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The Geology of the Louisiade Archipelago, T.P.N.G. Excluding Misima Island

by

I.E. Smith and P.E. Pieters

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS DEPARTMENT OF NATIONAL DEVELOPMENT AUSTRALIA

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ERRATUM

Many of the islands in the Louisiade Archipelago are prefixed with the word "Pana" which has been linked with the second part of the name in four different ways, i.e. Pana Tinana; Pana-rai-rai, Panapompom, and Pana rora.

At the time of writing there was some confusion on the correct spelling of Pana rora - and unfortunately it was spelt Pana rora in the text and Panarora on the maps and photo-captions. Subsequently we have decided to regard the spelling "Pana rora" as it appears on the Admiralty Chart as the correct spelling - thus the spelling "Panarora" on the map and captions must be regarded as wrong.

SUMMARY

The Louisiade Archipelago consists of Misima Island, Sudest Island, Rossel Island, the Renard Islands, the Calvados Chain, the Deboyne Group, the Torlesse Group and the Conflict Group. This report gives an account of the geology of the Louisiade Archipelago excluding Misima Island, based on field work carried out during March and April 1969.

The dominant lithology in the Louisiade Archipelago is the Calvados Schist consisting of slates and low grade schists. The Calvados Schist is correlated with metavolcanics occurring in the Deboyne Group; both units are thought to be Mesozoic, possibly Cretaceous, rocks, which underwent metamorphism in the lower Tertiary. A reefal limestone of lower Miocene age crops out at the western end of the Calvados Chain. The Pana rora Volcanics of probable Pliocene to Pleistocene age crop out on a number of islands near the western end of the Calvados Chain. Raised coral reefs are common throughout the archipelago.

Ultrabasic pre-metamorphic intrusives occur on Rossel Island and basic pre-metamorphic intrusives occur on Rossel Island, Sudest Island and in the Calvados Chain. Post metamorphic basic and intermediate intrusives occur throughout the archipelago and minor acid intrusives occur at the western end of Sudest Island and the eastern end of Pana Tinani Island in the Calvados Chain.

Misima Island is thought to be separated from the remainder of the archipelgo by a major fault zone. A secondary fault zone may separate Rossel and Sudest Islands.

The islands are generally steep. On Sudest Island a platform of low relief surrounding the central dividing range is thought to have been formed by wave er .on and indicates subsequent uplifts of the order of one hundred meters.

The most favourable economic prospect in the archipelgo is alluvial gold on Sudest Island. The Sudest gold field was the scene of intense activity between 1888 and 1896 but the miners left the field before its potential was fully realised and since then activity has been sporadic. Geochemical sampling for copper, zinc, lead, cobalt and silver produced no significant anomalies. Chromite occurs in alluvium on Sudest by its source is unknown. Minor pyrite and traces of native copper occur elsewhere in the archipelago.

INTRODUCTION

The Louisiade Archipelago extends southeastward from the Eastern Papuan mainland to longitude 154°25' east. It is an area of numerous islands, islets and extensive coral reefs totalling approximately 2,400 sq. km. The three largest islands are Misima, Sudest and Rossel; smaller islands occur in the Calvados Chain, Renard Islands, Deboyne Group, Torlesse Group and Conflict Group (Fig. 1). The archipelago is administered from the subdistrict headquarters at Bwagaoia on Misima Island which is served by regular fortnightly flights from Port Moresby.

During March and April 1969, a Bureau of Mineral Resources field party mapped the geology of the archipelago, excluding Misima Island which had been mapped by the Bureau of Mineral Resources in 1959 (de Keyser 1961). The party consisted of I.E. Smith (party leader) and P.E. Pieters (Port Moresby Resident Staff). M.V. Explorer, a sixty two foot Fairmile launch owned by Exploration Enterprises of Port Moresby, was chartered for the duration of the survey and served as a mobile base. This report presents the results of the survey. The authors are indebted to Mr C.J. Simpson, photogeologist, for his photo-interpretation of the geology of Rossel and Sudest Islands and for his assistance in constructing a photo-scale base map of Rossel Island.

The discovery of the Louisiade Archipelago is credited to Louis Vaez de Torres in 1606. The islands were subsequently visited by the explorers Bougainville, D'Entrecasteaux, Hayes and D'Urville. The first detailed survey of the archipelago was undertaken in 1849 by Captain Owen Stanley who was largely responsible for the nautical charts of the Louisiade Archipelago in use at the present time. A number of vessels visited the islands during the middle part of the 19th century but in general there was little contact with native people until well into the 1870's at which time there was apparently an expansion of the pearling and beche-de-mer industries into the area (C. Freeman pers. comm.). During the 1880's a number of vessels visited the area seeking labour for the Queensland sugar plantations.

