COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/79

EXPLANATORY NOTES ON THE INNISFAIL 1:250,000 GEOLOGICAL SHEET, S.E. 55-6

by

F. de Keyser

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Compiled by

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INTRODUCTION

The Innisfail Sheet area in North Queensland is bounded by longitudes 145°30' E and 147° E, and latitudes 17° S and 18°S. It includes part of the Great Barrier Reef and of the coastal section between Cairns and Ingham. The mainland area is wholly covered by vertical air-photographs at a scale of 1:80,000 flown by Adastra in 1961, and an uncontrolled photomap at a scale of 1:250,000 was prepared from these photographs by the Division of National Mapping, Department of National Development. Older sets of air-photographs at a scale of 1:26,000 were flown for the Queensland Department of Lands in 1951/52. Contoured and accurate topographical maps are available from the Military Survey Map Series.

The area is connected with Cairns, in the north, and with the cities in the south of the State by the Bruce Highway and by the North Coast Railway, both of which follow the coastal plains. The Gillies and Palmerston Highways link the coastal plains in the east with the Atherton Tableland in the west. There is a dense network of roads in the coastal plains and on the Atherton Tableland, which are the more cultivated parts of the Innisfail Sheet area; access to the more rugged and mountainous rain-forest country in the centre is provided by a few vehicle tracks and forestry roads. A regular air service links Innisfail with Cairns and the cities in the south, and there is a landing strip suitable for small charter planes at the tourist resort on Dunk Island.

The climate is tropical and humid. The eastern coast between Tully and Babinda, where more than 170 inches of rain are recorded annually, receives the highest rainfall in Australia. Tully received its highest recorded rainfall - nearly 311 inches - in 1950. Farther inland the annual average decreases, and drops to about 50 inches in the south-western corner of the area. The rainfall is monsoonal; the wettest months are from January to April, the driest from July to October, though the coastal zone even then registers more than 3 to 4 inches in the driest month. Average monthly temperatures range from 80° F in January to about 65° F from May to the end of August.

The area can be subdivided into three regions of different land use: in the west, the Atherton Tableland with its dairy farming; in the east, the flat coastal plains with their sugar cane fields; and in the centre, the rugged rain-forest country with its timber.

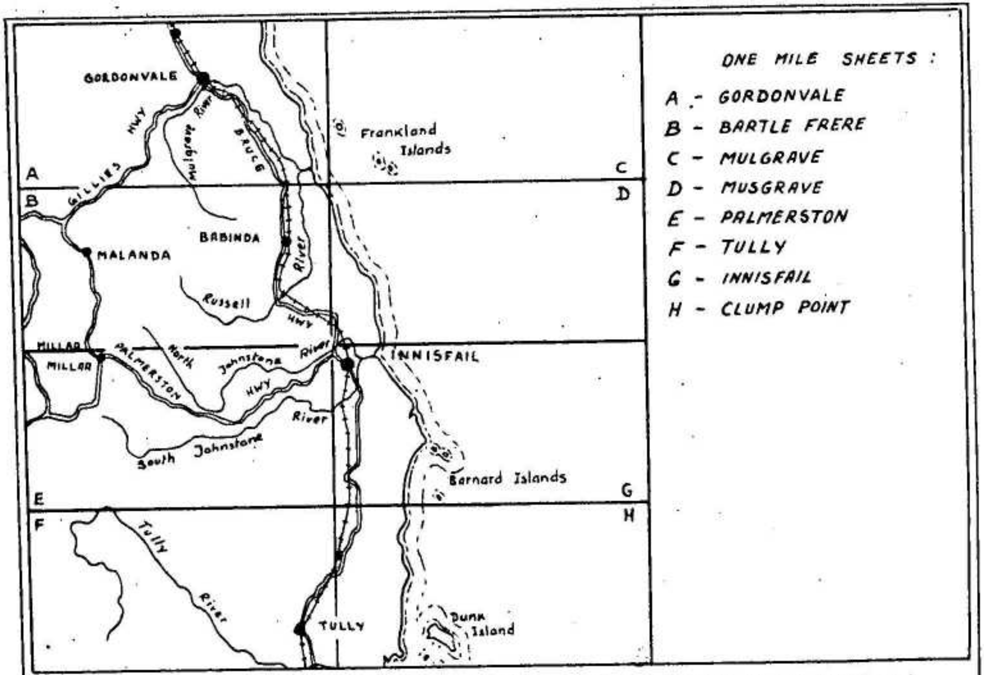


FIGURE 1 - ONE-MILE SHEETS, PRINCIPAL TOWNS, STREAMS, AND LINES OF COMMUNICATION, INNISFAIL 1: 250,000 SHEET

Previous Investigations

The first European to visit the Innisfail Sheet area was Captain Cook when he sailed past the coast and islands in 1770. His were the first geographical names - Dunk Island, Double Point, and Frankland Islands amongst them. In 1848 Kennedy set out on his ill-fated expedition from the Tully coastal plain, and worked his way up the Atherton Tableland via Cochable Creek; he was probably the first white man to venture inland. By the year 1880 the first sugar cane was grown along the Johnstone River, and Innisfail, then known as Geraldton, was founded soon afterwards.

At about the same time, in 1879, the first gold was found along the Mulgrave River, west of the Bellenden Ker Range. The Russell River and Jordan Creek (or Johnstone River) Gold Fields were discovered in 1887 and 1898, respectively, and were followed by the Mount Peter (1915) and Bartle Frere (1937) Gold Fields. Gold has been the only mineral of any importance mined in the Innisfail Sheet area; tin, tungsten, and other metallic and also non-metallic materials have been recovered from time to time in negligible quantity, or are of mineralogical interest only.

Most of the previous geological information is scattered, and is derived from observations made during inspection trips to the mining fields by various geologists among whom are Jack, Ball, Morton, Reid, Saint-Smith, Denmead, Jensen, and Broadhurst (see Bibliography).

Perhaps the most comprehensive regional accounts were given by Jensen (1923, and in A.G.G.S.N.A., 1941), who formed the opinion that the coastal sediments (named "Barron River Metamorphics" by Whitehouse, 1930) in the Cairns and Innisfail 1:250,000 Sheet areas are the equivalent of the Hodgkinson Formation which crops out in the adjoining Atherton and Mossman Sheet areas to the west. In 1946 the high-grade metamorphic rocks along parts of the coast and on the islands were grouped as the "Coastal Series" (Bryan and Jones), and were renamed "Barnard Metamorphics" in 1956 (Jones and Jones). These have been regarded as Precambrian or even Archaean, but there is evidence now that they are Palaeozoic, and represent the higher-grade metamorphic equivalents of the Barron River Metamorphics.

Much attention has been given, from the earliest days, to the physiography of North Queensland, especially to the morphological development of the corridors and scarps, the development and change of the drainage system, the nature of the continental shelf, and the description of the basalt vents. Hedley, Griffith Taylor, Danes, Jardine, Süssmilch, and Bryan were among those most directly concerned with the area dealt with in these notes.

Systematic regional geological mapping in North Queensland was begun in 1956 by joint field parties of the Bureau of Mineral Resources and of the Geological Survey of Queensland, and has contributed greatly to the understanding of the geology of the Innisfail Sheet area (White, Best, Branch, de Keyser, Amos,

Fig. 1b. The topographic relief of the north-eastern part of the Atherton Tablelands and the Cairns-Russell River area.
(Photograph of topographic model in the Geology Department of the University College of Townsville).

Morgan). Some regional problems were extensively investigated: Branch (1962), for instance, presented his views on the genetic relationships between the various granites and porphyries in North Queensland, and Amos (1961, 1962) worked out the type and succession of the phases of deformation that have affected the Palaeozoic geosynclinal sediments in the Mossman and Cooktown Sheet areas. The sedimentary, igneous, and tectonic history of the Cairns - Townsville Hinterland was synthesized by White (1961).

The Bureau of Mineral Resources also carried out a regional reconnaissance gravity survey in the coastal area of North Queensland (B.M.R., 1961).

The map, which these notes accompany, was compiled from information obtained during fieldwork carried out between April and October, 1962, by a joint party of the Bureau of Mineral Resources and the Geological Survey of Queensland.

PHYSIOGRAPHY

(See Plate 2)

From west to east, the following physiographic units may be distinguished in the Innisfail 1:250,000 Sheet area:

a. The Atherton Tableland with remnants of the Herberton Highland.
b. A central highland consisting of mountainous, jungle-covered ranges mostly of granite.
c. The flat, alluvial, coastal plain.
d. The low coastal ranges.
e. The continental shelf with the Great Barrier Reef.

The Atherton Tableland is elevated to altitudes ranging from an average of 2600 feet in the south to 2300 feet in the north. Most of its northern and central parts are covered by late-Cainozoic basaltic flows and pyroclasts which filled the depressions in the old land surface, so that the topography now ranges from flat in the north to undulating in the centre. Several prominent hills represent old basaltic volcanoes and cinder cones (Figs. 5, 6, 7). In the southern part of the Tableland, in the region of the upper Tully River, little basalt has remained, so that there the land is more densely incised and hilly.

Remnants of what has been named the Herberton Highland in the adjoining Atherton 1:250,000 Sheet area (Best, 1962) occur in the region west and south-west of Millaa Millaa. Its topography is more rugged, and its general altitude is considerably greater than that of the Atherton Tableland, being well over 3000 feet and reaching a maximum of 3954 feet at Mount Hugh Nelson, 4 miles west of Millaa Millaa. In the Innisfail Sheet area the Herberton Highland is carved out solely in the Glen Gordon Volcanics, which had apparently been resistant enough to remain as topographic highs during and after the Tertiary period of denudation and planation.

Between the plateau of the Atherton Tableland and the alluvial flats of the coastal plains there is an irregular zone of rugged topography, here designated the central highland, which is characterized by deeply incised valleys, precipitous mountain sides, and steep, narrow spurs. Streams flow down the slopes in a series of cascades and rapids. The highest points are those of Mount Bartle Frere (5275 ft) and Bellenden Ker (5225 ft), which are the highest mountains in Queensland.

This central zone, which in places narrows down to an irregular scarp line, represents the transition from Atherton Tableland to coastal plains. Much of this zone is occupied by the granite massifs of the Lamb, Bellenden Ker, and Walter Hill Ranges, and Mount Bartle Frere. Owing to the resistance of these granites compared with the Barron River Metamorphics, differential erosion has been marked, thus accentuating the topographic relief, and forming subsequent valleys along the granite borders. These valleys were later partly filled with basalt - the upper Mulgrave River, the Russell River, Cochable Creek, and Downey Creek are good examples of such valleys.

The central highland is thickly overgrown with tropical rain-forest; access is difficult, and is by means of a few forestry roads and foot pads. This rugged belt was the old main divide between the Pacific and the Carpentaria drainage systems, as pointed out by Griffith Taylor (1911), but river captures and stream reversals following vertical movements during the late Tertiary have shifted the divide to the west, so that at present virtually the whole of the Innisfail Sheet area is being drained into the Pacific.

Most of the eastern part of the Innisfail Sheet area is occupied by the alluvial flats of the coastal plains, which extend north and south beyond the limits of the area mapped. A subdivision can be made into the Mulgrave River Corridor, the Innisfail Plain, and the Tully Plain, separated from one another either by a few low, hilly ranges, as at Tully, or by a thin sheet of basalt, as between the North Johnstone and Russell Rivers. The Mulgrave River Corridor was named by Jardine (1925), who thought, as did Daneš (1912) and others, that the feature was a rift-valley. The Tully and Innisfail Plains were named and described by Süssmilch (1938).

The coastal plains are the locus of the sugar cane industry, and consist of low, flat surfaces of thick (over 100 feet) alluvium and, in the east, swampy lagoonal deposits and old beach sands.

From Double Point northwards, the coastal plains are separated from the ocean by a line of coastal ranges whose altitudes increase from some 500 feet in the south (Moresby Range, Fig. 14) to a maximum of 3360 feet in the north (Bell Peak, in the Malbon Thompson Range). The northern and higher segments of this line of ranges are composed of granite, the southern sections of schists and amphibolite.

