum australe</u> <u>Stigmaria ficoides</u>, <u>Sigillaria</u>	Oldest unit in the area

bedding. The siltstone is generally white to brown, but in some places it contains dark carbonaceous bands. At Finlayson's Point, it contains marine fossils, and grades from a calcareous siltstone to a calcilutite. Sandstone in the sequence includes cross-bedded quartz sandstone, grading in places to quartz pebble conglomerate, feldspathic sandstone, and tuffaceous sandstone. Tabular cross-bedding is well developed in sandstone at Hallidays Bay (Fig. 1).

Sediments and volcanics crop out on the north-western promontory of Hallidays Bay. A pink granite, well exposed on the south-eastern promontory, has slightly metamorphosed the sequence to the greenschist facies. Acid and intermediate dykes intrude the sequence but are not abundant.

The regional structure of the Campwyn Beds is difficult to discern with the small number of dip measurements made, but folding appears moderate, and faulting important only on the margins of the area of outcrop. On the coast, near Seaforth, the unit dips at about 20° to the south-west, but further inland dips are about 35° to the south. At Midgeton the dip is 27° west, but as one traces the beds to the north the dip swings to the north. Beds on Cape Conway dip about 30°north.

Rocks on the Repulse Group strike north-west as do those on the southern mainland. Simmonds and Tucker (1960) show the rocks of South Repulse Island folded into two folds with parallel axes, and those of East Repulse dipping to the north-east at 30°. W.C. White (pers.comm.) regards the rocks on South Repulse as dipping to the north-east and not folded into two parallel folds; he noted a limestone bed dipping to the south-west on the southern tip of East Repulse Island.

Neither the type of fault separating the Permian freshwater beds and the Campwyn Beds, nor the structural relationship between the Campwyn Beds and the Lower Bowen Volcanics is known. On comparative ages both Permian units may overlie the Campwyn Beds unconformably.

The section of Campwyn Beds exposed from Outer Red Cliff Island to a point near the faulted contact between the Campwyn Beds and the undivided freshwater beds, is about 10,000 feet thick; this may include some repetition of section by folding.

Both Upper Devonian and Lower Carboniferous fossils have been found in the sequence. Upper Devonian marine fossils, (see Appendix A part (i) Cyrtospirifer sp. Stenosia sp., Aviculopecten sp., and Syringopora sp., together with Leptophloeum australe were found on Outer Red Cliff Island by members of a student excursion from the University of Queensland, in 1957;

Figure 1: Tabular cross bedding in the Campwyn Beds at Hallidays Bay. Sediments here very indurated See Figure 13 for locality. File No.M264/2.

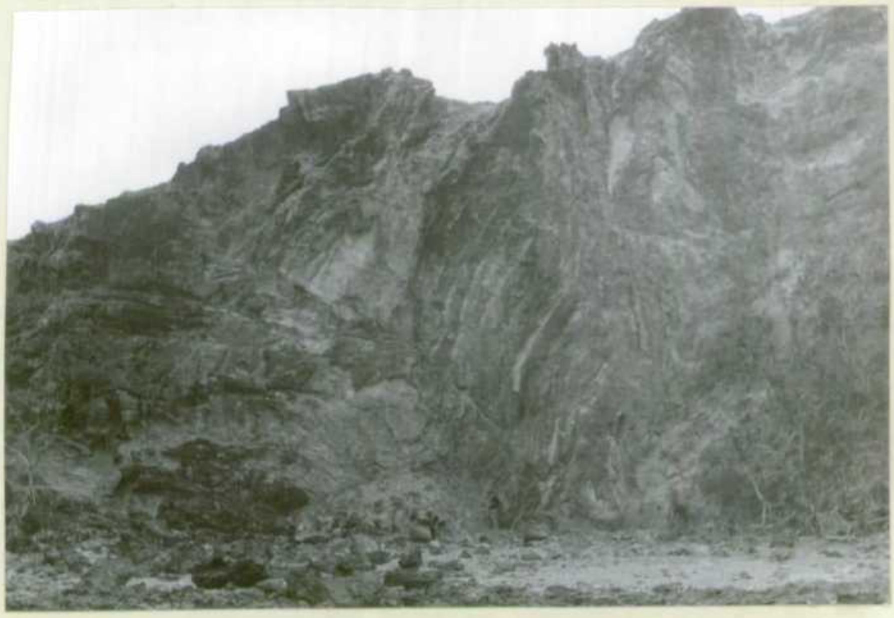


Figure 2: Folding and faulting in Campwyn Beds on Red Cliff Island. File No.M267/10

they also found L. australe on Newry Island. Alveolites sp., and Macgeea sp., assigned to the lower part of the Upper Devonian, were found on East Repulse Island (Simmonds and Tucker, 1960).

Lower Carboniferous fossils have been found at Victor Creek and Finlaysons Point both near Seaforth, Midge Point, and near St. Helens Homestead (see Appendix A). The Victor Creek locality was discovered by the student excursion and found to contain Lepidodendron veltheimianun, Stigmaria ficoides, and Sigillaria sp.

Collections made at Finlaysons Point include marine fossils of Upper Tournaisian age; determinations and relevant discussion is given in Appendix A.

Reid (1924a) recorded marine fossils in an oolitic limestone near old St. Helens homestead. Fauna identified (Appendix A part (i)) in the collection, which is now housed in the Geological Survey of Queensland museum, were:

Prospira striatoconvoluta (Benson and Dunn)
Spirifer sp.
Orthotetid
Camarotoechia sp.

Professor Hill (pers. comm.) reports that a student of the University of Queensland found Ectochoristites near Midge Point. Dr. K.S.W. Campbell, (pers. comm.) regards this as Tournaisian or possibly Visean.

(b) Permian

The Lower Bowen Volcanics

The name 'Lower Bowen' has been used since 1879 when Jack introduced it as the lowest division of the Bowen Group in the Bowen River Coalfield. Reid (1929b) extended the scope of this unit to include a sequence of andesitic tuffs formerly placed above the 'Lower Bowen Series'. In the Proserpine area Reid (1929a) used the name 'Lower Bowen' for the 'series of freshwater beds with plant remains, interspersed with volcanic rocks'. In this report the unit is referred to as the 'undivided freshwater beds'; a formal name cannot be proposed until more information on the unit has been obtained. The term 'Lower Bowen Volcanics' will be restricted to those rocks which resemble closely those of the formation in the type area.