Relations between visiting vessels and native peoples were not always smooth. Natives on Panaete Island are held responsible for the murder of a trader in 1885 and at least two groups of Europeans were murdered by natives from Utian Island in the Calvados Chain. The most extraordinary incident occurred on Rossel Island where the natives murdered and consumed over three hundred Chinese who were shipwrecked on the Island on their way to the Victorian gold fields.

In 1888 gold was discovered on Sudest Island and for nearly a decade miners were working in the western half of the Island; nearly all of these miners had left Sudest Island for other gold fields by 1896 and since then mining activity has been sporadic. At the present time the islands lead an unhurried existence. At fortnightly intervals small copra boats ply between Samarai and the islands of the archipelago but apart from these, activity is confined to small trading vessels and mission boats.

GEOLOGY

The first geological observations in the Louisiade Archipelago were made by Macgillivray in 1849 (Macgillivray 1852), followed by Gibb Maitland in 1891 (Gibb Maitland 1892). More recently Davies has given an account of his geological observations on Misima Island (Davies 1958) and in the Louisiade Archipelago (Davies 1959); the geology of Misima Island has been described in some detail by de Keyser (1961).

Much of the geological data from Sudest Island presented in this report is drawn from an unpublished account of the geology by D.J. French (1966) who spent three months engaged in geological mapping and geochemical sampling on the island.

The dominant rock types in the archipelago are low-grade metamorphics; they have been intruded by basic, intermediate and minor acid, dykes and stocks. Volcanics crop out on a number of islands near the western end of the archipelago and limestones, mainly raised coral reef, are common throughout the archipelago.