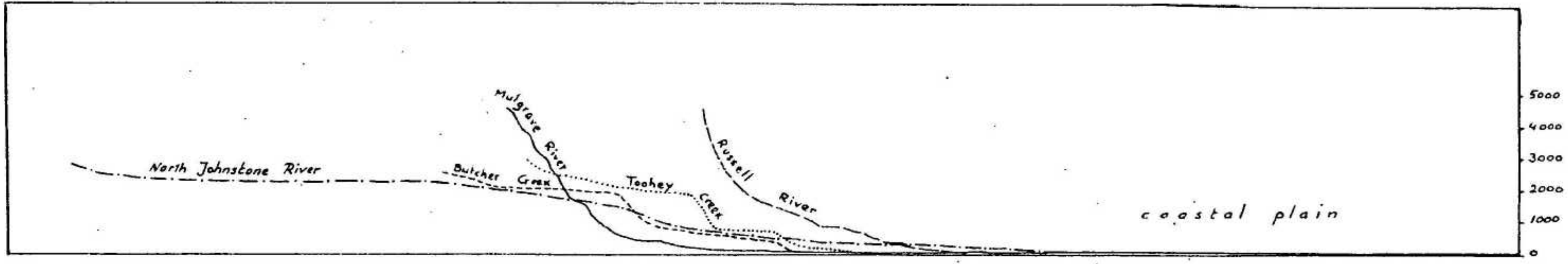


FIGURE 2 - LONG-PROFILES OF NORTH JOHNSTON RIVER, MULGRAVE RIVER, RUSSELL RIVER, TOOHEY CREEK, BUTCHER CREEK; INNISFAIL SHEET AREA

Süssmilch (1938), and others, were convinced that these coastal ranges represent narrow horsts between the down-faulted blocks of the Mulgrave River Corridor and the continental shelf.

The continental shelf, with the coral islands of the Great Barrier Reef, extends 40 to 50 miles off the coast of the Innisfail Sheet area. The depth of the sea is here generally not more than 100 feet to 200 feet, but beyond the shelf edge (which is probably a hinge fault - Fairbridge, 1950) the sea bottom slopes abruptly at an angle of about 8° to a depth of more than 4000 feet.

The drainage of the Innisfail Sheet area is rather complex owing to lithological and structural conditions. In the basalt country of the Atherton Tableland the drainage network is open, consequent, and, around old lava cones, radial. On the Palaeozoic igneous rock masses the streams are to a large extent controlled by joint systems, and tend to follow a rectangular pattern. Where flat stretches of slate and schist are exposed the network is relatively fine-textured and dendritic. In the coastal plains the drainage is consequent, and is characterized by meanders. Tidal channels are common in the coastal swamps. Subsequent valleys have been carved out by differential erosion along many of the granite boundaries, whereas the headwaters of some of the streams, e.g., North Johnstone River, are probably obsequent, and show a barbed pattern as a result of the reversal of the main streams.

The longitudinal profiles of the rivers flowing off the Atherton Tableland (Fig. 2) show graded upper and lower sections, which are interrupted by a steeply-sloping middle section characterized by two or three nick points. This points to a multicyclic period of base-levelling probably explicable in terms of repeated uplifts of the Atherton Tableland. The existence of terraces along the upper reaches of the Russell River (Broadhurst, 1955-57) may also point to rejuvenation of the drainage system, again most likely by uplift.

Deflection of streams, and river caputre, have been described by several investigators. A classical example is the deflection of the Mulgrave River, which used to flow into Trinity Bay, Cairns, but was diverted southwards near Gordonvale. This has been unanimously ascribed, from as early as 1828 (Jack), to obstruction by basalt lavas from the Green Hill vent. However, no remnants of basalt were found in the old path of the Mulgrave River west of Green Hill, and it is conceivable that the deflection may have been caused by a slight updoming due to magmatic pressure before the actual eruptions.

Hedley (1925) and Jardine (1925) both thought that not only the Mulgrave River but also the Russell River and even the North Johnstone River (Jardine) originally had their outlets in Trinity Bay.

Fig. 3. Thin-bedded siltstone and phyllite sequence of the Barron River Metamorphics. Upper valley of the Mulgrave River.

An example of possible river capture is given by Jardine (1925), who was of the opinion that the upper reaches of the North Johnstone River used to form part of the north-flowing upper Barron River (which, in turn, was part of the Mitchell River system), but that the basalt eruptions destroyed this pattern. Indeed, the barbed pattern shown by the headwaters of the North Johnstone River may be taken as evidence, though it might be partly ascribed to radial drainage from the flanks of volcanoes.

Two main groups of theories have been advanced in attempts to explain the fundamental geomorphological features; they are based on (a) vertical movements (favoured by most investigators), as opposed to (b) differential erosion (Marks, 1924; Bryan, 1930, in part). The conclusion reached in this report is that differential erosion, though very active in places, has only modified and accentuated the relief forms that had been caused primarily by faulting along north-north-west trending lines. This explanation is favoured not only because of the abrupt transition between Atherton Tableland and coastal plains, but also because of their contrasting vertical movement, which suggests repeated uplift for the tableland ~~(c.f. page 8)~~, and subsidence for the coastal plains and the continental shelf as indicated by borings ~~(c.f. page 27, 28)~~. Furthermore, differential erosion alone does not explain why some of the granite has been planed down to the level of the Atherton Tableland and is deeply decomposed, whereas similar granite in the central ranges is highly elevated and relatively fresh, and remnants of granite (and metamorphic rocks) in the coastal plains are again deeply weathered, but now at a topographic level below that of the Atherton Tableland. Finally, it is quite likely that the granite masses are in places bounded by faults, as is shown by the example of the Lamb Range massif with its faulted eastern margin.

Summarizing the geomorphological history of the Innisfail Sheet area as envisaged in this report, and as favoured by most authors, it may be concluded that a Tertiary surface of denudation was broken up, by block faulting at the end of the Tertiary, into alternating zones of uplift and subsidence. The movements took place in several phases, spanning a long period of time. The principal block of uplift was the Atherton Tableland, the main block of subsidence was the continental shelf, and narrower horsts and graben were formed between these two units, though not everywhere in regular fashion. Aggradation occurred in the sunken segments, dissection and erosion in the uplifted parts. The development of relief was accentuated by differential erosion. Geologically the eustatic oscillations of sea-level were of relatively little importance.

STRATIGRAPHY

(see Table 1)

The Innisfail Sheet area covers part of the south-eastern extension of the Hodgkinson Basin, which belongs to the Palaeozoic Tasman Geosynclinal system, and was the site of deposition of predominantly silty and sandy sediments and a few basic volcanics during the Middle Palaeozoic. During a Carboniferous orogeny these deposits were intensely folded and faulted, and at the same time metamorphosed, to become the Barron River Metamorphics (low-grade facies of metamorphism) and the Barnard Metamorphics (high-grade facies). Postkinematic and some synkinematic granite intruded the folded belt, and were accompanied by massive extrusions of acid to intermediate volcanics. The region, after having been submitted to a long period of denudation and planation, was then covered in the Cainozoic by outpourings of the Atherton Basalt. Pleistocene and Recent sediments have accumulated since upper Tertiary times in down-faulted areas now represented by the coastal plains and the continental shelf.

Palaeozoic

The Barron River Metamorphics were first named in 1930 by Whitehouse, (who used the term "Barron River Series"), and were subsequently indicated as Barron River Metamorphics on the Geological Map of Queensland (1953). They include slate, thin-bedded siltstone, massive quartzitic greywacke, phyllite, sericitic schist, subordinate deposits of bedded chert and greenschist, and an occasional lens of recrystallized limestone and ultrabasic schist. The clastic rocks are grey to dark bluish-grey where fresh, and weather to rusty brown, yellow, and pink. Bedding structures are not very common, but some thin-bedded siltstones and fine sandstones show graded bedding. Quartz veining is common, particularly in the belts of post-metamorphic shearing, as at Etty Bay and Mourilyan Harbour.

Microscopic examination shows most of the schists and phyllites to be composed of quartz, sericite, and lesser amounts of chlorite, biotite, and feldspar. The porphyroblasts in the spotted schists are completely transformed to fine-grained aggregates of secondary minerals, and were probably originally cordierite and andalusite. Thin sections of two of the ultrabasic schists show them to be talc schist and tremolite-chlorite schist.

Although the Barron River Metamorphics are, by volume, the main representatives of the Palaeozoic rock units in the area, large tracts are hidden from view by a sheet of Cainozoic basalt and alluvium. Outcrops are generally very weathered on the Tablelands and in the coastal plain regions; fresh outcrops are found in the rejuvenated sections of the streams running off the tableland, and along the coast.

The Barnard Metamorphics crop out along the southern part of the coast between Tam O'Shanter Point and Maria Creek, on the North Barnard Islands, and on the Frankland Islands. Originally grouped as the "Coastal Series" (Bryan and Jones, 1946) they were renamed Barnard Metamorphics by Jones and Jones in 1956. They include quartz-mica schist, gneiss, and migmatite. Andalusite and sillimanite occur in the highest grade of metamorphism in the form of andalusite-sillimanite-muscovite-plagioclase-potash feldspar-biotite-quartz gneiss and migmatite, as on the Frankland Islands. Cordierite and kyanite have also been reported from these islands (Jones and Jones, 1956). Migmatites are also found on South Mission Beach and Tam O'Shanter Point where the para-gneisses are intruded by gneissic granite. Talc-antigorite-carbonate rock occurs on Kent Island (Jones and Jones, 1956). Pegmatite veins containing quartz, feldspar, muscovite, biotite and tourmaline are common on some of the islands.

Originally included with the Barnard Metamorphics were the rocks in the coastal strip between Mourilyan Harbour and Rocky Point, and on the South Barnard Islands and Dunk Island. However, the South Barnard Islands are composed of Cainozoic basaltic pyroclasts, and in the coastal strip the schists are "high-grade" in appearance only, being actually the result of post-metamorphic deformation of low-grade Barron River Metamorphics.

Age and relationships of the Barron River and the Barnard Metamorphics

The low-grade Barron River Metamorphics grade imperceptibly into the Hodgkinson Formation without any sign of a significant time break (De Keyser, 1961). Jensen (in A.G.G.S.N.A., 1941) was of the same opinion, and considered the "coastal metamorphics" in the Cairns-Gordonvale area as the more sheared equivalents of the Hodgkinson Formation. Hence the Barron River Metamorphics are essentially of Lower to Upper Devonian age, but it is probable that they also include the pelitic, deeper-water time-equivalents of the Upper Silurian to Lower Devonian Chillagoe and Mount Garnet Formations which form shelf deposits in the western part of the Hodgkinson Basin.

The Barnard Metamorphics are distinguished from the Barron River Metamorphics by coarser grain-size and a higher grade of metamorphism, and have usually been considered to be sediments deformed and metamorphosed during a Precambrian or even Archaean orogeny (Jones and Jones, 1956), on the basis of their high-grade metamorphism and contorted appearance. It now seems likely, however, that they are nothing but the higher-grade equivalents of the Barron River Metamorphics: intergrading between the two formations has been indicated in a few places in the field, and there is no lithological or structural suggestion of an angular unconformity.

This hypothesis - based on observations in the field - has been strengthened by the findings of Miyashiro (1961), who distinguishes various categories of metamorphic facies series in regional metamorphism according to an order of increasing pressure. The mineralogical composition of the Barnard Metamorphics, and their relationships with the Barron River Metamorphics, find their logical explanation in Miyashiro's "andalusite-sillimanite type of metamorphism", which has a facies series consisting of the greenschist and amphibolite facies whereas the epidote-amphibolite facies is virtually absent. Miyashiro has found his andalusite-sillimanite type, which is characteristic of conditions of low pressure, in various other parts of the circum-Pacific belt, and his conclusion is that the high-grade andalusite-sillimanite gneisses which form nodes or "highs" in a low-grade metamorphic environment of greenschist facies were formed during the same cycle of orogeny and metamorphism as the low-grade metamorphic formations.

Igneous Rocks. The folded Barron River and Barnard Metamorphics were intruded by probably prekinematic basic igneous rocks and by synkinematic and above all post-kinematic upper Palaeozoic granites, and were unconformably overlain by massive volcanic rocks that were possibly related to some of these granites.

The basic igneous intrusions were metamorphosed to what is now the Babalangee Amphibolite, a massive rock unit forming the Graham Range north-east of Babinda. Fragments of the amphibolite are also common as inclusions in the Cainozoic agglomerate on the South Barnard Islands. The rock is an even-grained plagioclase-hornblende amphibolite with nematoblastic texture, in which the green hornblende constitutes about 75 percent of the rock by volume. Undeformed specimens do not contain quartz, but where the amphibolite is strongly sheared much quartz and tourmaline have been introduced by silica-boron metasomatism.

Three post-orogenic granites can be distinguished within the limits of the Innisfail Sheet area: the Mareeba Granite, the Tully Granite Complex, and an unnamed and undifferentiated granite around Koombooloomba Dam in the south-western corner of the Sheet area.

The Mareeba Granite, first named by Jensen (1923) and described by Morgan (1961, 1963), forms the mountain masses of the Lamb and Bellenden Ker Ranges and Mount Bartle Frere, of the Malbon Thompson coastal range, and a few smaller outcrops. The Granite comprises adamellite, granodiorite, and granite, in which the potash feldspar is very commonly microcline and the mafic minerals are biotite and muscovite. In some places, as in the northern part of the Malbon Thompson Range and west of Tinaroo Dam, tourmaline is disseminated throughout parts of the granite, and occurs also in aplite and pegmatite veins. Greisenization is common west of Tinaroo Dam in the mineralized areas. The granite is generally creamy white and medium-grained, and has a texture ranging from aphyric to coarsely porphyritic. There is some evidence that the "phenocrysts" in the porphyritic granite, which are in many places aligned in the direction of regional trend, are probably a late-stage product due to autometasomatism; hence they are probably porphyroblasts rather than first-generation crystallization products (phenocrysts).