The Volcanics crop out in two separate areas, one north and the other south of Calen. Topography produced by the unit in the northern area ranges from moderately hilly to fairly flat plains, and that of the southern area from hilly to moderately rugged. The small inlier of Lower Bowen Volcanics, east of Cathu, forms a group of low hills.

Like the Campwyn Beds, the Lower Bowen Volcanics comprise both volcanics and sedimentary rocks, the volcanics being predominant. It is often difficult to distinguish the two units except on fossils and type of sedimentary rocks. Volcanic rocks include intermediate, acid and basic types, andesite being the most common. The andesite is often green and generally porphyritic in this section, but on a larger scale it is massive. It is associated, in places, with andesitic agglomerate and tuff. Neither acid nor basic volcanics are common in the sequence but red and green rhyolitic lapilli tuff, similar to the lapilli tuff found commonly in the Campwyn Beds, has been observed.

Sedimentary rocks in the sequence include shale, siltstone, lithic sandstone, tuffaceous sandstone and conglomerate. The shale is generally dark in colour, often plant bearing, and although it varies from soft to hard in places it exhibits a shaley 'cleavage' as well as close random jointing, especially in weathered outcrops. Siltstone is uncommon and where seen was thought to be tuffaceous.

Sandstone occurring in the sequence contains a high proportion of lithic fragments - mostly of volcanic origin, and in places it grades into a tuffaceous sandstone. It is moderately well sorted, containing a low proportion of silt or clay matrix but grades into a poorly sorted pebble conglomerate in places. Colour varies from brown to green, and the bedding from thin to thick; ripple marks, with a wave length of one foot were observed at one locality. Like the sandstone, conglomerate in the Lower Bowen Volcanics is composed mainly of volcanic fragments, up to three inches in diameter.

Little is known of the structure of the block of Lower Bowen Volcanics south of Calen, because of the abundance of massive volcanics. Bedding in a shale bed south of Barren Creek, near fossil collection P22 (shown on map) is horizontal. This fact coupled with the absence of bedding trends indicates that the unit in this block is not tightly folded. A common fault direction is north-east/south-west, and slicken sides associated with the fault near locality P22 indicates lateral displacement. These strike slip faults affect the undivided freshwater beds as well as the Lower Bowen Volcanics.

In the block north of Calen the regional dip is to the west, except on the coast where, the only dip measured is to the east. This regional dip to the west is interrupted by structures connected with the acid intrusion east of Bloomsbury, and by the north-south trending fault along the O'Connel River. The eastern side is of the fault the upthrow, but the nature of the fault is not known.

The nature of the contact between the Lower Bowen Volcanics and the underlying Campwyn Beds is not known, and the boundary shown on the map is uncertain. The oldest age suggested for the Volcanics is Upper Carboniferous;and the top Campwyn Beds are Lower Carboniferous, Tournaisian possibly Visean, and it is probable that a time break exists. A possible disconformity separates the overlying freshwater beds from the Volcanics, and the evidence for this is discussed in the section on the undivided freshwater beds.

Fossil plants found in the unit indicate a Lower Permian to possibly Upper Carboniferous age. They include:

Vertebraria indica

Noeggerathiopsis hislopi Bunb.

Samaropsis dawsoni Shirley

Glossopteris fragments.

The thickness of the unit is unknwon but elsewhere (Malone et.al.1961) it is thought to be in the order of 10,000 to 20,000 feet. Mapping on Proserpine does not conflict with this.

The Undivided Freshwater Beds

The undivided freshwater beds comprise the coal measures near Calen as well as the underlying sequence of freshwater sediments and volcanic rocks formerly included in the Lower Bowen Volcanics by Reid (1929a). The unit crops out from the northern part of the Mackay Sheet area to Bloomsbury in the Proserpine area. It forms moderately hilly country with many strike ridges and cuestas. No type section has been measured and there is no place where the whole sequence is exposed.

Sedimentary rocks make up the bulk of the unit but there are some interbedded volcanic rocks. The sediments comprise shale, siltstone, chert, sandstone, and coal. The shale is generally dark and thin bedded, and contains plant fragments. Siltstone is friable to hard, and white to grey. It is commonly cross-laminated and in some places the laminae are of dark carbonaceous material. (Fig.3). Blue, micaceous siltstone crops out in a road cutting south of Bloomsbury; this is an uncommon lithology in the unit but it is commonly seen in the Middle Bowen Beds of the Bowen Basin. Chert was noted at a few places in the sequence, and coal occurs near the top of the sequence (Reid 1929a).

Figure 3: Dark carbonaceous laminae undivided freshwater beds. File No.M265/23.

Sandstone in the area includes quartz sandstone, and variations of feldspathic-quartz-lithic sandstone. Quartz sandstone is thick bedded and almost invariably cross-bedded; ripple marks and small scale slumps have been observed. Grain-size ranges from medium to coarse and in places well rounded quartz pebble conglomerate has been noted. Quartz sandstone is common at the top of the unit where it overlies the Lower Bowen Volcanics, south of Calen, and in the Whiptail Range west of that town. It also crops out on the eastern margin of the unit near the fault that separates the unit from the Campwyn Beds.

Lithic sandstone in this unit contains differing proportions of feldspar, quartz, and lithic fragments. It is seldom cross-bedded but cross-lamination has been observed. In places it has a calcareous cement. Lithic sandstone is most common towards the base of the sequence, east of Cathu.

Porphyritic rhyolite, generally white to buff, is the most common volcanic in the sequence. Interbedded rhyolite flows were seen on the Mount Ossa - Seaforth road. The unit is intruded by rhyolite and trachyte dykes, the plug-like intrusion forming Mount Jukes, the Urannah Complex west of Calen, and diorite south-east of Pindi-Pindi.

Quartz sandstone near the top of the unit dips off the Lower Bowen Volcanics, south of Calen, at 15^{o} to the north-east, with no sign of an angular discordance. North of Calen, the base of the unit is marked by the appearance of lithic sandstone interbedded with rhyolite. It is therefore possible that the unit overlies the Lower Bowen Volcanics conformably, north of Calen, and with a disconformity south of Calen. There is no evidence for a disconformity within the unit, between the lithic sandstone sequence and the coal bearing quartz sandstone sequence.