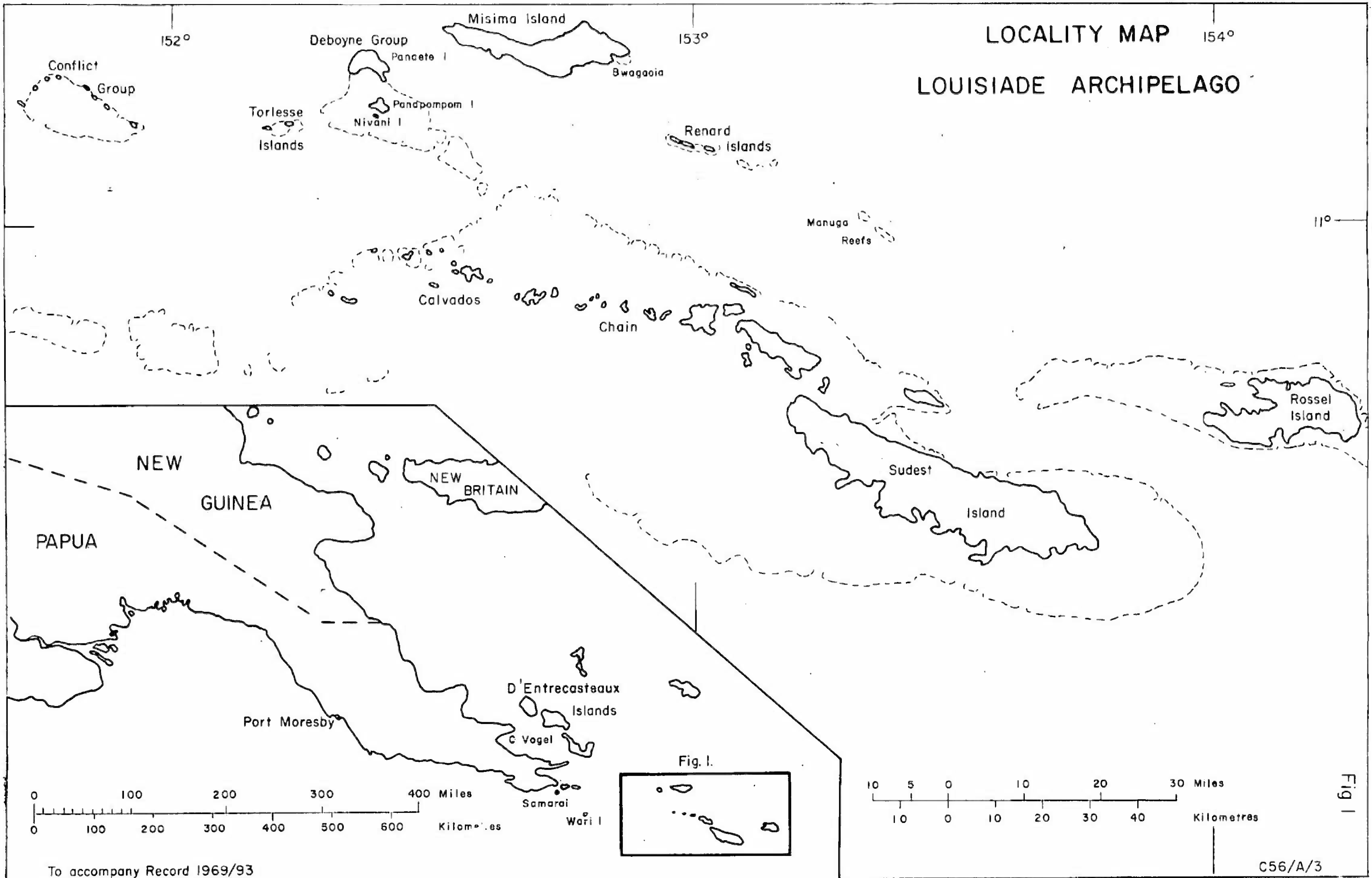
STRATIGRAPHY

MESOZOIC

Calvados Schist

The name Calvados Schist was first used by Davies (1959) to describe the low-grade metamorphics in the Calvados Chain, on Sudest Island, and on eastern Misima Island. The name was not subsequently used by de Keyser (1961) in his account of the geology of Misima Island. In this report the name Calvados Schist is used for low-grade metamorphic rocks occurring on Rossel Island, Sudest Island, the Renard Islands, and in the Calvados Chain, west to Moturina Island; it is by far the dominant lithological unit in the archipelago.

The Calvados Schist crops out over more than sixty percent of Rossel Island, ninety percent of Sudest Island and the Calvados Chain, and the whole of the Renard Islands. It consists of a well bedded series of pelitic siltstones, sandstones and minor conglomerate which have


LOCALITY MAP
LOUISIADE ARCHIPELAGO
152°
153°
154°
11°
Conflict Group
Torlesse Islands
Deboyne Group
Panaete I
Pandpompom I
Nivani I
Misima Island
Bwagaoia
Renard Islands
Manuga Reefs
Calvados Chain
Sudest Island
Rossel Island
NEW GUINEA
PAPUA
NEW BRITAIN
D'Entrecasteaux Islands
C Vogel
Port Moresby
Samarai
Wari I
0 100 200 300 400 Miles
0 100 200 300 400 500 600
Fig. I.
10 5 0 10 20 30 Miles
10 0 10 20 30 40 Kilometres
Fig 1
To accompany Record 1969/93
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been subjected to low grade regional metamorphism. The maximum observed metamorphic grade is lowermost greenschist facies (the quartz-albite-muscovite-chlorite subfacies of Turner and Verhoogen (1960)). The series is gently to moderately folded on a regional scale with measured dips ranging from 10° to 50°. Locally tight isoclinal and recumbent folds of the order of 0.5 to 2 metres in amplitude have been observed. Primary sedimentary structures such as graded bedding and intraformational micro-slumping are preserved at some localities but in others they are obscured by one or more metamorphic foliations.

In outcrop the schists generally have a poorly to well developed slaty cleavage or schistosity parallel to the original bedding. Where the bedding was on a fine scale the rocks have a banded appearance. A second and in some outcrops a third metamorphic lineation may be superimposed on the primary metamorphic texture giving rise to spectacular microfolding (Plaes 1a and b).

In thin section the texture varies from fine-grained clastic, with little sign of metamorphism, to strongly schistose in which the platy minerals are concentrated in subparallel planes. The banding and folding observed in outcrop are commonly visible on a microscopic scale.

The most common mineral assemblage is quartz, albite, sericite (muscovite) and chlorite, with minor epidote, zosite, sphene, prehnite and varying amounts of opaques. Small detrital grains of plagioclase, pyroxene and hornblende are a very minor constituent of some specimens. Quartz, albite, epidote and zosite may occur as porphyroblasts up to 6mm across.

The schists have been extensively veined by quartz in central and western Sudest Island; elsewhere they are veined by calcite, albite, prehnite and epidote.

Davies (1959) records schistose conglomerate occurring with mica schist in the Renard Islands. The conglomerate is composed of, probably volcanic, porphyritic boulders up to 5 centimetres in diameter in a schistose matrix.

The structure of the Calvados Schist is illustrated in the sections in Figure 3. On Rossel Island it apparently forms the core of an anticlinal structure flanked on either side by pre- or early tectonic foliated metagabbro and metavolcanics. Elsewhere in the archipelago it is gently to moderately folded about axes that strike approximately east west.

In Figure 2 all the metamorphic lineations measured at outcrops of the Calbados Schist are diagrammatically represented. In the lower part of the diagram the poles of the metamorphic planes are plotted; in the upper part, their corresponding strikes are plotted on a rose diagram as a percentage of the total.