The Tully Granite Complex, 45 miles long and 15 miles wide, and emplaced in the area between Tully and the Millaa Millaa - Malanda region, is a heterogeneous mass made up of rocks whose composition ranges from (quartz) gabbro to acid micrographic granite, through quartz diorite, granodiorite, and adamellite, the latter two being the most common. The potash feldspar is generally microperthite, though microcline and orthoclase are also present in many specimens. Hornblende and biotite are the normal mafic constituents; hypersthene and clinopyroxene appear in some of the more basic rock-types. The texture ranges from fine-grained to coarse-grained, from aphyric and uneven-grained to seriate-porphyritic, and is generally xenomorphic-granular. Micrographic textures are common in the acid, leucocratic, and alkaline members. The Tully granites are distinguished from the Mareeba Granite by the presence of hornblende, by the absolute lack in muscovite, and by their more diversified compositions.

The country from Koombooloomba Dam southwards and extending into the Ingham Sheet area, is largely occupied by an unnamed and undifferentiated pink, leucocratic aphyric granite which appears to be fairly homogeneous within the Sheet limits although its grainsize ranges from fine to fairly coarse. It is, on the whole, probably an alkali granite or alaskite, composed of quartz, perthitic potash feldspar, albite, and very little biotite.

These three postkinematic granites appear to have had little effect on the intruded phyllites and slates, apart from some induration and the formation of andalusite and possible cordierite in some of the schists.

A probably synkinematic granite is exposed on South Mission Beach and Tam O'Shanter Point, where it is seen to intrude gneisses of the Barnard Metamorphics, transforming them into coarse migmatite complexes. It is a biotite-hornblende granite composed of phenocrysts (or (?)porphyroblasts) of quartz, albite, and microcline set in a granular quartz-feldspar mosaic containing clusters of brown biotite and crystals of blue-green to dark green hornblende. The granite has a gneissic texture.

The southern half of Dunk Island consists of grey, medium-grained, uniform biotite adamellite or granodiorite in which the biotite is arranged parallel to a vertical, south-south-east trending plane.

The Upper Palaeozoic extrusive igneous rocks that unconformably overlie the Barron River Metamorphics are represented by the Glen Gordon Volcanics (named by Best in 1959), which occupy the south-western part of the Innisfail Sheet area as an extension from the same rock unit in the adjoining Atherton Sheet area, where they have been described as "pink rhyolite and grey ignimbrite" (Best, 1962). Specimens from the Innisfail Sheet area were found to have a compositional range from andesite through (rhyo)dacite and quartz latite to rhyolite. The rhyodacites and quartz latites are probably the most common types. Flow-banded pink rhyolite and coarse agglomerate are found locally, but generally the rocks are massive and featureless, greenish-grey and bluish-grey quartz-feldspar porphyries with crypto-crystalline or micro-crystalline groundmass. It is possible that an older series of volcanic rocks, known as the Sunday Creek Volcanics in the Atherton Sheet area (Best, 1962), is present among the outcrops mapped as Glen Gordon Volcanics, but it has not been possible to distinguish the two series either in the field or on air-photographs.

The relationships between the Glen Gordon Volcanics and the granite is not certain, and may be more complicated if Sunday Creek Volcanics are present as well. Denmead (1947c) was inclined to consider the volcanics as younger than the unnamed granite in the Koombooloomba area which is enclosed on all sides by the Glen Gordon Volcanics. However, the presence of inclusions in the granite of recrystallized, probably volcanic porphyries, the apparent recrystallization in some of the volcanics (which may account for these porphyritic rock types that seem to form a transition between the granite and the volcanics), and the intrusive geometry shown in some of the creek outcrops, indicate that the pink granite intrudes the Glen Gordon Volcanics.

The wide compositional range of the calc-alkalic series of volcanics suggests that they might be co-magmatic with the Tully Granite Complex, which shows a comparably wide range.

A last category of probably Upper Palaeozoic igneous rocks are the basic dykes which traverse the Tully Granite Complex and the Barron River and Barnard Metamorphics on Dunk Island and South Mission Beach, generally in directions ranging between east and south-east, and which seem to be concentrated in a wide zone extending from Dunk Island to Cochable Creek.

They consist of calcic plagioclase - probably labradorite - and a pale-green hornblende or actinolitic hornblende, and contain phenocrysts of clinopyroxene in places; their texture tends to be sub-ophitic.

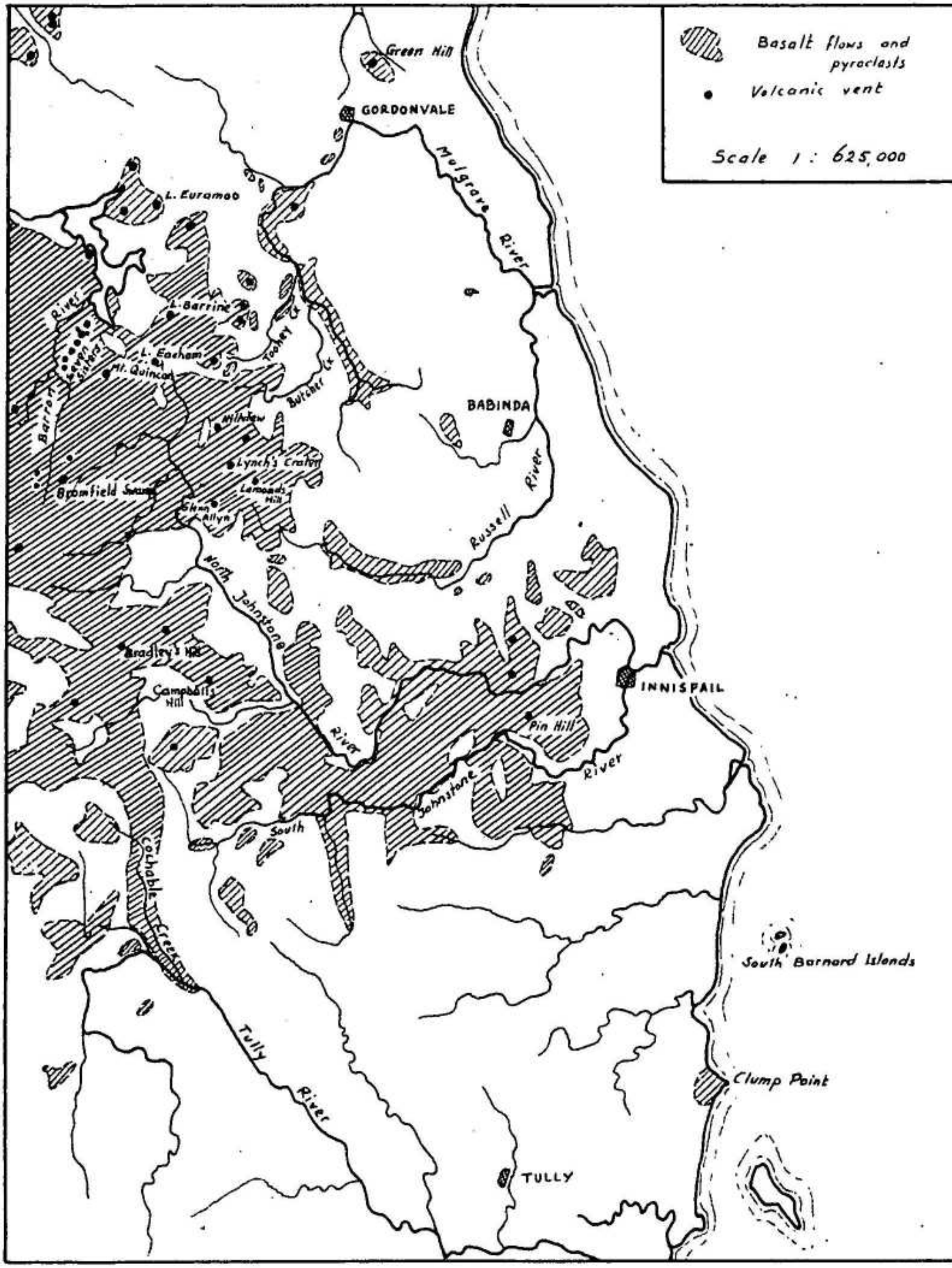


Figure 4 – The distribution of the Cainozoic basaltic lavas and pyroclasts; Innisfail Sheet.

Cainozoic

Lavas and pyroclasts of the Atherton Basalt (Best, 1960) are spread over large areas of the Atherton Tableland, have flowed down many of the post-Tertiary valleys towards the coast, and occur in parts of the coastal plains and on the South Barnard Islands (Fig. 4). The lavas as well as the pyroclastic deposits weather easily to characteristically deep red-brown or chocolate-brown, fertile soils. In parts of the area the basalts are underlain by lacustrine and fluviatile Tertiary sediments.

The lavas are all olivine-rich augite basalts, and the pyroclasts consist of cinder deposits with bombs and some agglomerate, and include fine-grained volcanic and terrigenous ash blankets. Bombs and nodules of peridotite are very common in some of the pyroclastic deposits (e.g., at Mount Quincan and on the Gillies Highway 5 miles north-east of Lake Barrine), whereas they are completely lacking in others (Seven Sisters cinder quarry). Around some of the explosion craters the admixture of terrigenous material in the efflata is so large that the volcanic nature of the deposits is hardly recognizable save for the typical deep red-brown colour of the soil.

More than 40 eruptive centres have been mapped in the Innisfail Sheet area (Fig. 4), most of them on the Atherton Tableland. Several of these have been described by Jardine (1925), Ball (1931), and Best (1960). They may be categorized as composite volcanoes, cinder cones, and explosive craters or "maares". The first group includes, inter alia, Lamonds Hill, Bradleys Hill, Glen Allyn, and Hill View. The second group is represented by the Seven Sisters, Mount Quincan, Green Hill (?), and a number of scattered unnamed cones around the Tinaroo Dam Reservoir and elsewhere. The last category, that of the explosion craters, includes Lake Barrine, Lake Eacham, Lake Euramoo, Lynch's Crater, Bromfield Swamp, and unnamed craters near the Gillies Highway and three miles east of Lake Eacham. Several of these explosion craters have large diameters - Bromfield Swamp is about a mile wide, Lake Barrine and Lake Eacham 4000 feet and 3000 feet, respectively - and their bottoms have a depth of a few hundred feet below the crater rim. They are all concentrated in the north-eastern corner of the Atherton Tableland.

The composite volcanoes are the most intensely eroded, and may carry explosion craters like Bromfield Swamp on their flanks; they are, therefore, in general the oldest vents. The shapes of the vents in the other groups are so well preserved that they may be Recent to Pleistocene. Even the older, composite volcanoes may be largely post-Tertiary because thick flows of basalt supposedly derived from these volcanoes filled many of the post-Tertiary gorges descending from the Atherton Tableland. It is, nevertheless, quite possible that the oldest flows on the Atherton Tableland date back to the Pliocene (Best, 1960).

Fig. 5. Atherton Tableland with the group of cinder cones known as the Seven Sisters, near Yungaburra.

Fig. 6. Photo-stereo pair of the cinder cones of Mount Quincan and the Seven Sisters, south and west of Yungaburra, respectively. Scale 1:80,000.

Fig. 7. Mount Quincan scoria cone with swampy crater and elevated north-western rim. Crater is about ½ mile wide.

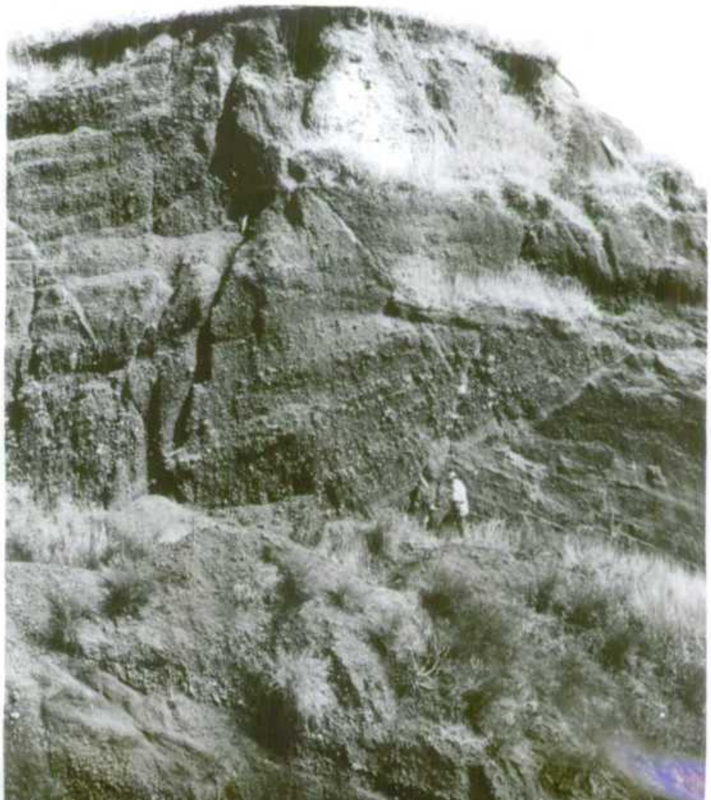


Fig. 8. Quarry near centre of one of the Seven Sisters' group of vents, showing layered scoria deposits with cross-cutting relationships (successive explosion phases) and settling faults.