The regional strike in the freshwater beds is in a north-west direction. The beds are folded in the central part of the area but the folding is not severe, the steepest dip recorded being 50^{o}. However dips steepen near the edge of the area of outcrop, near Seaforth, and west of Bloomsbury, where, in both cases faults are postulated. Evidence for the fault south-west of Seaforth is meagre, based mainly on the fact that the younger beds are more folded than the older unit and that there is at least one place where the beds appear to dip under the Campwyn Beds. Evidence for the major fault along the O'Connel River is (a) the absence of the unit on the other side of the fault line, (b) the straightness of the River, (c) the fact that the unit dips vertically in the vicinity of the fault line. The hade of the fault is not known.

Small strike-slip faults south of Calen were discussed in the previous section, and other faults shown in the unit are based on photo-interpretation. Dips are also steep where the beds are domed by the Urranah Complex west of Calen.

The presence of coal, plant fragments, cross-stratification in sandstone, and interbedded rhyolite indicates a continental environment, fluvial or lacustrine and possibly paludal in places. No marine fossils have been found in the sequence although they have been reported by a local resident further to the south on the Mackay 1:250,000 Sheet area. This report was investigated, but not confirmed.

The undivided freshwater beds are probably Lower Permian. Noeggerathiopsis hislopi, of Upper Carboniferous to Lower Permian range was found in the lower part of the unit, indicating that part of the unit could possibly be as old as Upper Carboniferous.

Plant fossils identified are Noeggerathiopsis hislopi, Glossopteris indica and Vertebraria indica. The last named species is reported by Reid (1929), to occur at the Calen colliery. Samples of coaly shale from this locality were tested for plant spores without success. David and Brown (1950) mention that Rhocopteris has been noted in terrestrial beds conformably overlying equivalents of the Rockhampton Series (in this report Campwyn Beds), but do not give the source of information.

The thickness of the unit is unknown but an estimate, based on regional outcrop dimensions and not on section measuring is 10,000 feet, north of Calen, and about 2,000 feet south of Calen where the top of the unit only is present.

(c) Tertiary

Tertiary rocks are found on the mainland, on Cape Conway, and on various islands off the coast. On the mainland they crop out south-west, north, and east of Calen. Rocks of this age have produced moderately hilly country except on Cape Conway, where the terrain is mountainous.

South-west of Calen, massive trachytic and rhyolitic volcanics unconformably overlie the Lower Bowen Voclanics. They are fine, even grained, and white or blue-grey in colour. The limits of outcrop have been determined by photo interpretation, and it is on lithological correlation with the Tertiary rocks at Cape Hillsborough that a Tertiary age has been assigned to the sequence. White porphyritic rhyolite, cropping out north of Calen on Zamia Creek, and lying unconformably on Lower Bowen Volcanics and Calen Beds, is also thought to be Tertiary.

Tertiary strata at Cape Hillsborough consist of rhyolite, rhyolitic agglomerate, and conglomerate, underlain by shale and sandstone. The top of the sequence, consisting of rhyolite and rhyolitic agglomerate forms the high hill at Cape Hillsborough. Pebble conglomerate (Figs. 4 and 5), the constituents of which are all of volcanic origin, is found near the base of the hill, under a conglomerate of tuff and agglomerate boulders up to six feet in diameter (Figs. 4,5,6). Beneath this conglomerate bed, on the north side of Cape Hillsborough, soft brown carbonaceous shale with plant debris, and current bedded friable quartz sandstone crops out. Oil shale is reported to occur here, (Reid 1939). The Mackay Oil Prospecting Syndicate (MOPS) hole No.4, located south of the main hill, drilled through 303 feet of soft shale and mudstone, and finished in hard silicified sandstone. The location of MOPS No.5 is not known precisely, the only description of its location being 'Cape Hillsborough, approximately two chains from high water mark forming the south boundary of Reserve R60, Parish of Ossa - 30 feet above sea level'. This hole passed through 195 feet of shale (from 30 feet to 225 feet), and then passed into 500 feet of sandstone, tuffaceous in part, from 225 feet to 725 feet. From 725 feet to the bottom of the hole at 2,405 feet, andesitic tuff was encountered except for 60 feet of tuffaceous sandstone at 1870 feet. Outcrop geology indicates that the andesitic sequence is probably within the Campwyn Beds.

Newry, Outer Newry, and Mausoleum Islands are composed of flat lying sandstone unconformably on Campwyn Beds. Fossil wood, thought at that time to be Mesozoic, was discovered by the Queensland University Students Excursion in 1957. However, it is much more probable that the sandstone is Tertiary, assuming correlation with the sequence at the base of Cape Hillsborough. Two bores put down in search of coal, in 1912, on Newry Island, encountered 85 feet of soft sandstone, pebbly conglomerate and shale, before going into Campwyn Beds. The logs, recorded in a notebook of W.E. Cameron, and held at the Queensland Geological Survey, are:

Figure 4: Conglomerate of volcanic agglomerate at Cape Hillsborough, with a bed of finer conglomerate at base. File No.M267.Neg.8.

Figure 5: Closer view of conglomerate at Cape Hillsborough. File No.267.Neg.9.

Figure 6: Volcanic agglomerate at Cape Hillsborough.
File No.M264. Neg.4.

Bore No. 1

Top Measures	Hard white sandstone, ironstone, hard and pebbly conglomerate - horizontal
20-50 ft.	Hard sandstone, coarse and fine - horizontal
50-85 ft.	Coarse sandstone with 13 ft. blue shale from 65-78 ft. - horizontal
	UNCONFORMITY
85-200 ft.	Volcanic tuff and coarser breccias, dip 20^{o} distinct in places
200-335 ft.	Volcanic breccia with clacite vein, dip steep, somewhat indistinct.

Bore No. 2

Top Measures	Horizontal sandstone (soft)
42-68 ft.	Mostly shales, horizontal
68-75 ft.	Rough carbonaceous sandstone (horizontal)
	UNCONFORMITY
75-150 ft.	Sandy volcanic breccias with one thin mudstone dip 35^{o} distinct
150-281 ft.	Coarse volcanic breccia, dip 35^{o} indistinct.

Many of the islands south-east of Cape Conway consist of volcanic agglomerate and tuff with interbedded flow banded rhyolite, and thin basalt flows. Volcanics on the eastern side of Cape Conway are correlated with those of the islands. Greater detail concerning the geology of the islands is given by White and Brown (1963).