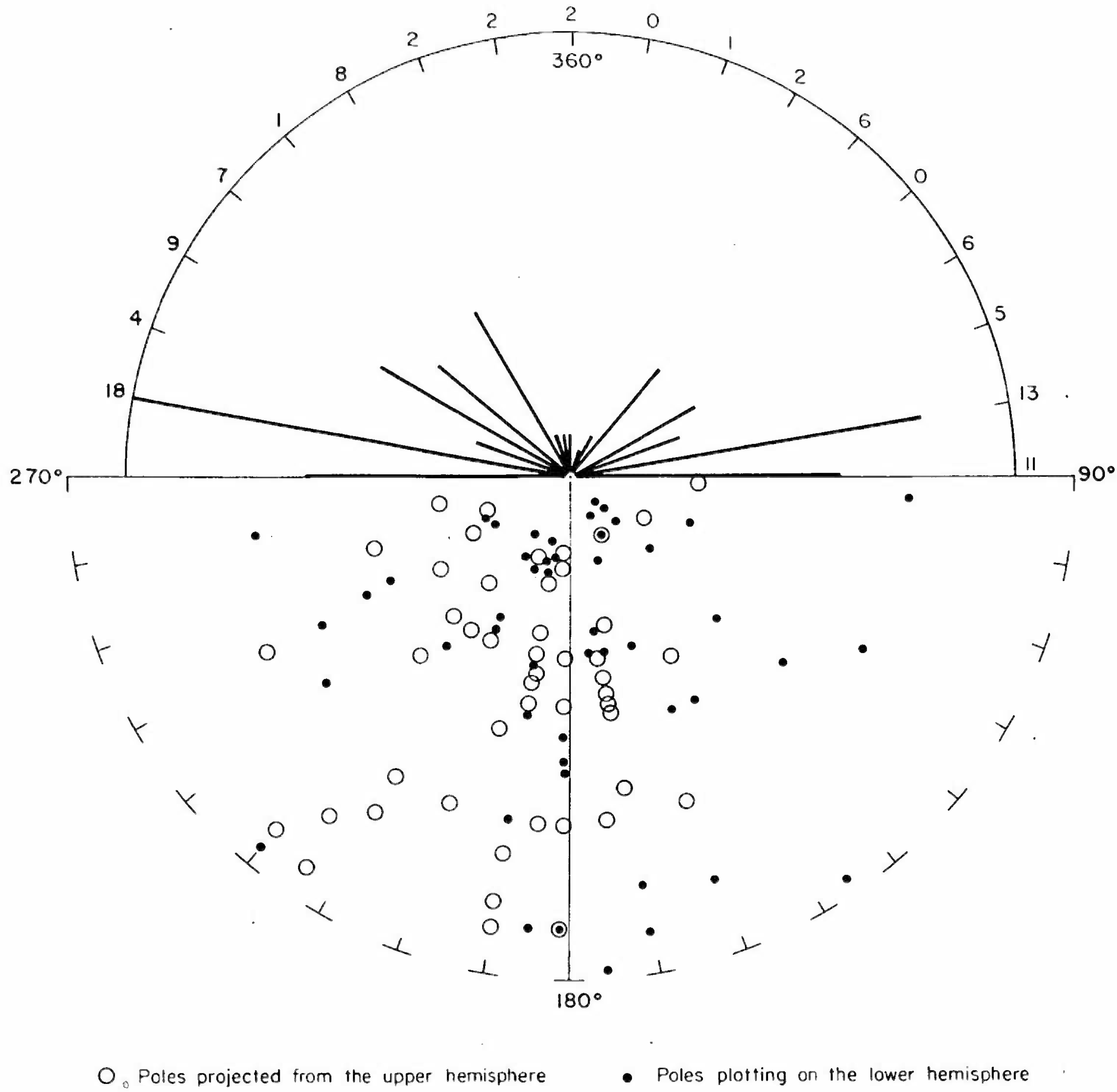


Fig. 2 — Diagramatic representation of structural planes measured in the Calvados Schist.

In the lower half of the diagram the poles of all the bedding and metamorphic planes are plotted on a sterio-graphic projection.

In the upper half of the diagram the corresponding strikes are represented as a percentage of the total.