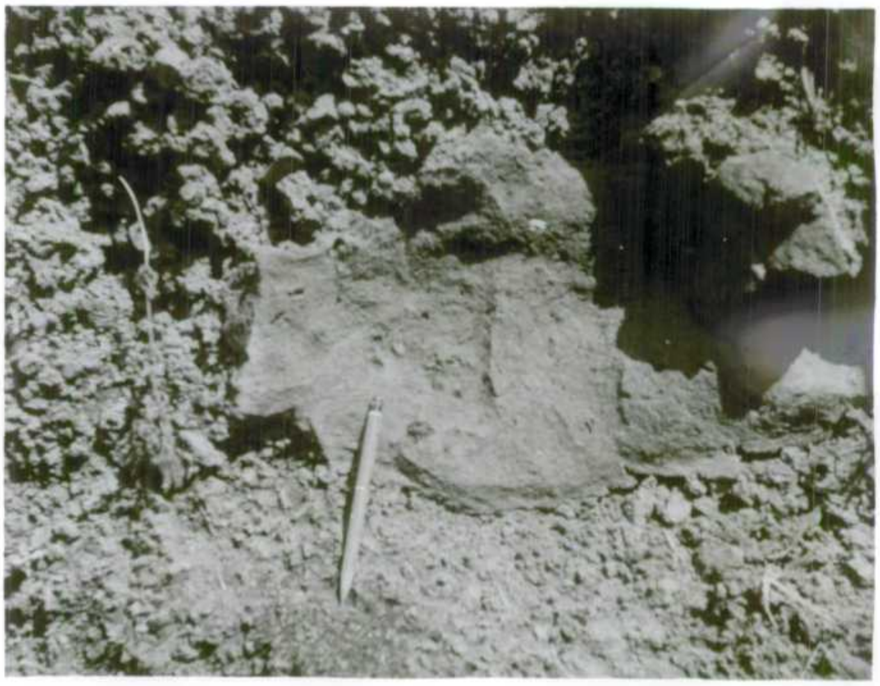


Fig. 9. Basalt bomb in coarse cinder deposits. Seven Sisters' quarry (cf. Fig. 8).

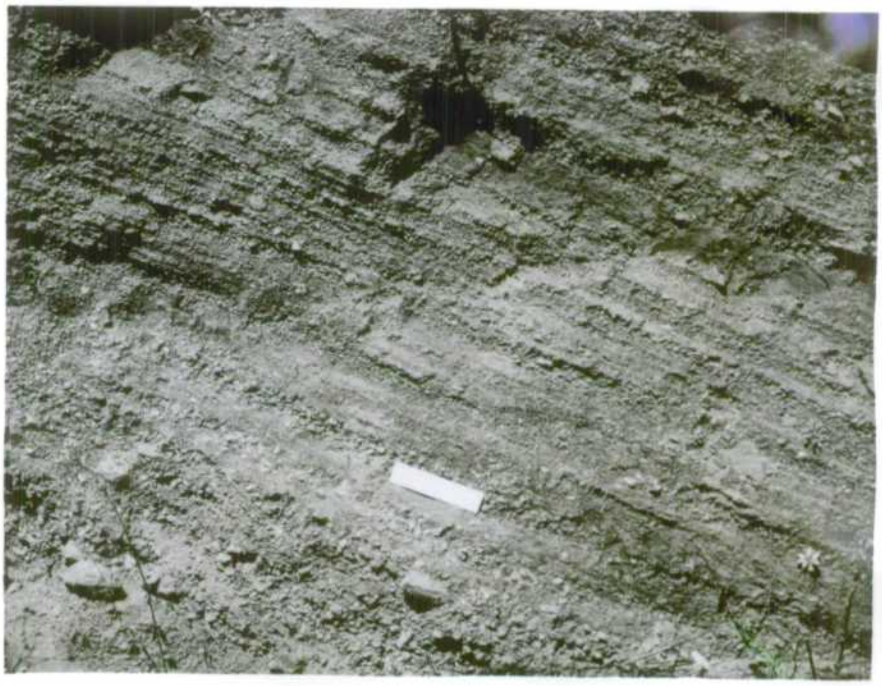


Fig. 10. Bedded pyroclastic deposit, dipping away from crater. Quarry at top of Gillies Highway. Terrigenous fragments predominate over volcanic material in many layers.

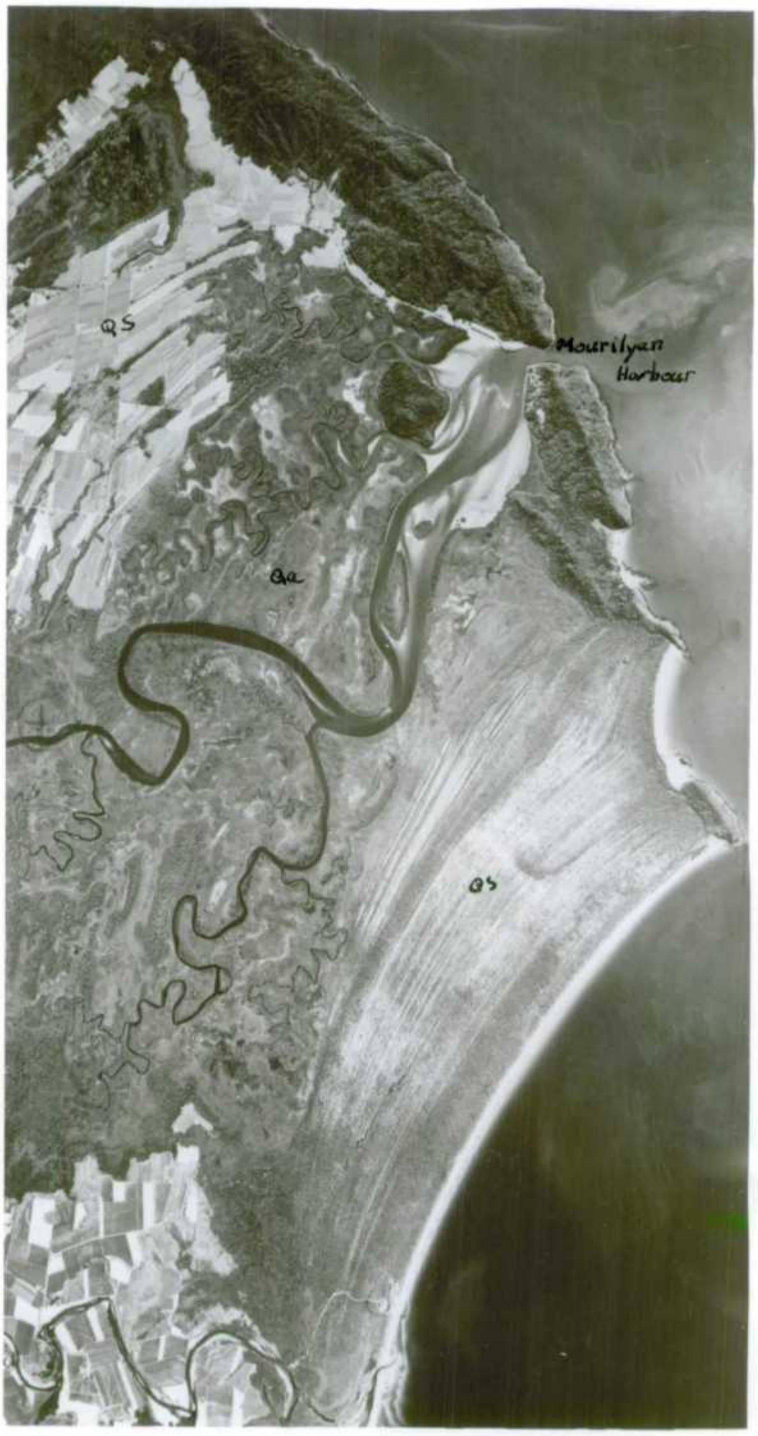


Fig. 11. Mourilyan Harbour area, showing two areas of old beach sand (Qs) separated by a swampy mangrove area of lagoonal deposits and tidal flats.
Scale 1:80,000.

The sub-basaltic sediments are irregularly distributed in parts of the area, notably in the Peeramon-Malanda-Butchers Creek-Russell River region, and comprise auriferous gravels and both thick-bedded and thin-bedded sands, silts, shales, clays, and some impure coal (Denmead, 1947b). Their thickness is variable, and locally may exceed 40 feet. Impressions of dicotyledonous leaves and fragments of wood were found in the Johnstone River gorge and near Peeramon. The sediments are considered to be Upper Tertiary.

Recent sediments, some of which date back to the Pleistocene, are represented by the alluvial deposits, beach sands, and lagoonal deposits of the coastal plains, by the marine deposits on the continental shelf, and by a single outcrop of travertinous limestone in the valley of the Little Mulgrave River.

The alluvial deposits consist of gravel, sand, silt, and clay. Lensing and cross-bedding are common. Many of the larger streams have cut out terraces in their alluvial fans where they enter the coastal plains. South of Gordonvale three such terraces have been preserved at about 75 feet, 30 feet, and 20 feet above river level, and the thickness of the sediments underneath the upper terrace may be inferred to be well over 100 feet in view of boring results at Gordonvale, so that the lower beds are now below sea-level (Jardine, 1925).

Fossil beach sands are found in interrupted stretches along the coast and locally as far as 6 miles inland. Their old coastline patterns are clearly discernible on air photos (Fig. 11). In places they were originally sand spits and bars behind which former lagoons have been silted up. It is evident, in general, that they were gradually growing and shifting northwards under the influence of the long-shore currents caused by the prevailing south-easterly winds.

Deposits of silt and mud occur in a number of places along the coast where they have choked up former lagoons separated from the open sea by protecting sand spits and barriers. They have commonly, by filling in bays and coves, straightened the former coastline, and are on the landward side partly enclosed by sections of the coastal ranges. Those at the mouths of the larger rivers grade into tidal flats interwoven with a network of tidal channels fringed with mangroves.

It is likely that in the coastal plains fluviatile alluvium interfingers with brackish and littoral-marine sediments, as is also indicated by mangrove remains at depth in the borings at Gordonvale. In the Tully Plain, coastal swamps gradually merge with fluviatite swamps, and probably extended farther inland before the most recent emergence of the order of a few feet, recognized by many authors.