Little is known concerning the structure of the unit. Strata at Cape Hillsborough dip to the south at 10^{o}-15^{o} but as MOPS No. 4 intersected no rhyolitic flows or pyroclastics, either the dip is primary or the section thins rapidly to the south. At this locality the sequence is faulted, against the Campwyn Beds to the west. Evidence for this fault is the absence of the thick Tertiary sequence west of the supposed fault line. Possibly an abutment unconformity would produce the same result but topographic relief at the time of deposition would have to be in the order of 1,600 feet.

Dips shown on the map on islands composed of Tertiary rocks, were taken by White and Brown (1963). Many of these could represent primary attitudes, not reflecting any tectonic movement. A few small faults are also recorded, but these could be penecontemporaneous with the vulcanism.

The thickness of the unit at Cape Hillsborough is of the order of 1600 feet, assuming that the strata above the andesitic volcanics are Tertiary. South-west of Calen the unit appears to be about 300 feet thick, and elsewhere the thickness is unknown.

Shale from the northern side of Hillsborough yielded dicotyledonous leaves, and small gastropods similar to Sigaretus (Whitehouse 1939). Cuttings from MOPS No.4 between 235 feet and 303 feet yielded Tertiary spores, (Appendix C). A Tertiary age can be established for much of the sequence at Cape Hillsborough but the age of other occurrences is based only on lithological correlation.

INTRUSIVE ROCKS

The Urannah Complex

The name 'Urannah Complex' was introduced by Malone, Jensen, Gregory, and Forbes, in 1962, in a description of the geology of the Bowen 1:250,000 Sheet area. In that area the Complex is composed of large bodies of diorite, granite, granodiorite, and gabbro, traversed by dykes of dolerite, andesite, dacite, and feldspar and quartz feldspar porphyry. In the Proserpine area, only large granite intrusions were observed, but it is most likely that the other rock types are present. The granite was cut by intermediate and basic dykes.

The Complex intrudes both Permian units, causing some folding and contact metamorphism in the undivided freshwater beds.

A K-A age determination on a sample of granodiorite from the Complex on the Bowen Sheet area indicates an absolute age of 270 million years. This places the intrusion, at this place, at the junction of Carboniferous and Permian time. However, in the Proserpine area, the Complex intrudes the freshwater Beds and hence the age of intrusion at that place must be post Lower Permian. It is thought that the Complex has had a long history of separate intrusions, starting in the Upper Carboniferous and possibly ending in the Mesozoic at the time of folding of the Bowen Basin sequence. (Jensen, Gregory and Forbes, 1963).

Possible Tertiary Intrusives

Intrusive rocks are found on Shaw, Keyser, Thomas, Silversmith, Wigton, Scawfell, Derwent, Keswick, and St. Bees Islands. The islands generally consist of massive, medium grained, pink or grey granite, cut by thick acid dykes and thin, irregular, basic dykes. Flat sheet jointing is common and it often coincides with the most common direction of dyke emplacement.

W.C. White (pers. comm.) believes these granites to be Tertiary, because of their association with the Tertiary volcanic sequence.

The granite of the islands is correlated by White and Brown(1963) with the coarse grained, pink soda granite, with flat sheet jointing, which crops out two miles east of Seaforth, at Hallidays Bay. Pinnacle Rock, 700 feet high, on the southern margin of this granite, is composed of a fine grained trachyte (Fig. 7). Its shape strongly suggests that it is a volcanic plug, and if so it is a good example of the intimate association of the granite with volcanics. A sample of this granite has been taken for age determination, but as yet no results are to hand. Mount Springcliffe, near Seaforth, is also a trachytic plug of Tertiary age. (Fig.8).

Mount Jukes, possibly another Tertiary intrusion, is a spectacular topographic feature, on the south boundary of the Proserpine Sheet area. (Figs. 9 and 10). The top of this feature is 1850 feet above sea level. The mountain is almost surrounded by a narrow valley, which in turn is ringed by a low circular ridge. The intrusion is reported to be a ring-complex, (Hill et al.1960) consisting of a high core of granophyre with dolerite and rhyolite dykes. There is no outcrop in the valley, but trachyte and gabbro boulders have been found in small creeks. The surrounding ridge is composed of metamorphosed undivided freshwater beds, both sediments and volcanics, and in part by the granite of Mount Blackwood, on the Mackay 1:250,000 Sheet area.

Other Intrusives

A small stock of leucocratic, medium grained, hornblende diorite intrudes the undivided freshwater beds about two miles north of Calen. It is correlated with the Urannah Complex but as it intrudes Lower Permian rocks it must be part of the Upper Permian or Mesozoic intrusive epoch.

A somewhat larger stock of hornblende granite intrudes the Lower Bowen Volcanics two miles east of Bloomsbury. The intrusion varies from leucocratic microgranite to coarse granite, and the sediments and volcanics at the contact are metamorphosed. A small fault cuts across the stock.

GEOLOGICAL STRUCTURE

Faulting is more important than folding in the structure of the area, Two fault directions are common: north-west to north-north-west, and north-east.

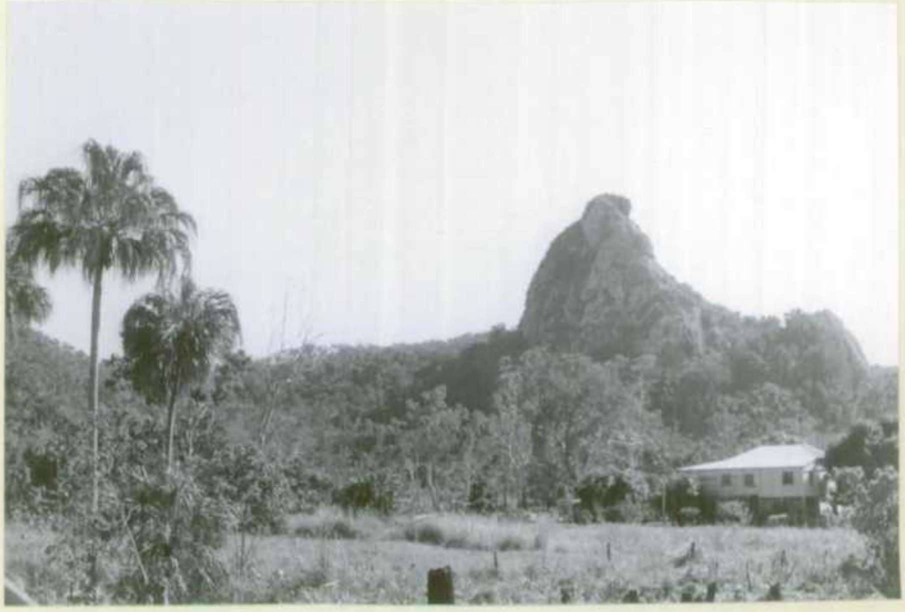


Figure 7: Pinnacle Rock, a trachytic plug near Cape Hillsborough. Photo taken looking north. See Figure 13 for locality. File M265.Neg.13.