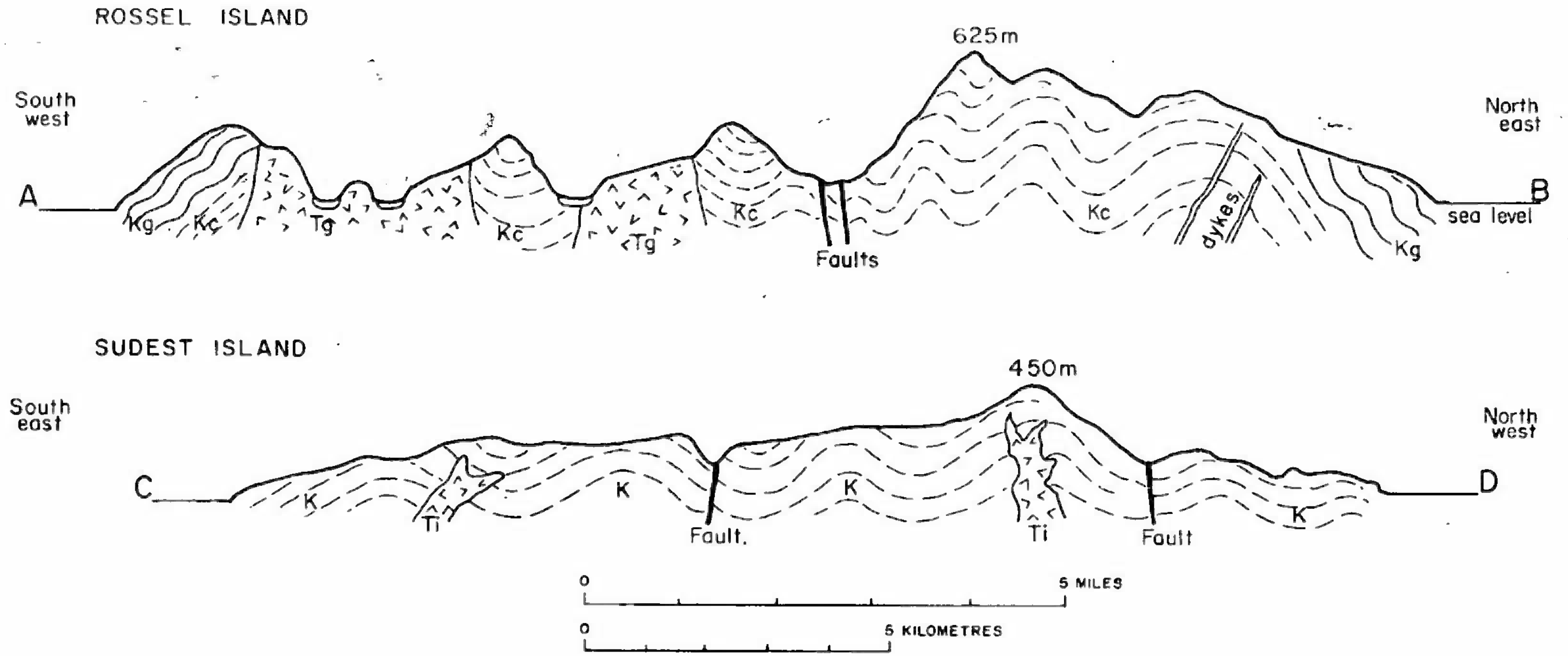
Plate 1a: Calvados Schist; the primary schistosity dips gently toward the left of the photograph. A second nearly horizontal metamorphic foliation is superimposed on the schistosity. (Rossel Island).

Plate 1b: Calvados Schist; kink folding caused by deformation of the schistosity (dipping right) by a secondary metamorphic foliation (dipping left). (Wanim Island).

Fig. 3

GEOLOGICAL SECTIONS

(For discription of symbols see figure 6.)



To accompany Record 1969/93

Vertical exaggeration x 4

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Principal trends striking between 255° and 355° are indicated.

The regional structure of the unit is discussed on page 10.

No evidence is available as to the age of the Calvados Schist. On the eastern Papuan mainland the Owen Stanley metamorphics are thought to be probably Mesozoic and the Goropu Metamorphics are Upper Cretaceous (Davies et al., 1968). It is reasonable to assume that the episodes of sedimentation and metamorphism on the mainland coincided with similar episodes in the Louisiade Archipelago. The Calvados Schist is here assigned a Mesozoic, possibly Cretaceous, age with metamorphism probably having taken place in the lower Tertiary.

Deboyne Metavolcanics (new name)

The Deboyne metavolcanics crop out on Panapompom Island and probably also on Panaete Island (Gibb Maitland, 1892), in the Deboyne Group. They consist of metamorphosed basic volcanics and interbedded fine grained deep water sediments; they have been intruded by basic and intermediate dykes.

The metavolcanics are uniformly dark grey to black, medium fine grained and commonly well jointed. Metamorphism has produced a retrogressive assemblage of brown-green hornblende, albite, epidote, calcite and a fine grained unresolvable secondary material. Relic augite is present is some specimens. The textures are only slightly schistose and this is not apparent in hand specimen.

The interbedded sediments consist of fine grained sandstone and siltstone composed of albite with minor plagioclase and detrital augite. Davies (1959) records a creamy fine grained chert containing dark siliceous lenses from Panapompom Island. The sediments were probably laid down in a deep water environment.

The Deboyne Metavolcanics may represent a local volcanic episode in the Mesozoic sedimentary trough in which the Calvados Schist was deposited. They are tentatively assigned a Mesozoic age.

MIOCENE

Panasia Limestone (new name)

The Panasia Limestone forms Panasia, Pana vara vara and Nasakoli Islands at the western end of the Calvados Chain. It consists of medium to fine grained, creamy yellow limestone composed of calcareous microfaunal remains in a matrix of fine grained calcite. In outcrop the limestone has a well developed vertical fluting.