TABLE 1 - STRATIGRAPHY OF THE INNISFAIL 1:250,000 SHEET

ERA	PERIOD	ROCK UNIT	LITHOLOGY	STRATIGRAPHIC RELATIONSHIPS	REMARKS	PRINCIPAL REFERENCES
CAINOZOIC	QUATERNARY	Alluvium (Qa)	Gravel, sand, silt, clay.	-	Maximum thickness more than 110 ft in coastal plains and swamps.	Jardine (1925)
		Residual soils (Qa)	Red-brown, red, and grey soils, lateritic krasnozems.	Derived from the underlying rocks.	Deep red-brown over basalt, grey over granite and some metamorphics	Simonett (1957)
		Lagoonal deposits (Qa)	Fine silts and muds.	Silted lagoons behind sand spits and bars.	Swampy deposits.	-
		Beach sands (Qs)	Fine and coarse quartz sands.	Old beaches, sand spits and bars.	Along the coast, and as interrupted strips amidst lagoonal deposits.	-
		Shelf deposits (not exposed)	Terrigenous material with lenses of reef sands and organogenic limestone; glauconitic quartz sand at (?) base; coral reefs of Great Barrier Reef.	-	Thickness over 600 ft under Barrier Reef; at least 500 ft on actual shelf platform.	Richards and Hill (1942); Fairbridge (1950).
	PLIOCENE TO RECENT	Atherton Basalt (Cza)	Olivine basalt, cinder deposits, terrigenous tuffs; basal gravels, sands, silts, coal layers.	Unconformably overlies the granites, Glen Gordon Volcanics, and metamorphics, and some alluvium.	Thickness extremely variable, reaching a maximum of about 700 feet in North Johnstone River valley. Plant remains (dicotyledonous leaves, wood fragments) in basal sediments.	Best (1959, 1960).
		Undifferentiated (Cz)	Ferruginous conglomerate and sandstone.	-	Small outcrop area 11 miles south-west of Koombooloomba Dam.	-
PALAEOZOIC	CARBONIFEROUS TO PERMIAN	Undifferentiated Granite (Pgc)	Pink, leucocratic alkalic granite, adamellite.	Probably intrudes Glen Gordon Volcanics. Overlain by Atherton Basalt.	Traces of molybdenite.	-
		Glen Gordon Volcanics (Pl)	Rhyolite, quartz latite, (rhyo) dacite, andesite, some agglomerate. Generally massive.	Probably intruded by the undifferentiated granite Pgc. Overlain by Atherton Basalt.	Maximum thickness at least 2000 feet.	Branch (1962), Best (1962).
		Mareeba Granite (Pgm)	Grey muscovite-biotite granite and adamellite, commonly porphyritic. Greisen, aplite, pegmatite, commonly containing tourmaline.	Intrudes Barron River Metamorphics and Babalangee Amphibolite. Overlain by Atherton Basalt.	Mineralization: tin, tungsten, molybdenum, gold.	Morgan (1961, 1963) Jensen (1923)
		Tully Granite Complex (Pgb)	Gradations between (quartz) gabbro and acid biotite granite through the range of quartz diorite-granodiorite-adamellite. Mafic minerals: biotite, hornblende, locally hypersthene and clinopyroxene.	Intrudes Barron River Metamorphics and Babalangee Amphibolite. Overlain by Atherton Basalt. Intruded by basic dykes.	Possibly co-magmatic with Glen Gordon Volcanics. Mineralization: gold, tin.	-
		Babalangee Amphibolite (Pzp)	Plagioclase-hornblende amphibolite with nematoblastic structure.	Intruded by Mareeba Granite. Probably intrudes Barron River Metamorphics.	Sheared zones are transformed into quartz-hornblende schist.	-
	MIDDLE PALAEOZOIC	Barron River Metamorphics (Pzb)	Slate, phyllite, sericite schist, quartzitic greywacke, subordinate greenschist, rare lenses of marble.	Intruded by the granites and basic dykes and probably by Babalangee Amphibolite. Overlain by Atherton Basalt.	Greenschist facies of metamorphism.	Whitehouse (1930); Jensen (1923); A.G.G.S.N.A. (1941); De Keyser (1961)
		Barnard Metamorphics (Pza)	Mica schist, gneiss, migmatite, Sillimanite-andalusite associations in highest grades of metamorphism.	Intruded by synkinematic granite and by post kinematic basic dykes. Overlain by Atherton Basalt.	Amphibolite facies of metamorphism. Age: Archaean (Jones and Jones) or Palaeozoic (this report)	Jones and Jones (1956).

An outcrop of travertinous limestone of very recent age occurs in the valley of the Little Mulgrave River within one mile of the Gillies Highway (Reid, 1926), 40 feet above the level of a gully bed; nowhere is it more than 30 feet thick. The limestone, which contains plant remains and some gastropods, was no doubt deposited in a fresh-water lake that had been formed as a result of the damming of the Mulgrave River valley by infilling basalt flows.

Some ferruginous, cemented conglomerate and sandstone at the border of the Sheet area, 10 miles south-west of Koombooloomba Dam, are of unspecified Cainozoic age.

The shelf sediments between the Great Barrier Reef and the coast are mainly terrigenous, but include lenses of organogenic reef sands and limestone whose proportions increase markedly in the vicinity of the reef zone (Fairbridge, 1950). Borings on the reef at Michaelmas Cay and on Heron Island, both outside the Sheet area, have shown an upper section of 400 to 500 feet of reef sands and coralline limestone overlying some 200 feet of (?)Pleistocene glauconitic quartz sand whose bottom was not reached (Richards and Hill, 1942). It follows that, given an average sea depth of 200 feet, the Quaternary sediments must be at least 400 to 500 feet thick.

Soil characteristics are good indicators, in places, for the underlying rock formation. The rich brown and red-brown colours of the basalt soils, for instance, are typical, and are distinguishable from the more rusty-red and grey tints of the metamorphic soils or the pink-red and grey shades of granitic soil. Some of the basalt soils in the Innisfail Plain have been described as lateritic krasnozems or very immature laterites (Simonett, 1957).

STRUCTURE

The Barron River and the Barnard Metamorphics are tightly folded along axes with a north-west or north-north-west regional trend. Amos (1961, 1962) has shown that, in the Mossman and Cooktown 1:250,000 Sheet areas to the north of the Innisfail Sheet area, the Palaeozoic geosynclinal sediments - including the Hodgkinson Formation and the Barron River Metamorphics - were affected by four distinct folding phases, with or without associated axial-plane cleavage, which nevertheless belong to the same Carboniferous orogeny. They are not equally well developed from place to place, and individual phases may be confined to limited belts outside of which they do not occur at all. Amos labelled the four fold systems B_1, B_2, B_3, and B_4, in chronological order.

Fig. 13. Barron River Metamorphics. The match lies parallel to an incongruent cleavage direction that resulted from a later deformation phase.

Fig. 14. Innisfail-Etty Bay area. Coastal range shows lineament pattern representing belt of post-metamorphic shearing.

The existence of multiple deformation and associated cleavage has also been proved for the Innisfail Sheet area, but no correlation with Amos' system was made for lack of outcrop information, although both his B_2 and his B_3 phases are probably present, and have deformed his B_1 folding. Commonly, however, the multiple deformation in the Innisfail Sheet area was caused by local and accidental stresses only. The cross-folding along the eastern margin of the Lamb Range, for example, was due to local faulting.

One phase of deformation does not seem to be represented in Amos' scheme: a post-metamorphic phase of shear-folding affected the already folded Barron River Metamorphics in a north-north-west trending belt, several miles wide, between the North Barnard Islands in the south-east and the Gordonvale-Green Hill region in the north-west (cf. page 8). This shear-folding, at its maximum development, has transposed the original schistosity, thus creating the semblance of a grade of metamorphism higher than that of the original schist. The granites in the north-western part of this belt of shearing are strongly foliated, crushed, and granulated. In some outcrops, however, the large feldspar porphyroblasts, though aligned in the north-north-west shear-direction, do not appear to have suffered much, even though the groundmass is granulated. This might suggest that the shearing took place at a time when actual intrusion had stopped and the granite had solidified, but when (auto-) metasomatic processes, which probably induced the formation of the porphyroblasts, were still continuing.

On air-photos the shear direction is visible as a lineament system (Fig. 14) which is definitely not the expression of bedding.

The intensity of shearing diminishes rapidly west of the actual shear belt, and its effect there is visible only as a lineation (minute crinkles) with a strike and plunge corresponding with those of the minor folds within the belt of shearing.

Faulting has no doubt played a considerable role during and after the Carboniferous orogeny, but its existence could not be proved as it has been proved in the adjoining Atherton and Mossman Sheet areas. Nevertheless, the shear-zone described above may be regarded as a system of closely-spaced faults that had been active towards the end of the Palaeozoic under conditions of fairly deep burial.

Later block-faulting must have been considerable, although the exact location of the major faults is not known, and physical evidence for their presence is lacking. The Tully River valley separating the Tully Granite Complex from the Glen Gordon Volcanics is one example of a fault whose existence has been inferred for various reasons.

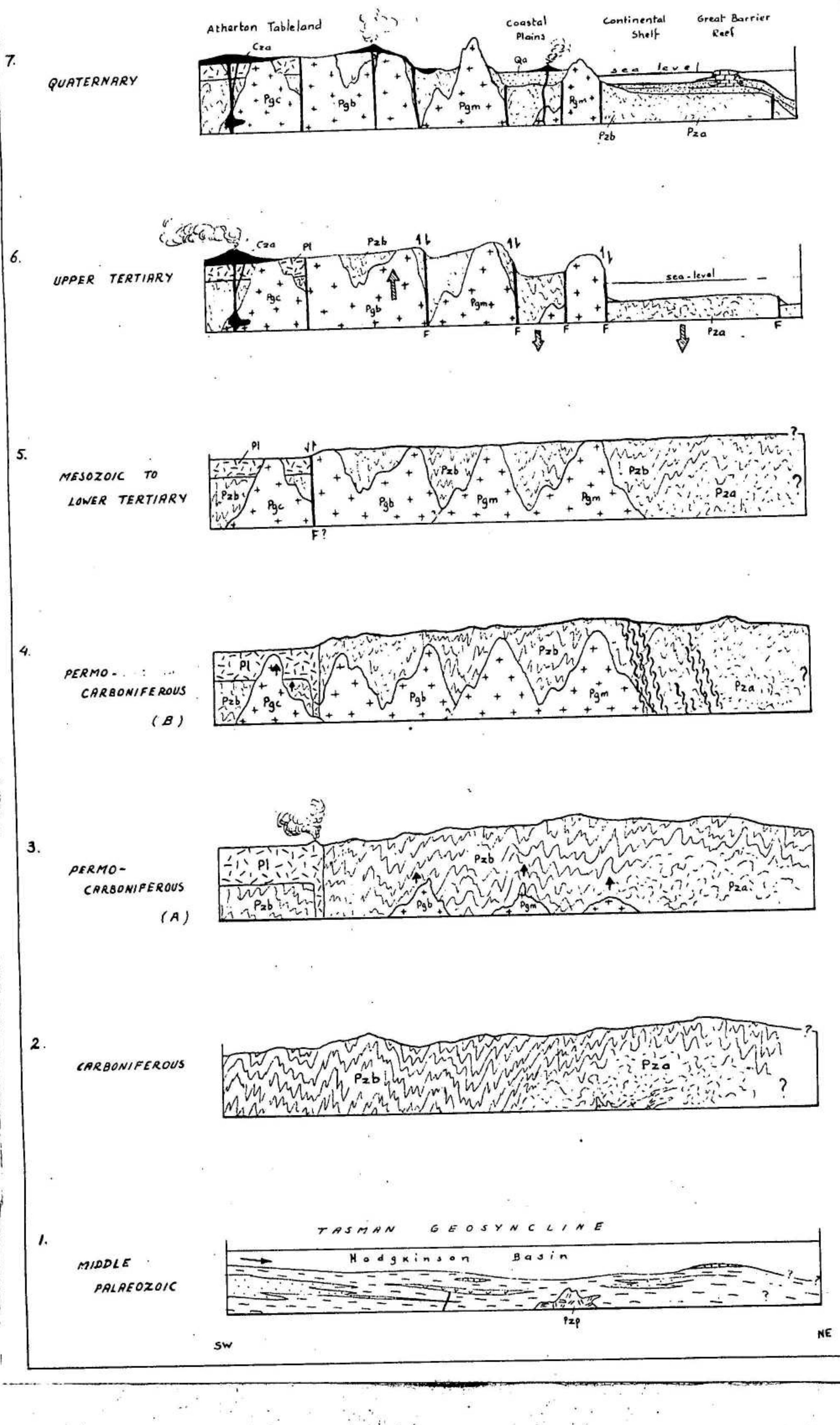
Fig. 15. Post-metamorphic folding in Barron River Metamorphics, Mourilyan Harbour. Scale 6" long.

Fig. 16. Post-metamorphic folding in Barron River Metamorphics. Scale 6" long. Mourilyan Harbour.

Fig. 17. Post-metamorphic folding in Barron River Metamorphics, Etty Bay. Movement more intense than in Figs. 15-16.

Fig.18. Post-metamorphic shear-folding in Barron River Metamorphics, more intense than in Fig. 15-17. New cleavage is developing to transpose first schistosity. Etty Bay.

FIGURE 12 - GEOLOGICAL HISTORY OF THE INNISFAIL 1:250,000 SHEET AREA.



Smaller but more clearly established post-orogenic faults have been recognized from various other parts of the Sheet area, as along the eastern margin of Lamb Range, and in the northern part of the Bellenden Ker Range.

Large-scale faulting must have occurred by the end of the Tertiary, causing the uplift of the Atherton Tableland and the subsidence of the continental shelf and the coastal plains. Evidence for this has been summarized on page 6. The linear arrangement of basalt vents such as the Seven Sisters near Yungaburra (Fig. 5, 6) is further indication for Cainozoic faulting.

Most of the faults in the Innisfail Sheet area appear to trend north-west or north-north-west, less commonly they trend north-south and north-north-east. East-west directions were not recognized. It seems probable, in view of observations made during the mapping of adjoining 1:250,000 Sheet areas, that many of the faults have been rejuvenated several times since birth, and have been active over a long period of time.

GEOLOGICAL HISTORY

Figure 12 summarizes the major events of the geological history of the Innisfail 1:250,000 Sheet area.