Figure 8: Mount Springcliffe, near Seaforth, another trachytic plug. Photo taken looking west. File M266.Neg.1.

Figure 9: Mount Jukes, an acid intrusion. Mount Blackwood in foreground. Cape Hillsborough to the right of Mount Jukes in the background. Looking north-east. File No.257.

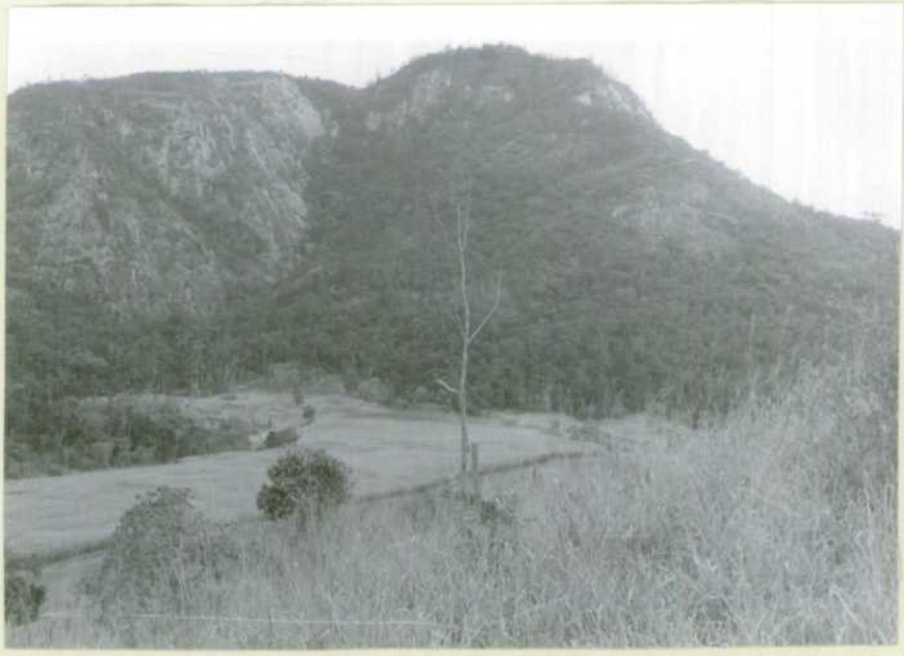


Figure 10: Closer view of Mount Jukes.
File No.265.Neg.17.

The Campwyn Beds are folded into broad structures which were not mapped in detail. They are faulted against the Permian units near Seaforth, and this fault trends north-west, but the dip of the fault plane is unknown. It could be steep and to the north-east, if the fault is a continuation of the supposed high angle reverse fault which separates the Lower Bowen Volcanics and the Carmila Beds from the Campwyn Beds, on the Mackay 1:250,000 Sheet area.

Almost parallel to the fault near Seaforth is one west of Cathu, down-faulting the undivided freshwater beds against the Lower Bowen Volcanics. The hade of this fault is also unknown, but beds near the fault are vertical and this probably indicates that the fault plane is steep. The fault which separates the Tertiary sequence from the Campwyn Beds trends nearly parallel to the faults already mentioned. A complex structure on the north-east end of Outer Red Cliff Island, is possibly a continuation of this fault, although no Tertiary strata were found on the island. (Fig.2).

The faults on Cape Conway and Goldsmith Island also trend north-west and parallel to the general trend of the coast line and the promontory north of Cape Conway. On this evidence alone it is tentatively suggested that the fault at Cape Hillsborough represents the western side of a Tertiary graben.

North-east trending faults in this area have a dominant lateral displacement in contrast to the north-west faults in which the movement is vertical. Perhaps the best example of a north-east fault is the one south-east of Calen, but there are at least four other faults which trend in the same direction.

Although the Campwyn Beds dip fairly consistently to the south-west on the mainland, the dip changes to the north and north-east on Cape Conway and on the Repulse Islands. This dip reversal probably represents the extension of a broad anticline in the Campwyn Beds, further to the south, on the Mackay Sheet.

The Lower Bowen Volcanics and the lower part of the freshwater beds dip regionally to the south-west, and the topmost part of the freshwater beds, where they are not faulted, to the north-east. Small folds in the undivided freshwater beds have axes trending north-north-east, and plunging to the south. The intrusion of Mount Jukes and the stock to the east of Bloomsbury, has in both cases locally increased the dip.

GEOLOGICAL HISTORY

During the Upper Devonian and Lower Carboniferous a shallow sea covered much of the area, receiving terrigenous sediment as well as volcanic material from nearby active volcanic areas. An hiatus in sedimentation was followed by the outpouring of andesitic flows and deposition of associated pyroclastics, of the Lower Bowen Volcanics, probably in Upper Carboniferous and Lower Permian time. Numerous freshwater lakes were formed and within them tuffaceous mud and, in places conglomerate, were deposited. Uplift commenced and deposition ceased in the south-western part of the area. However, Lower Permian sedimentation continued in the northern part of the area with deposition of lithic sand and silt of the undivided freshwater beds interspersed with periods of vulcanism, which produced rhyolite lavas. The site of deposition gradually spread to the south-west where a paludal environment lead to the eventual production of coal. The well sorted, current bedded sands at the top of the unit were deposited in a fluvial environment.

Deposition ceased in the Permian and arching of the strata took place in the Mesozoic, along an axis east of the present coastline. The Urannah Complex intruded the Permian freshwater beds and the Lower Bowen Volcanics and the stresses were reduced by faulting.

Tensional forces were applied to the area in the Tertiary or late Mesozoic, after some erosion of the mainland area, and a graben formed off the present coast. Volcanic activity resumed and this, together with deposition in lakes or lagoons, built up a sequence of interbedded rhyolite flows and pyroclastics, and coarse and fine sediments. Intrusions, such as Mount Jukes and the granite near Halliday's Bay were associated with volcanic activity, and probably intruded under under very little cover. Volcanic activity ceased in the Tertiary. A rise in sea level caused most of the area of Tertiary sedimentation to be covered by the sea, and produced the present coastline, which is characterized by tidal flats (Fig. 11).