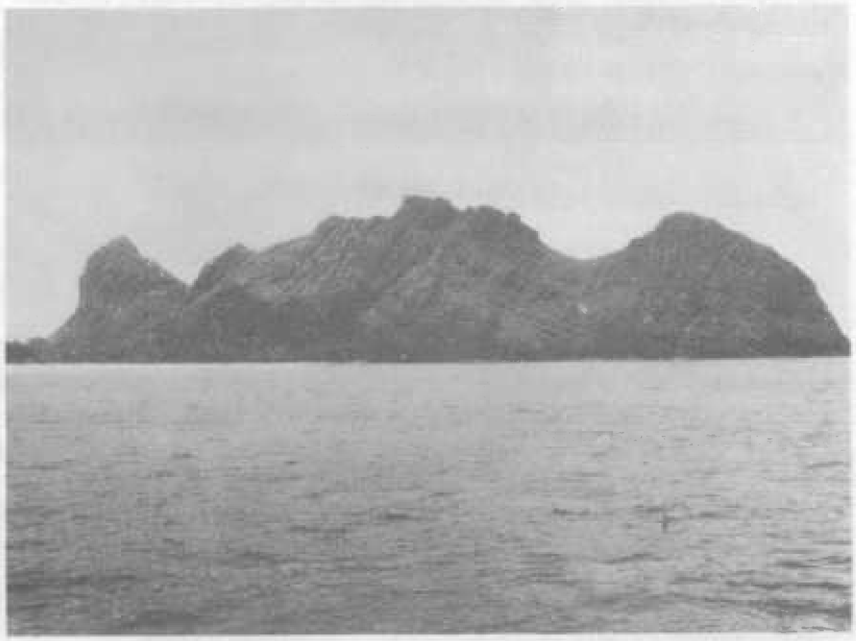

Plate 2a: Panarora Volcanics; volcanic agglomerate dipping 30° south east. (Panarora Island).

Plate 2b: Panarora Volcanics; poorly sorted, coarse volcanic agglomerate. (Panarora Island).

The limestone has been determined as Lower Miocene 'e' stage, probably upper 'e' stage (D.J. Belford, pers. comm.). It was deposited in a shallow water reefal environment. The Panasia Limestone represents one of a number of reefs which grew in the Eastern Papuan area during the Lower Miocene. Other examples are known from Cape Vogel.

PLIOCENE TO PLEISTOCENE

Pana rora Volcanics (new name)

Volcanic rocks occur on Pana rora, Utian, Pana udu udi, Gulewa, Tobaium, Venariwa, Ululina, Moturina and Panaroba Islands, near the western end of the Calvados Chain. Lavas and consolidated ash are recorded from Utian Island (Gibb Maitland 1892), but elsewhere the volcanics consist almost entirely of bedded volcanic agglomerate and minor tuff. The volcanics are named from Pana rora Island where over two hundred metres of bedded, coarse, unsorted, agglomerate dips 45° to the south (Plates 2a and b). On Moturina Island a sheet of agglomerate dipping 40° to 50° south-eastward, overlies schists and intermediate intrusives. On Venuriwa Island, massive, medium coarse, moderately well sorted volcanogenic conglomerate occurs as beds one to ten metres thick, dipping 25° south (Plate 3a).

On Pana rora Island the agglomerate contains a variety of pyroxene and hornblende bearing andesites. Specimens representative of the main types within the agglomerate are -

1. Vesicular pyroxene andesite

Specimen 3689B is a porphyritic rock with dark pyroxene phenocrysts and vesicles in a deep red fine-grained groundmass. It consists of euhedral augite, andesine (An_{40}) with minor hypersthene and magnetite in a fine-grained red groundmass containing microlites of augite and plagioclase. Rare pseudomorphs of fine-grained secondary material may represent olivine crystals.

2. Pyroxene andesite

Specimens 3689A and E are medium to dark grey, dense, fine grained rocks with small dark mafic crystals. They consist of andesine (An_{40}) and augite, with minor hypersthene and magnetite in a fine-grained plagioclase groundmass. Texture is slightly porphyritic and the plagioclase phenocrysts are oriented to form a weakly developed flow texture. Pseudomorphs of iddingsite after olivine and light brown hornblende crystals surrounded by an opaque reaction rim are rare constituents.

Plate 3a: Panarora Volcanics; bedded volcanic agglomerate. (Venariwa Island).

Plate 3b: Cataract tract where Billabong Creek enters the Feiori Estuary south east of Griffin Point, Sudest Island. The height of the cataract is approximately 12 metres.

3. Hornblende andesite

Specimens 3689C and D are medium grey with a patchy purple hue, they are generally lighter in colour than the pyroxene andesites. They are porphyritic with conspicuous dark mafic phenocrysts in a lighter groundmass. Euhedral brown hornblende and augite occur as phenocrysts in a fine grained groundmass of sodic labradorite (An_{54}), minor hypersthene, and brown biotite, in addition to augite, hornblende and magnetite. In one specimen (3689D) the groundmass contained minor glass.