1. During the Middle Palaeozoic, probably from Silurian to at least Upper Devonian times, deposition took place of marine shales and feldspathic and micaceous arenites and some cherts, partly as turbiditites, in that part of the Tasman Geosyncline known as the Hodgkinson Basin. There were minor extrusions of basic volcanics and rare, small deposits of limestone. Provenance was probably mainly from the south-west. The Babalangee Amphibolite was probably intruded during or shortly before the orogeny.
2. Folding, faulting, and metamorphism during a major Carboniferous orogeny transformed the geosynclinal pile into low-grade metamorphic (Barron River Metamorphics) and high-grade metamorphic rocks (Barnard Metamorphics and Babalangee Amphibolite). Syntectonic granite intrusions produced local migmatites.
3. Intrusions of postkinematic Mareeba Granite and Tully Granite Complex after the paroxysmal phase of the orogeny, and at the same time extrusion of the Glen Gordon Volcanics, perhaps in fracture-bounded cauldrons.
4. Intrusion of granite continued. Post-metamorphic deformation affected localized, north-north-west trending belts.
5. A long period of denudation and non-deposition lasted during most of the Mesozoic and Lower Tertiary, now and then probably disturbed by faulting.

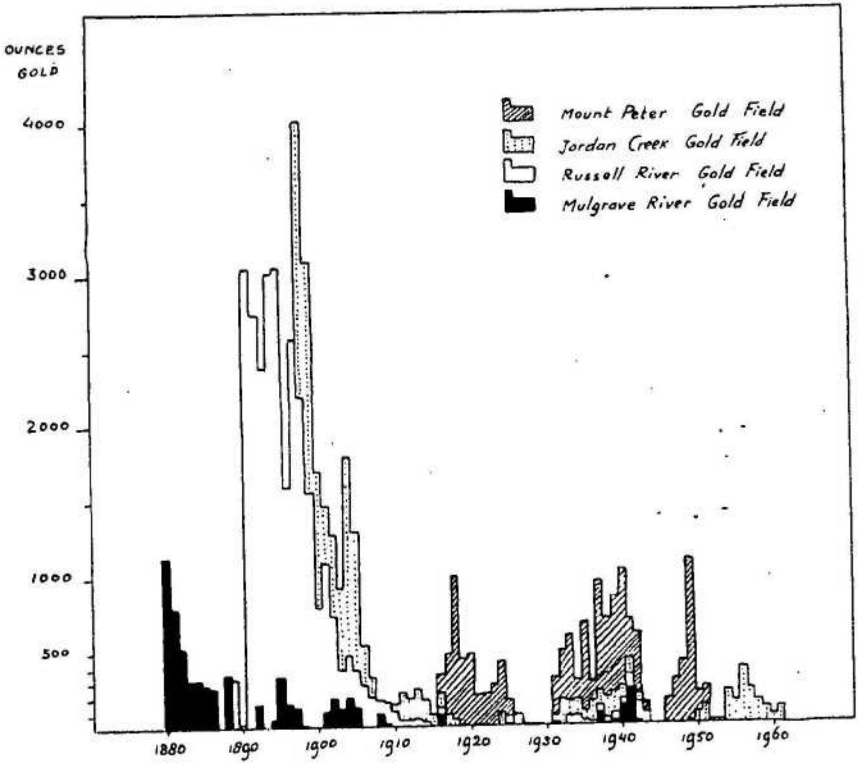


FIGURE 19 — GOLD PRODUCTION. INNISFAIL SHEET AREA

6. Strong block faulting broke up the Tertiary peneplain, and caused the uplift of the Atherton Tableland and the subsidence of the continental shelf and the coastal plains, probably during the Pliocene. Extrusion of the first basaltic lava flows.

7. The strongest phase of the Atherton vulcanism occurred during the Quaternary: basalt flowed down the deep valleys at the edge of the Atherton Tableland, and was accompanied and succeeded by pyroclastic deposits. Recurrent movements along some of the faults and differential erosion accentuated the relief. The Main Divide shifted to the west as a result of the re-adjustment of the drainage system to the new physiographic conditions. Alluvial deposits filled the sunken coastal plain areas while littoral-marine sediments were being laid down on the shelf platform and the Great Barrier Reef was formed.

ECONOMIC GEOLOGY

A number of metals as well as non-metallic materials occurs concentrated in deposits in the Innisfail Sheet area - gold, tin, tungsten, molybdenum, manganese, iron, copper, limestone, talc, and clay -, but of these only gold has been produced in any quantity (Fig. 19).

Gold. The recorded total production of 56,500 ounces of gold was obtained almost exclusively from the six goldfields shown in Figure (20). They are summarized in Table 2, in order of total production. Alluvial deposits yielded most of the output; lode mining, though widespread, was less successful. The ore shoots in the quartz lodes were generally found to be small, irregular, widely spaced, and not very high-grade, and offer little scope for large-scale development. The deposits are located in rough terrain, covered with dense rain-forest, and transport costs in the old days were so high that each group of workings relied on its own small stamp batteries rather than send its ore to some central treatment plant.

Of the goldfields the Russell River Field with the Russell Extended (Fig. 21) (Table 2) took first place with 47 percent of the total output, and has been the most intensively surveyed geologically. According to Broadhurst (1955-1958) these alluvial deposits form a number of narrow terraces along the slopes of the steep-sided valleys of the Coopooroo Creek-Wairambah Creek drainage system, and were buried by late-Cainozoic basalts. They have been exposed following re-incision during Recent rejuvenation of the drainage.

The gravel was worked by hydraulic sluicing from adits. Among the difficulties experienced were the lack of accessible water (notwithstanding the high rainfall), the rough terrain, the soft, decomposed ground which gave rise to cave-ins, and the fact that parts of the gravel are firmly cemented by iron hydroxides. Other adverse conditions are the low grade and irregularity of the

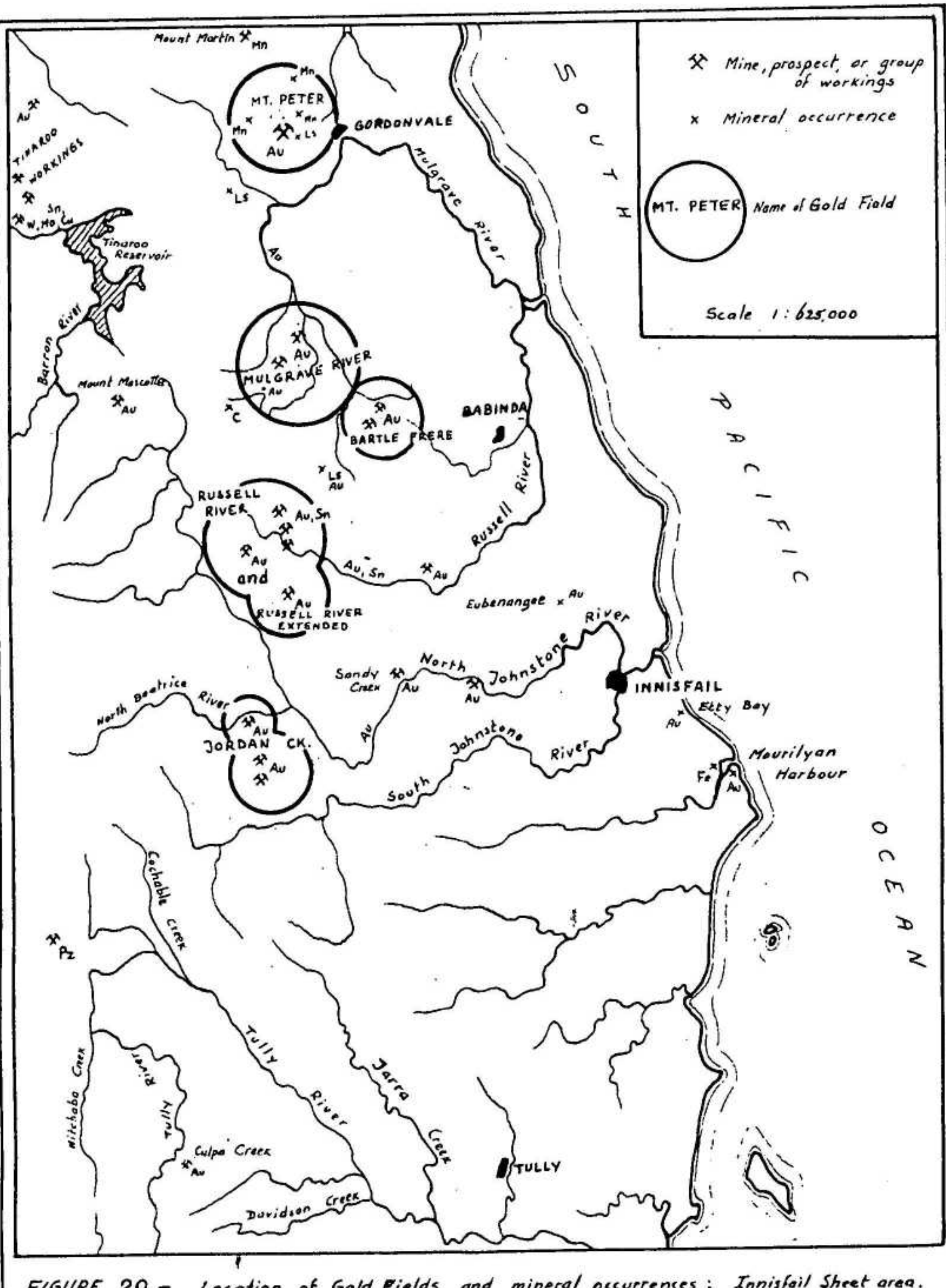


FIGURE 20 – Location of Gold Fields and mineral occurrences; Innisfail Sheet area.

TABLE 2 - THE GOLD FIELDS, INNISFAIL 1:250,000 SHEET AREA (See Figure 2c)

NAME OF GOLD FIELD	DISCOVERED	APPROXIMATE LOCATION	APPROX. TOTAL PRODUCTION IN OUNCES	DESCRIPTION OF DEPOSITS	MAIN REFERENCES
Russell River ("Russell Terraces") ("Topaz", "Boonjie") and Russell Extended	1887	Headwaters of Russell River, about 10 miles E.S.E. of Malanda in Coopooroo Creek - Wairambah Creek area. Lodes at Towalla, 13 miles S.E. of Malanda.	26,780	(a) Buried alluvial deposits in late-Cainozoic terraces along the sides of steep valleys, exposed by rejuvenation. Auriferous basal gravel beds overlain by up to 20 ft of sand, silt, and clay, under cover of 40 ft to 100 ft of basalt. The gold is very fine-grained, and is associated with cassiterite. Latest workings: Astronomer, Marvel, Lady Clive.	Jack, 1888, 1893; Morton, 1937a; Broadhurst, 1955-1958.
				(b) North-west striking quartz reefs, generally less than 1 foot thick, dipping steeply to vertical in decomposed Barron River Metamorphics. Recovery grade 2 to 3 oz/ton, but shoots are very small. Deserted after 1905.	Rands, 1894.
Jordan Creek (or Johnstone River)	1898	Two main groups:		(a) Recent creek alluvium, now exhausted.	
		1. Jordan Creek - Henrietta Creek area, 10 miles S.E. of Millaa Millaa, and 1-2 miles south of Palmerston Highway. 2. Myee Creek area, 7 miles S.E. of Millaa Millaa, and $\frac{3}{4}$ mile N. of Palmerston Highway.	12,650	(b) Quartz veins and leaders in decomposed granite, in places with alteration haloes that are also slightly auriferous. Reefs trend generally north-east, are about $\frac{1}{2}$ ft - 1 ft thick, and dip 65° to 90°. Assay values ranging up to 1 and 2 oz/ton reported, but recovery generally much less. The most intensively worked mine: Wyreema (= J.B.J. mine = Two T's Lease).	L.C. Ball, 1901, 1913; C.W. Ball, 1944; Morton, 1934.
				(c) A few deep leads under basalt covering the granite. Prospecting activity only.	
Mount Peter	1915	3 miles west of Gordonvale on steep northern slopes of Mount Peter.	11,000	Irregular quartz reefs in Barron River Metamorphics, dipping 60° to 75° south or north, or vertical, and trending north-east and east-south-east across the regional strike of the schists. Shoots are small and widely spaced. Average grade of total production 1 oz 18 dwt/ton. Little activity after 1951. The largest lode was the Talisman.	Saint Smith, 1915; Jensen, 1919; Reid, 1931; Denmead, 1947, p 50.
Mulgrave River	1879	12 to 16 miles south-south-west of Gordonvale along the spur forming the watershed between South Toohey Creek and Butchers Creek.	5,580	(a) Recent alluvium, now exhausted. (b) Quartz reefs, $\frac{1}{2}$ ft - $1\frac{1}{2}$ ft thick, with irregular ore shoots, and subparallel with, or oblique to, the strike of the enclosing Barron River Metamorphics. Low grades caused poor returns notwithstanding favourable assay values. Deserted after 1905.	Saint Smith, 1923; Reid, 1931; Morton, 1937c
				(c) Buried alluvial deposits similar to those of the Russell River Gold Field, but in many places with less overburden. Eastern rim of Atherton Basalt, on watershed between South Toohey Creek and Butchers Creek. Little information.	C.W. Ball, 1941.
Bartle Frere	1937	7 miles west of Babinda, between the granite massifs of Bartle Frere and the Bellenden Ker Range.	520	Quartz reefs subparallel to, or in places oblique to, the strike of the enclosing Barron River Metamorphics. Thicknesses commonly between 1 ft and 5 ft, and dips steep to vertical. Assay values generally ranging between $\frac{1}{2}$ oz and 3 oz/ton, but shoots patchy and irregular. Deserted after 1942.	Redmond, 1937; Morton, 1938, 1939; Cribb, 1940.