Figure 11: Tidal flats on the coast west of Midge Island. File M257.

ECONOMIC GEOLOGY

Coal

Coal near Calen and clay at Pindi Pindi constitute the only mineral deposits worked in the district. The coal, occurring at the top of the undivided freshwater beds was noted by R.L. Jack in 1887, and the coalfield was subsequently visited by W.E. Cameron (1889), L.C. Ball (1910), and J.H. Reid (1924-29). Reid in his report mentions the 'ill-starred attempt to open up the coal seams', when in 1927-28 about 500 tons were produced at the Calen Colliery. However between the years 1932 and 1939, 8,864 tons were mined at the Fleetwood Colliery. This high rank, bituminous, non coking coal, was found to be contained in measures which are tightly folded and faulted, and intruded by the Urannah Complex. Production from both collieries was:

Colliery	Year	Tons	£
Calen	1927	300	445
Calen	1928	214	261
Total		514	706
Fleetwood	1932	151	106
"	33	376	300
"	34	1545	1155
"	35	956	740
"	36	801	652
"	37	3238	2593
"	38	1543	1172
"	39	254	199
Total		8864	6917

Two coal shafts were sunk near the junction of Macquarie and Jolimont Creeks, near Hampden, in 1920. Saint-Smith (1920) reports that only minor coaly bands were encountered, both the shafts going to about 90 feet. The coal was altered to graphite and of no commercial value.

Clay

Clay has been mined at Pindi Pindi since 1934. Production figures available are :

Year	Brick Clay	Fire Clay	Approx Value
1934	470		£470
35	400		£600
36	1060		£500
37	6750		£700
38	6620		£730
1952	500		£250
53	1500		£1400
54	2400		£1920
55	700		£610
56	1110		£1200
57	1830		£2230
59	600		300
60	2630	300	£1960
61	3200	600	£3130

Petroleum

Traces of bitumen have been reported in coastal areas north and south of Mackay for some time. In 1961 a local resident observed a hot spring in the surf off the beach at Halliday's Bay, (Fig.12 and 13) and the next day he collected bitumen from the beach. Small patches of bitumen were seen at Finlaysons Point and at Halliday's Bay at various times during the 1962 field season, but never any signs of hot springs. Halliday's Bay lies close to the fault which has down-faulted the Tertiary sequence against the Campwyn Beds. The bitumen could originate from the Tertiary sediments or from the numerous ships passing along the coast. Samples of the bitumen have been submitted for chemical analysis.

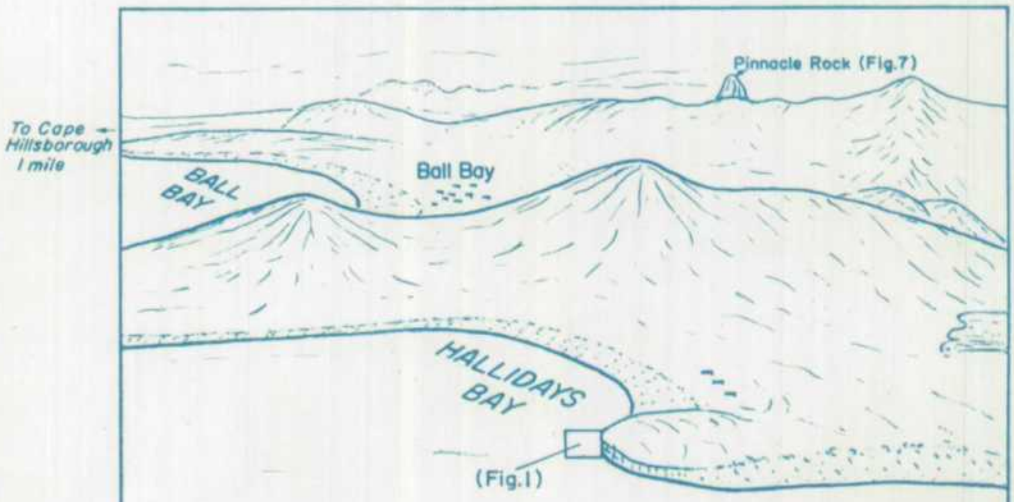
The Mackay Oil Prospecting Syndicate drilled two holes during 1956-57 near Cape Hillsborough, one to 303 feet and the other to 2,405 feet, but no oil or gas was encountered. The second hole (MOPS No.5) penetrated about 700 feet of Tertiary strata. In his report on the bores, Lawrence (1956) mentions a greasy laminated shale which when analysed gave:

Solids and non combustibles 82%
Volatiles (incl. Sulphur and
higher hydrocarbons)........... 8%
Water 10%

FIG. 12

HALLIDAYS BAY AND BALL BAY

LOOKING S.E. (SEE SKETCH BELOW)



EXPLANATION OF FIG. 12

Limestone

Connah (1958) noted several small occurrences of limestone at Cape Hillsborough, Seaforth and St. Helens homestead, none of which offers prospects of large reserves.

Simmonds and Tucker (1960) examined a deposit of excellent quality, on the Repulse Islands, and estimated reserves of 87,000 tons.

Opal and Banded Agate

Maitland (1889b) reports opal and banded agate occurring frequently in the debris at the foot of Cape Hillsborough Cliffs.

Water

Surface water is plentiful in the district and little resort has been made to underground supplies, except in shallow wells.

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APPENDIX A Part (i)

by

J.F. Dear.

Faunal and floral lists from known localities in the Proserpine Sheet area.

Locality: Victor Creek; Grid ref.658823, St. Helens 1-mile sheet.

Determinations; *Lepidodendron veltheimianun*
Stigmaria ficoides
? *Sigillaria* sp.

Age: Probably Lower Carboniferous

Locality: Grid reference 658825, St. Helens 1-mile sheet.

Determinations: Fragmentary plant stems and leaves.

Age: ? Lower Carboniferous

Locality: Outer Red Cliff Island; Reference 682900, St. Helens 1-mile sheet.

Determinations: *Cyrtospirifer* sp.
? *Sentosia* sp.
? *Aviculopecten* sp.
? *Syringopora* sp.
Leptophloeum australe

Age: Upper Devonian

Locality: Newry Island; Reference 640917, St. Helens 1-mile sheet.