Specimens from the volcanogenic conglomerate on Venuriwa Island and the agglomerate on Moturina Island are fine grained and have an altered appearance. In thin section they are either porphyritic or fine and even grained and consist of augite, plagioclase, magnetite and green interstitial mesostasis. Some specimens contain iddingsite after olivine. In the porphyritic varieties the phenocrysts are augite set in a fine-grained groundmass.

These rocks are basaltic rather than andesitic in character. They appear to be older than the fresh agglomerate on Pana rora Island; they probably represent an early phase of volcanic activity in the area.

The Pana rora volcanics are unrelated to any other rock unit in the Louisiade Archipelago; they may be correlative with volcanic rocks reported from Wari Island approximately one hundred and sixty kilometres to the west (Fig. 1), (Gibb Maitland, 1892). No age data are available at present but on the basis of the fresh unweathered appearance of the agglomerate on Pana rora Island the Pana rora volcanics are thought to be Pliocene to Pleistocene.

PLEISTOCENE TO RECENT

Raised Coral Reefs

Raised coral limestone is common in the Louisiade Archipelago. The islands of the Conflict Group and the Torlesse Islands are entirely composed of reefal limestone; coral limestone forms an extensive platform up to three metres in height on Pannaete Island in the Deboyne Group and small coral islets occur along Tawa Tawa Mal reef north of the Calvados Chain (Fig. 8); the most substantial of these is Sabari Island which rises to a maximum of 55 metres above sea level. A small area of raised coral limestone occurs on the north coast of Sudest Island immediately to the west of Rabuso Harbour but none is known from Rossel Island. On Misima Island coral reefs have been raised to a spectacular 460 metres above sea level (de Keyser, 1961); no similar phenomenon has been observed elsewhere in the archipelago.

Alluvium

Because of the steep hilly nature of the islands in the archipelago there are no extensive areas of alluvium and the only deposits are in the lower reaches of the rivers and to some extent along the coasts of the larger islands.

PRE-METAMORPHIC INTRUSIVES

Ultramafic (pyroxenite and serpentinite) and basic (metagabbro and basalt) rocks, which are thought to have intruded the Calvados Schist prior to metamorphism crop out on Rossel Island and to a lesser extent on Sudest Island and probably in the Calvados Chain.

Ultramafic

Pyroxenite and serpentinite form a sheet approximately 150 metres thick, which conformably overlies low-grade schists at the south-western tip of Rossel Island. The joint planes in the ultramafics are subparallel to the bedding and schistosity planes in the schists. The ultramafics are intruded by minor basalt and diorite near West Point.

The pyroxenite is medium to coarse grained, crystalline and grey green when fresh, tending toward medium green grey with dark mafics in a light matrix when altered. Serpentinite is typically dark green to dark grey and fine grained; it commonly has a greasy lustre.

The pyroxenite consists of anhedral augite crystals up to three millimetres across, with interstitial fibrous, secondary, tremolite and some fine-grained secondary vein material. The augite commonly shows strain effects such as bent cleavage planes and development of strain twinning; it is altered to a varying degree. In highly altered specimens only minor augite remains in a contorted matrix of tremolite with fine grained secondary material, including albite and vein serpentine. Shearing is common.

The serpentinite consists of medium to fine grained fibrous serpentine and irregular grains and lenses of chromite. The chromite is commonly aligned in sub-parallel planes representing cleavage planes in the primary crystals.

The ultramafics may be a small thrust sheet of ultramafic oceanic crust analogous to the Papuan ultramafic thrust sheet on the mainland (Davies 1968), but the small size of the sheet and its apparent conformity with the schists would make this seem unlikely. The authors favour the view that the sheet is an ultramafic sill intruded into the schists, probably prior to metamorphism.

No other occurrences of ultramafics are known in the islands but the occurrence of chromite in sluice box tailings in the Griffin Point area suggest that minor ultramafics may crop out on Sudest Island.

Basic

Foliated metagabbro and metabasalt crop out over approximately twenty percent of Rossel Island. They form a discontinuous strip along the northern, western and southern coasts of the island; metagabbro and metabasalt also occur locally on Sudest Island and may occur locally in the Calvados Chain. The rocks are weakly to moderately foliated and are thought to have been intruded into the sedimentary sequence (Calvados Schist) prior to, or at an early stage in metamorphism.

Hand specimens are medium grey green, medium to fine grained and usually have a foliated texture. Augite, plagioclase and opaques are the primary minerals but they are invariably substantially or completely altered to sericite, brown green hornblende, tremolite-actinolite chlorite, albite and fine grained unresolvable alteration products. Epidote prehnite and calcite are common secondary and vein minerals. Quartz occurs in variable minor quantities and is probably mainly secondary.

POST METAMORPHIC INTRUSIVES

Basic

Gabbro and dolerite intrusives occur quite extensively on Rossel Island, to a lesser extent on Sudest Island and on Panapompom and Nivani Islands in the Deboyne Group. They form dykes and small stocks which intruded the Calvados Schist during the final stages and after the completion of metamorphism. French (1966), has distinguished a syntectonic gabbro and post tectonic gabbro and dolerite, cropping out on Sudest Island.