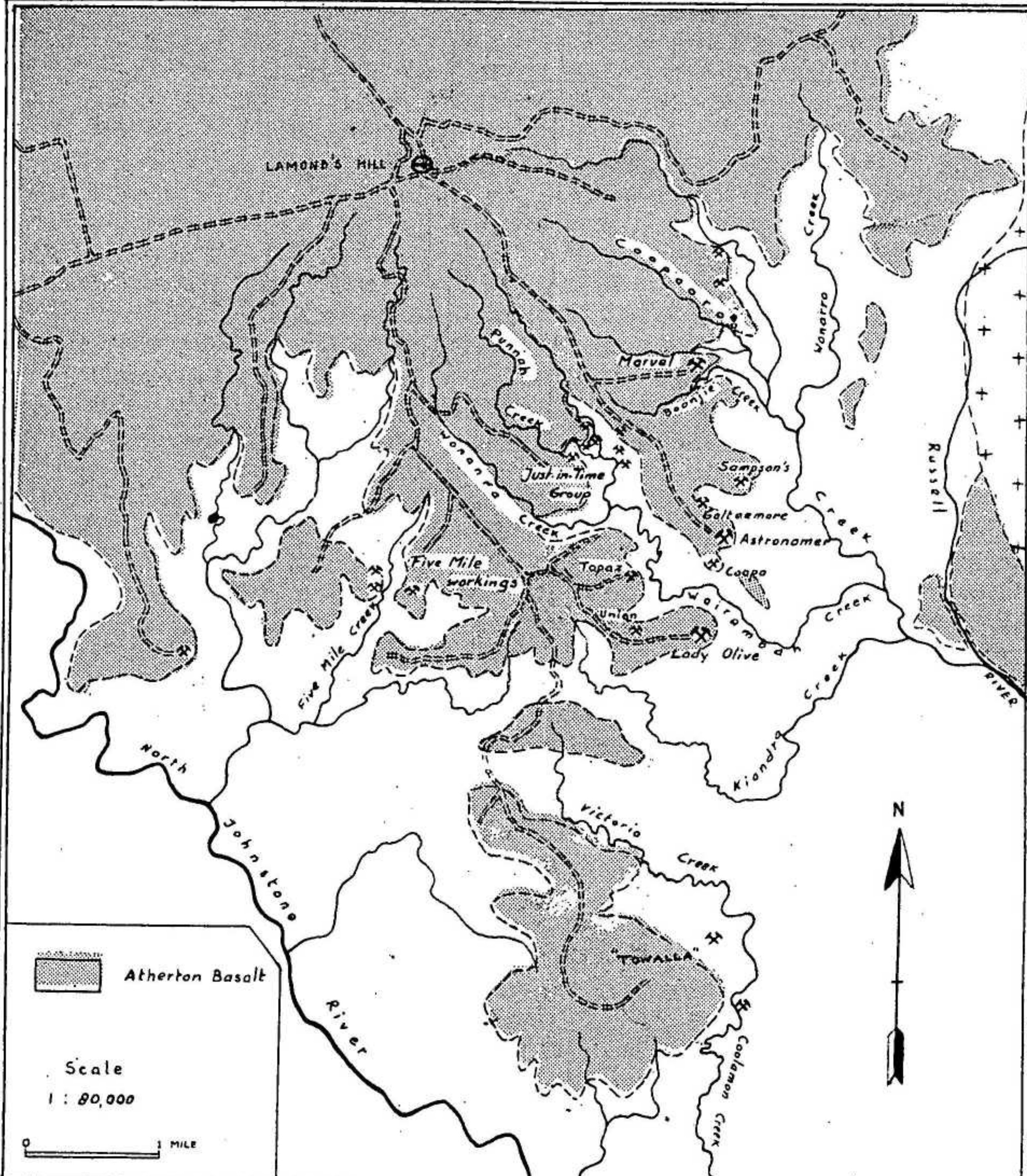


FIGURE 21 — RUSSELL RIVER GOLD FIELD ; locality map showing position of main workings.

scattered deposits, and the thick overburden.

Broadhurst (1957-1958) with the help of an engineer, Garth, made thorough geological and economic investigations of the area, and came to the conclusion that mining of the remaining reserves could not be profitably carried out.

For a short period, auriferous quartz lodes were mined in the vicinity of Towalla, some 2½ miles south of the Russell River terraces. The originally reported grades of two to three ounces per ton were apparently not sufficient to counterbalance the high cost of transport and the inadequacy of the reserves, and the field was deserted from the year 1905.

The Jordan Creek Gold Field (Table 2) comprises two separated groups of workings: the original prospects in the Jordan Creek and Henrietta Creek area, and a later group of workings in the Myee Creek area north of the Palmerston Highway.

Many of the thin quartz leaders in which the gold is contained are manganiferous, and a little pyrite and arsenopyrite are also present.

The geological map shows the workings in the Wyreema group arranged in a north-north-east trending belt; the north-east trending lodes here are apparently arranged en echelon, and may have been produced as tension cracks caused by a dextral shear couple in a north-north-east trending zone.

Much of the old production came from creek alluvium which was worked out long ago.

Some prospecting has been carried out on a few deep leads under the basalt covering the granite, but the gold values are not high, and tunnels need much timbering on account of the soft ground.

Production from the Mount Peter Field, (Table 2) west of Gordonvale, was exclusively from about half a dozen irregular quartz lodes trending north-east and east-south-east across the regional strike of the enclosing Barron River Metamorphics. Again the shoots were small and widely spaced. The average recovery grade for the total production was 1 oz. 18 dwt per ton, though values of 4½ oz. per ton were reported from some of the shoots.

The Mulgrave River field (Table 2) is the oldest in the Innisfail Sheet area. Both alluvial gold and lode gold were won, but lode mining was never successful.

Alluvial deposits of pre-basalt age and similar to those of the Russell River Field occur at the eastern edge of the basalt-covered Atherton Tableland, 8 miles east of Peeramon. They contain at least three levels of "wash", and the basalt cover is thin in places, or even stripped off locally. It appears that little systematic geological work has been done in this area, but C.W. Ball (1941) believed that the "wash" forms an almost continuous sheet underneath its basalt cover.

Last in the order of discovered fields, and least successful, were the Bartle Frere workings, (Table 2) situated some seven miles west of Babinda in Barron River Metamorphics at the foot of Mount Bartle Frere, between the Bartle Frere and Bellenden Ker mountains.

Outside the goldfield areas described, prospecting took place in a number of scattered localities. At Mount Mascotte, about 2½ miles south of Yungaburra, gold was mined at times from a quartz lode in a small window of chiastolite schist amidst Atherton Basalt. Assay values ranged from a few pennyweights to a few ounces per ton. Low-grade quartz lodes were prospected, without success, at Mourilyan Harbour and Etty Bay. Small quantities of gold occur in some of the Tinaroo workings, a few miles west of Tinaroo Dam, but were not payable. Alluvial gold was won from Culpa Creek, a tributary of the Tully River, between 1894 and 1905. The Christmas Creek area, at the head of the West Mulgrave River, is another locality from which gold was reported. At Sandy Creek, a tributary of the North Johnstone River, some gold was won from high-level alluvium in a saddle between two hills, which apparently represents an old river channel. Sluicing prospects were tested in the middle course of the Russell River where it enters the coastal plains; in the North Johnstone River 8 miles west of Innisfail; and in creek alluvium at Eubenangee, 7 miles north-west of Innisfail.

Manganese (A.G.G.S.N.A., 1941; Jensen, 1919; Morton, 1943).

Manganese occurs in siliceous replacement deposits along north-south shear-zones at various places between Gordonvale and Cairns. They are small, low-grade - considerably less than 25 percent, as a rule - and highly siliceous, and contain some iron. The ore consists of finely divided pyrolusite and psilomelane in a fine-grained groundmass of quartz. Rhodonite has also been reported.

Mount Martin, 7 miles south-west of Cairns and 3 miles west-north-west of Edmonton, is the only prospect that actually marketed ore. It is reported to be an irregular replacement body without sharply defined walls, dipping at right angles to the dip of the surrounding schist, and with the ore contained in lenticular shoots with short downward extent (Morton, 1943a). Assay values of the ore ranged between 25 and 40 percent of manganese oxide. The total production was about 1120 tons of ore that had been handpicked to a grade exceeding 40 percent.

Tin, known in sizeable deposits in the adjoining 1:250,000 Sheet areas to the west and south, is generally not found in commercial quantities in the Innisfail Sheet area. Cassiterite was obtained as a by-product from the auriferous gravels of the Russell River Gold Field and farther down the river valley south and west of Mount Bartle Frere. Several prospects in the Tinaroo group of leases, west and north-west of Tinaroo Dam, carry tin in association with tungsten and molybdenum minerals and some chalcopyrite. Robson's tin workings, for instance, 2½ miles west of Tinaroo Dam, were in aplitic dykes and open stockworks of thin, generally east-west trending tourmaline-quartz leaders in aplitic biotite granite (Saint-Smith, 1916; Jensen, 1920). As the overall cassiterite content of the lodes is only about 0.6 percent, the lease cannot be worked economically. In the Tinaroo area cassiterite has also been won from a few small alluvial deposits in gullies leading into the Barron River.

Tungsten and molybdenum occur only in the Tinaroo group of lodes six to ten miles north-north-east of Tolga, and are generally associated with cassiterite and base-metal sulphides (Morton, 1943; Connah, 1952). The lodes commonly are quartz veins at or near the granite contact, and contain wolframite, though scheelite has also been recorded from one of the leases. Only a few tons of wolfram concentrate have been produced: the recovery grade is low - generally less than 1 percent - and the values are irregularly distributed. Mention was also made of a wolfram lode about three miles south-west of Lake Eacham, but no further details are known (Dept. of Mines, Annual Rept. for 1909). Specks of molybdenite were noted in the alkali granite west of Koombooloomba Dam.

A banded quartz-hematite iron deposit has been described from Mourilyan Harbour, where it forms the backbone of a low hill at the western side of the harbour, opposite its entrance (Morton, 1937b). The ferruginous body is 15 to 20 feet wide, strikes north-west and dips steeply north-east, and is conformable with the surrounding schist. Morton considered the deposit as an obvious replacement of schist by silica and iron. Iron-rich and quartzose layers alternate, and the whole body is irregularly traversed by white quartz veins. Selected specimens from iron-rich portions assayed between 45 percent and 58.3 percent iron (Morton, 1937b), but the overall-value is much lower owing to the abundance of quartzose layers.

Base metal sulphides are not present in any significant quantity. Chalcopyrite is a minor constituent in some of the Tinaroo tin and wolfram workings, and occurs as a sprinkling in the lodes of the Bartle Frere and Mount Peter Gold Fields. Malachite and azurite staining has been reported from some of the Mulgrave quartz lodes and from small quartz lenses in manganiferous country between Mount Peter and Edmonton. Arsenopyrite and pyrite occur in most of the gold quartz lodes, some of which also contain traces of galena and sphalerite.

Non-metallic mineral occurrences of some interest include those of limestone and talc.

Limestone is known from three localities in the Innisfail Sheet area (Connah, 1958). At Mount Peter a lens of marble, 200 feet long and 12 feet wide, crops out on a steep northern spur, at an altitude of 1700 feet. On Christmas Creek, a headwater branch of the West Mulgrave River, small, bouldery exposures of a fine-grained marble are found over a length of 200 feet, and disappear in the south-west under a cover of basaltic soil more than 20 feet thick. In both localities the lenses are intercalated in the phyllites and schists of the Barron River Metamorphics. Leases for quarrying the marble were taken out on several occasions, but very little work was done.

A third occurrence, in the valley of the Little Mulgrave River, and within a mile from the Gillies Highway, consists of a porous and travertinous Recent limestone which was probably laid down in a small lake that had resulted from the damming of the Mulgrave River valley by flows of basalt. The limestone is, at the most, 30 feet thick, and cannot be very extensive judging by the local topography.

Talc is found at Mourilyan Harbour and in a road cutting on the Bruce Highway, ½ mile north of Liverpool Creek. At Mourilyan Harbour the talc schist is found as boulders on the south side of the harbour entrance, and in a 350-foot wide, north-west trending zone across the bottom of the harbour. Specimens submitted for analysis showed moderate to fairly good grades. Lower grades are reported from the road cutting on the Bruce Highway, where the rocks are tremolite-talc schist intercalated with tremolite-chlorite schist.

Rock types quarried or tested for economic purposes include clay, pozzolan, bauxite, and aggregate.