Determinations: *Leptophloeum australe*

Age: Upper Devonian

Locality: Outer Newry Island; Reference 649917, St. Helens 1-mile sheet.

Determinations: Fossil wood

Age: Mesozoic

Locality: Reference 577807, St. Helens 1-mile sheet.

Determinations: ?*Noeggerathiopsis* sp.

Age: ? Permian.

Locality: Reference 573802, St. Helens 1-mile sheet.

Determinations: Fragmentary plant remains.

Age: ? Permian

Locality: Reference 574801, St. Helens 1-mile sheet.

Determinations: Fragmentary leaves showing anastomosing venation.

Age: Permian

Locality: Andrews Pt.; Reference 795825, Hillsborough 1-mile sheet.

Determinations: Dicotyledonous leaves

Age: Tertiary

Locality: Approximately $1\frac{3}{4}$ miles east of old St. Helens Homestead.

Determinations: Prospira striatoconvoluta (Benson and Dun)
Spirifer sp. with high area on pedicle valve.
Orthotetid
Camarotoechia sp.

Age: Lower Carboniferous

Remarks: The last mentioned collection is housed in the G.S.Q. Collections; all others are incorporated in University of Queensland collections.

APPENDIX A Part (ii)

by

J.F. Dear

Palaeontological report on fossils from Seaforth.

Locality: P.28F Finlayson's Point, Seaforth; map reference 388167, Proserpine 4-mile sheet.

Collector: Combined B.M.R. - G.S.Q. party, 1962.

Determinations: Rugosochonetes kennedyensis var. magnus Maxwell
Schellwienella sp.
Schuchertella sp.
Rhipidomella australis (McCoy)
Spirifer sp.
Prospira tellebangensis Maxwell
Tylothyris sp.
Brachythyris productoides (Eth.fil.)
Cleiothyridina sp.
Straparollus sp.
Baylea sp.
Indet. aviculopectenid
Indet. trilobite fragments

Age: Upper Tournaisian

Remarks: The assemblage compares closely with the Upper Tournaisian faunas of the Yarrol Basin, in particular with that described by Maxwell (1961a) from the Tellebang Formation at Old Cannindah. The specimen figured by Maxwell as Ectochoristites wattsi Campbell compares closely with Spirifer sp., and in addition Rugosochonetes kennedyensis var. magnus, Rhipidomella australis, and Prospira tellebangensis occur in both faunas. Straparollus australis, which was described by Maxwell (1961b) from the same locality in the Tellebang Formation, closely resembles Straparollus sp. Maxwell considered the fauna at Old Cannindah to be Upper Tournaisian in age.

In Three Moon Creek, Cania, 26 miles to the north-west of Old Cannindah, a fauna strikingly similar to that from Finlayson's Point occurs in mudstones immediately overlying an oolitic limestone. It includes Rugosochonetes kennedyensis var. magnus, Rhipidomella australis, Prospira tellebangensis, Brachythyris productoides, and species that closely resemble Schellwienella sp., Schuchertella sp., Cleiothyridina sp., and Straparollus sp., respectively. A form identical to Spirifer sp. occurs in mudstones approximately 150 feet below the oolitic limestone. The fauna at Cania is thought to be slightly younger than that from Old Cannindah, but is of Upper Tournaisian age.

Spirifer sp. also compares closely with the species figured by Maxwell (1954) as Spirifer cf. liangchowensis Chao from the Spirifer Zone of the Mt. Morgan district. Rugosochonetes kennedyensis var. magnus is also present in the Spirifer Zone, which was considered by Maxwell to be Visean in age. The latest evidence available suggests however, that the fauna of this Zone may be approximately correlated with the Upper Tournaisian faunas at Old Cannindah and at Cania.

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APPENDIX B

SUMMARY OF PERMIAN FOSSIL PLANTS IN AREA

Based on identifications by M.E. White (1963)

UNIT	*LOCALITY	SPECIES
Undivided freshwater beds	P2	Noeggerathiopsis hislopi (Bunb.) ?Glossopteris fragments
"	P4	N. hislopi
"	P17	N. hislopi Equisetalean fragments Glossopteris fragments
"	P40	N. hislopi
"	P93	Glossopteris fragments Equisetalean fragments
"	P174	Equisetalean stems
"	P153	Glossopteris indica Equisetalean stem
Lower Bowen Volcanics	P22	Glossopteris fragments Vertebraria indica
"	P52	Noeggerathiopsis hislopi (Bunb.) Glossopteris venation fragments Equisetalean stems
"	P150	N. hislopi Samaropsis dawsoni Shirley Equisetalean stems

* Localities shown on map of the southern half of the Proserpine Sheet area, accompanying this report.

APPENDIX C

Palynological determination.

by

E.A. Hodgson

Three samples, submitted by R. Jensen, from Cape Hillsborough Bores No's 4 and 5, have been examined for spores.

The sample from Bore No.4 (235-300 feet) produced a good yield of well preserved pollen among which triporate species including *Triorites harrisii* were relatively abundant. Rare specimens of *Nothofagus* cf. *deminuta* were recorded. The remainder of the assemblage was made up of *Inaperturopollenites* sp., podocarpaceous species and unidentified pollens including an inter-semiangular form. This sample is of Tertiary (probably Lower Tertiary) age.

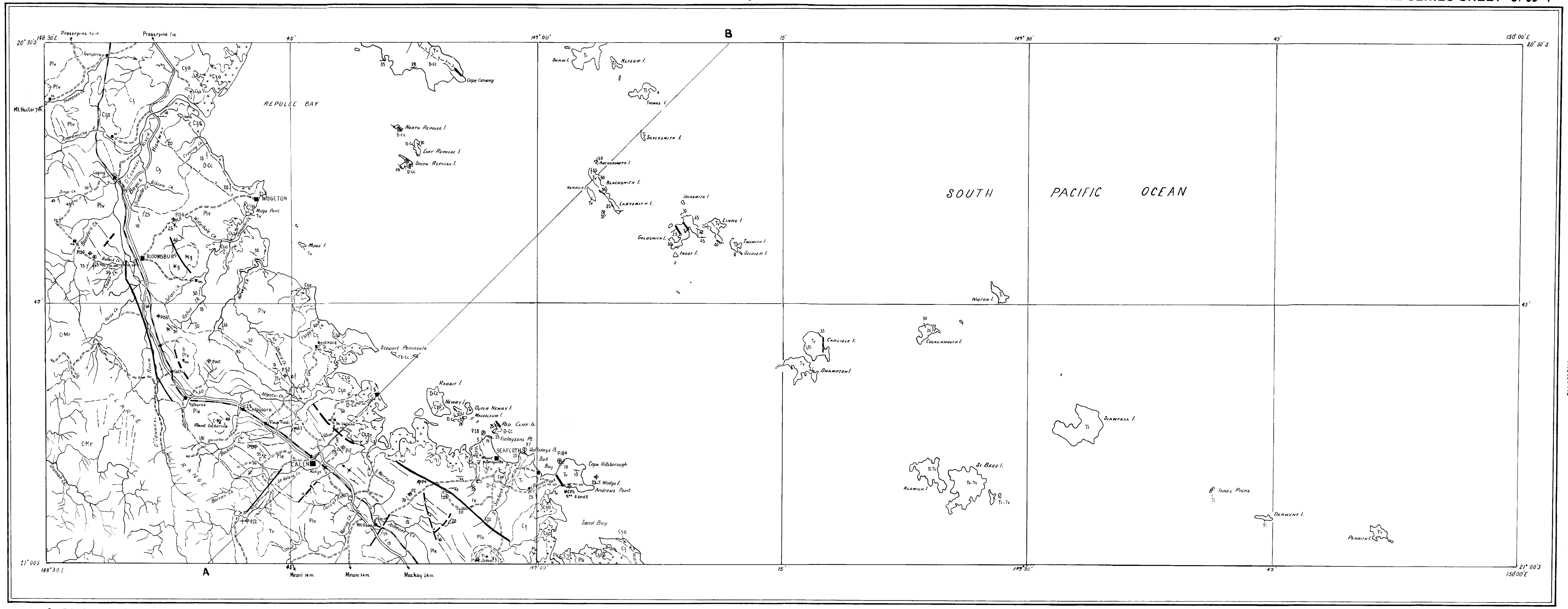
Two samples from Bore No. 5, from 40 feet and from 660-665 feet, failed to produce a microflora.

AUSTRALIA 1:250,000

PROSERPINE (STH.)

QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SF 55-4



Reference

CAINOZOIC

Cs	Soil, sand
Csa	Alluvium; Coastal alluvium, tidal flats

TERTIARY

Tv	Rhyolite and trachyte, with associated pyroclastics, minor sandstone, shale, conglomerate
Ti	Granite

MESOZOIC

Mg	Granite
Md	Hornblende diorite

CARBONIFEROUS to MESOZOIC — Urannah Complex

C-Mr	Granite-granodiorite-diorite complex, with basic to intermediate dykes

PALAEOZOIC

LOWER PERMIAN

Plc	Lithic and quartz sandstone, shale, carbonaceous shale, siltstone, chert, coal, rhyolite
Plv (Lower Bowen Volcanics)	Andesite, rhyolite, and associated pyroclastics; lithic sandstone, carbonaceous shale, conglomerate

UPPER DEVONIAN to LOWER CARBONIFEROUS — Campwyn Beds

D-Cc	Andesite, rhyolite, basalt, and associated pyroclastics; sandstone, siltstone, oolitic limestone

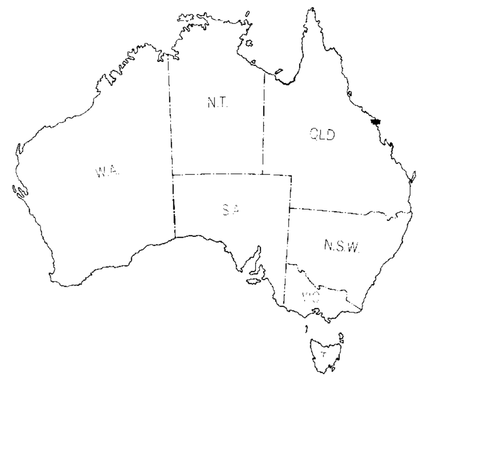
- Geological boundary
- Syncline showing plunge
- Fault

Where location of boundary, fault or fold is approximate, line is broken; where inferred, queried.

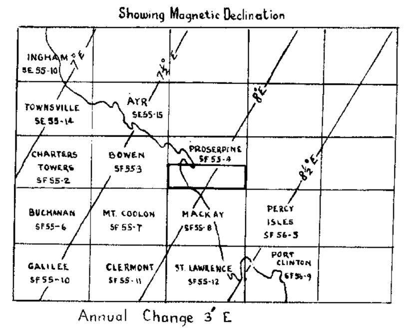
- Trend of bedding
- /20 Strike and dip of strata
- Metamorphic aureole
- Vertical strata
- Joints - air photo interpretation
- Macrofossil locality
- Plant fossil locality
- P184 Fossil collection number
- Mine, C- coal
- Fe Minor occurence of magnetite
- MOPS Dry hole — Mackay Oil Prospecting Syndicate.

- Sealed road
- Vehicle track
- Railway line
- Coping Railway station
- CALEN Town or village
- Homestead
- Top of hill

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, in conjunction with the Geological Survey of Queensland. Topographic base compiled by the Division of National Mapping, Department of National Development. Aerial photography by Adastra Airways Pty Ltd, complete vertical coverage at 1:85,000 scale. Transverse Mercator Projection.



INDEX TO ADJOINING SHEETS

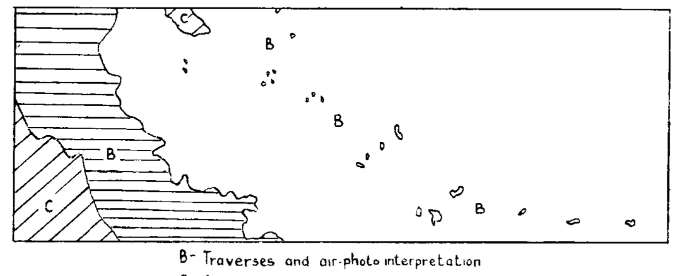


Scale 1 : 250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM



B- Traverses and air-photo interpretation
C- Air-photo interpretation

Geology, 1962, by A. R. Jensen and C.M. Gregory (BMR); V.R. Forbes (GSQ).
Geology of islands by W. C. White and G.A. Brown (Ampol Exploration Ltd.)
Compiled and drawn by A.R. Jensen.

Section A-B