Clay, found near Silkwood, has been used for the manufacture of bricks for the last ten years. The average annual production is about 1500 tons of clay, with a maximum of 4000 tons in 1959.

Pozzolan, used during the construction of Koombooloomba Dam, was mined from a roadside quarry 12 miles from the dam. The deposit consists of soft, grey, massive, clayey material which rapidly turns red on exposure to the atmosphere, and is a weathered basaltic ash deposit (Bush, 1960), although weathered flows may be intercalated. The deposit is shown by drill holes to be more than 72 feet thick.

The decomposed basalts in the Innisfail Sheet area are rich enough in alumina to make them interesting as possible sources of aluminium. They were included in a prospecting programme for bauxite carried out between Cairns and Townsville in 1960 by Carpentaria Exploration Co. Pty Ltd (Znebejanek, 1961). Assay results of numerous samples showed an approximate average value of 35 percent acid-soluble alumina; none of the decomposed basalts contained enough alumina to be classified as bauxite.

Aggregate, road metal, and construction stone has been produced from many quarries in basalt, cinder deposits, and granite, and have all been grouped under the heading "aggregate" on the geological map (Plate I).

Geochemical Investigations. Scattered samples of stream sediments taken irregularly from the Innisfail Sheet area were spectrographically analyzed by E.J. Howard, of the Bureau of Mineral Resources, and semiquantitative estimations were made of their nickel, cobalt, copper, vanadium, tin, molybdenum, lead, and beryllium content. No economically significant anomalies were found, but certain tendencies could be recognized: the stream sediments from basalt-covered areas invariably carry low anomalies, of the order of 10 to 50 ppm., of nickel and cobalt; sediments from the granite area in the Koombooloomba Dam region are characterized by a little molybdenum (up to 10 ppm) and by absence of tin, whereas the Tully Granite Complex and the Mareeba Granite have yielded sediments in which tin and lead are commonly present but molybdenum does not occur.

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INNISFAIL
QUEENSLAND

AUSTRALIA 1:250,000

1:250,000 GEOLOGICAL SERIES SHEET SE 55-6

PRELIMINARY EDITION, 1963
SUBJECT TO AMENDMENT

Reference

		Unit	Symbol	Description
CAINOZOIC	QUATERNARY		Qa	Alluvium, soil, lagoonal deposits
			Qr	Beach sand, showing trend of old shore lines
	PLIOCENE TO RECENT	Atherton Basalt	Cza	Olivine basalt and pyroclasts, in places underlain by grit, sand and clay
	UNDIFFERENTIATED		Cz	Ferruginous conglomerate, sandstone
PALAEOZOIC	UPPER CARBONIFEROUS TO PERMIAN	Mareeba Granite	Pgm	Grey biotite granite, with muscovite some tourmaline; Finegrained muscovite and biotite granite
		Tully Granite Complex	Pgb	Biotite-hornblende granite, diorite, granodiorite; Diorite
		Undifferentiated	Pgc	Pink leucocratic granite
		Glen Gordon Volcanics	Pl	Pink and grey rhyolite and dacitic ignimbrite
	LOWER TO MIDDLE PALAEOZOIC	Babalangee Amphibolite	Pzp	Plagioclase-hornblende amphibolite
		Barron River Metamorphics	Pzb	Phyllite, slate, sericite schist, quartzitic greywacke some greenschist and lenses of limestone
		Barnard Metamorphics	Pza	Mica schist, gneiss, migmatite

- Geological boundary
- Fault

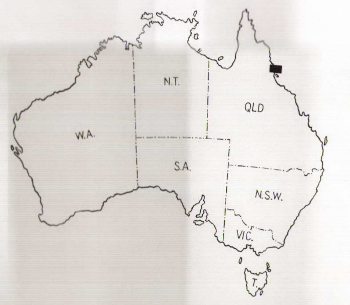
Where location of boundaries, faults and folds is approximate, line is broken, where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

- 20 Strike and dip of strata
- Vertical strata
- Joint pattern, air-photo interpretation
- 45 Strike and dip of schistosity
- 40 Strike and dip of foliation in granite
- Vertical foliation
- 50 Direction and plunge of lineation
- 60 Strike and dip of cleavage
- Vertical cleavage
- 40 20 Apparent dip of bedding on cleavage plane
- Basic volcanic vent, extinct
- Plant fossil locality
- Dyke or vein: b-basalt (Cainozoic), do-dolerite or other basic dyke rock, q-quartz, r-rhyolite or other acid dyke

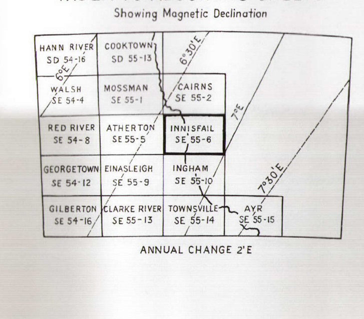
Cu	Mine
•T	Minor mineral occurrence
Agg	Aggregate, road metal, etc.
Bi	Bismuth
C	Coal
Cu	Copper
Au	Gold
Fe	Iron
Ls	Limestone
Mn	Manganese
Mo	Molybdenum
Pz	Pozzolan
T	Talc
Sn	Tin
W	Tungsten

- Dam
- Falls
- Swamp
- Mangroves
- Coral reef
- Road
- Vehicle track
- Railway line
- Power transmission line
- Airport
- Landing ground
- Trigonometrical station
- • 970 Height in feet, barometric; datum: mean sea-level

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 Royal Australian Survey Corps. Aerial photography by Adastra Airways Pty.Ltd.; complete vertical coverage at 1:80,000 scale. Transverse Mercator Projection.



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



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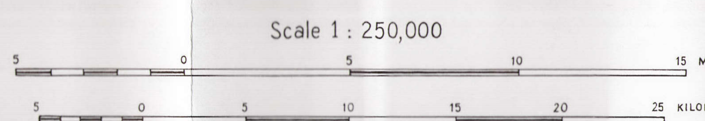
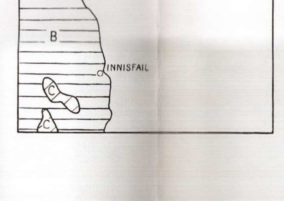


GEOLOGICAL RELIABILITY DIAGRAM



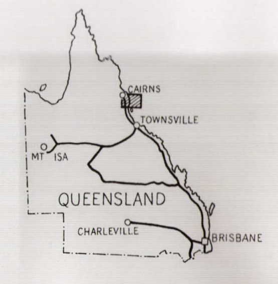
B - Detailed reconnaissance-numerous traverses and air-photo interpretation

C - Air-photo interpretation only

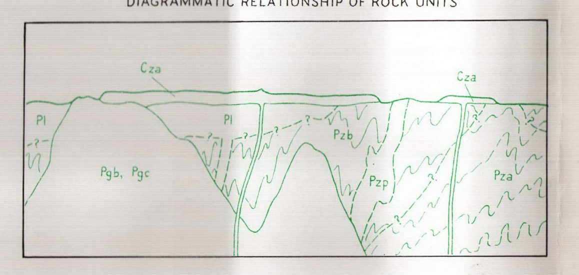
Geology, 1962, by: F. de Keyser, R.S.H. Fardon, U Kyaw Nyein (B.M.R.), L.G. Cuttler (G.S.Q.)

Compilation, 1962, by: F. de Keyser, A.S. Mikolajczak, F.H. Peniguel Jr.

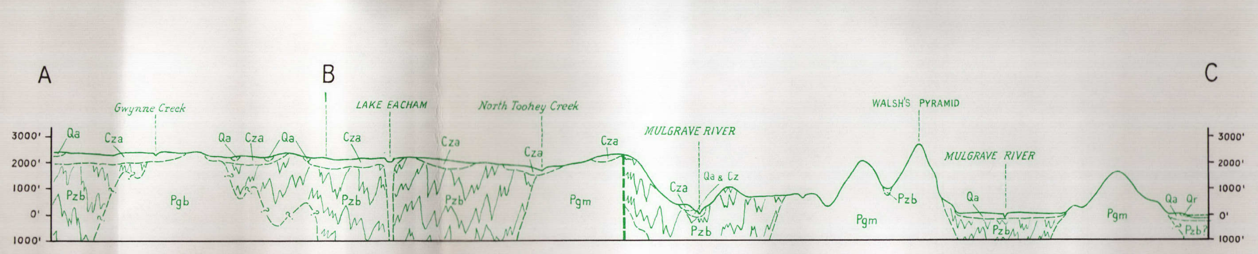
Drawn by: A.S. Mikolajczak

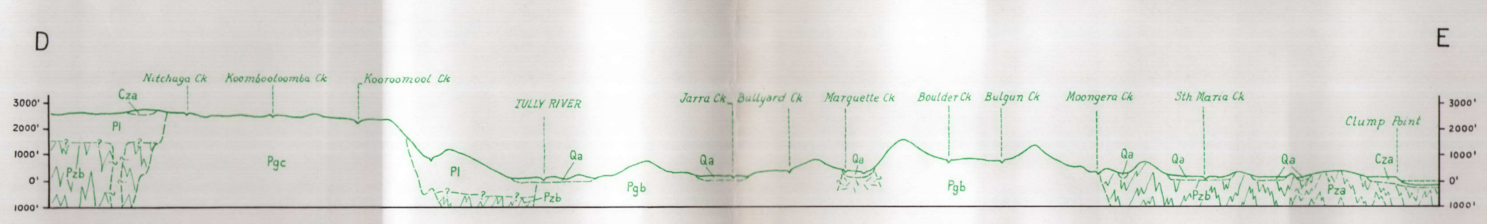


DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Sections
(Folding diagrammatic)





INNISFAIL
SHEET SE 55-6

PLATE 2

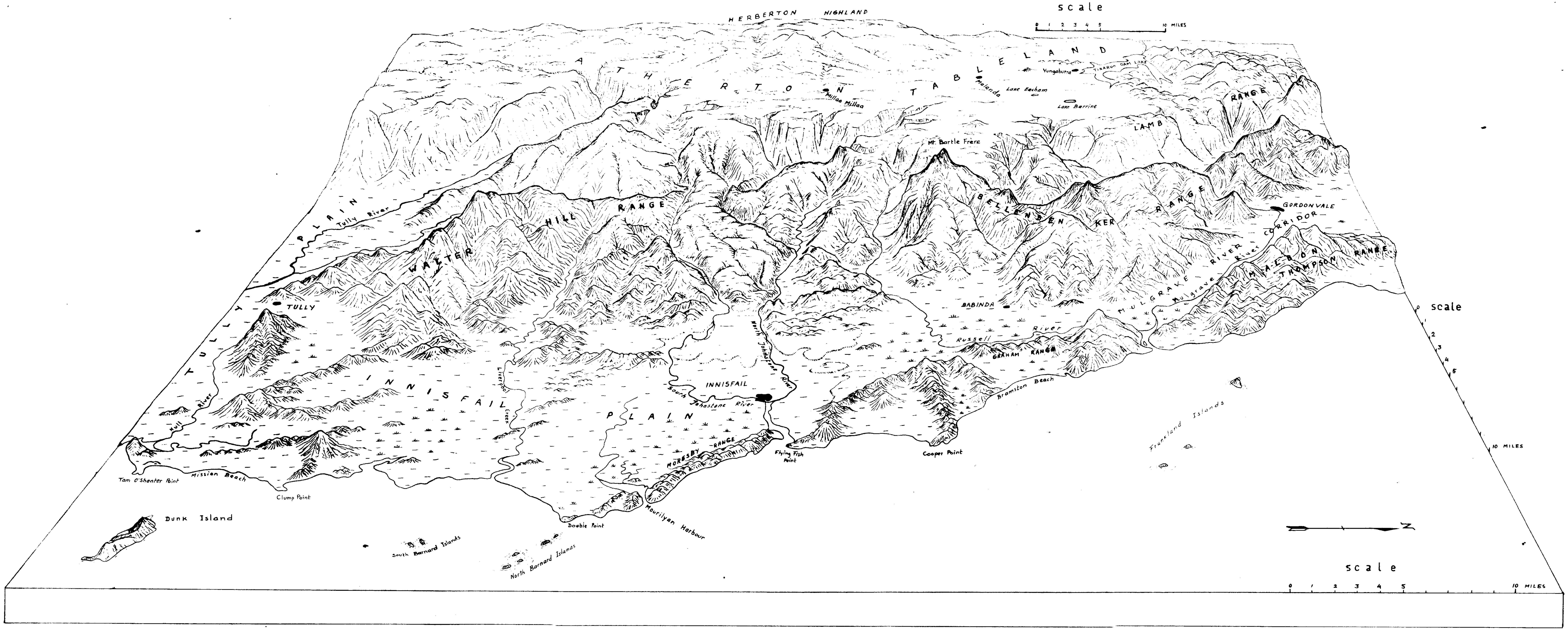


PLATE 2 _ Physiographic block diagram of the Innisfail 1:250,000 Sheet area. Vertical scale approximately 5x horizontal scale.