The basic intrusives are medium fine to medium coarse grained, medium to dark grey with a granular texture. They consist of augite, plagioclase and opaques. The augite is generally partly to completely altered to brown hornblende and the plagioclase is mostly extensively altered to sericite and fine grained alteration products. Secondary albite and fine grained interstitial mesostasis are common. In one less altered specimen (3643B), the texture is subophitic in part and the original plagioclase is tentatively determined as calcic andesine.

In the Deboyne Islands alteration of the basic intrusives is less severe. Augite is marginally altered to green-brown hornblende and is subophitically intergrown with sodic labradorite. Albite, epidote and prehnite occur in veins and in the body of the rock.

Intermediate Intrusives

Intermediate intrusives occur throughout the islands. On Rossel Island hornblende diorite intrudes ultramafics near West Point; French (1966) records diorite forming small bodies on Sudest Island; microdiorite, porphyritic microdiorite and andesite occur as dykes intruding schists in the Calvados Chain, especially on Moturina Island and an andesite dyke intrudes metavolcanics and gabbro on Panapompom Island in the Deboyne Group.

1. Diorite

The diorite is medium grained, medium grey, granular and generally contains conspicuous dark mafic crystals. It is composed of slightly pleochroic, light green to brown hornblende, plagioclase (oliogoclase to andesine) and minor opaques. Epidote and albite are common vein minerals.

2. Microdiorite

Microdiorite occurs as dykes on Panapompom Island and Moturina Island, and probably elsewhere in the Calvados Chain. It is generally medium fine grained with dark mafic crystals in a medium to dark grey matrix.

Plagioclase (andesine to labradorite) is accompanied by pale green brown slightly pleochroic hornblende and minor opaques. Minor brown biotite and augite occur in some specimens and orthoclase is usually present. Chlorite, calcite and fine grained secondary material are common in some altered specimens. Textures are fine grained and may be slightly porphyritic.

3. Porphyritic Microdiorite

Porphyritic microdiorite has been observed as dykes intruding the schists on Pana Tinani Island and Moturina Island; it probably also occurs elsewhere in the Calvados Chain. The rocks are porphyritic with dark mafic crystals in a fine grained medium to dark grey matrix.

In thin section the texture is strongly porphyritic with euhedral phenocrysts of pale, brown green, slightly pleochroic hornblende and less commonly euhedral pseudomorphs of sericite after feldspar. The groundmass consists of hornblende and plagioclase with secondary fine grained alteration products and calcite. Small augite phenocrysts are a minor constituent in a specimen from Pana Tinani Island.

4. Andesite

A dyke of strongly porphyritic andesite intrudes schists on Moturina Island. It consists of phenocrysts of zoned, euhedral andesine up to 3mm across, with smaller pale green hornblende and brown biotite phenocrysts (1-1.5mm across) in a fine grained groundmass of feldspar and mafics.

The intermediate intrusives described above are thought to be younger than the basic intrusives described earlier. The andesite dyke intruding the schists on Motorina Island may be related to the Pana rora volcanics.

Acid Intrusives

Minor granite(?) occurs at the western end of Sudest Island and may occur at the eastern end of Pana Tinani Island (Dr W. Manser, pers. comm.); it was not reported by French (1966) and was not observed during the present survey. The presence of granite underlying western Sudest Island may explain the occurrence of gold bearing quartz veins intruding the schists of the island.

STRUCTURE

The major trends in the Louisiade Archipelago are illustrated in Figure 8; in general they are at an angle to the physiographic trend of the archipelago. Faults and folds on the islands have been largely interpreted from aerial photographs. The major faults presented in Figure 8 are largely sepculative, however, the authors believe that the available evidence points toward a major fault between Misima Island and the remainder of the archipelago; the evidence is as follows.

1) Recent uplift of coral reefs to heights of 460 metres above sea level observed on Misima Island (de Keyser 1961), have no parallel anywhere else in the archipelago.

2) The geology of Misima Island includes high grade metamorphics with sialic afinities, which are unknown in the remainder of the archipelago but possibly are correlative with similar rocks in the D'Entrecasteaux Islands (Davies and Ives, 1965).

3) Misima Island is separated from the remainder of the archipelago by a trough up to 1650 metres in depth which may be structurally controlled.

A secondary structural trough may separate Rossel Island and Sudest Island. Evidence is sparse, but there does seem to have been some differential uplift between the islands (see geomorphology below).

On a broader scale the Louisiade Archipelago can be regarded as a series of parallel structural ridges troughs and closed basins representing the eastward extension of the Papua-New Guinea mainland. Krause (1967) from topographic evidence, has suggested the existence of a major fault extending eastwards from Guadalcanal in the Solomon Islands and passing to the north of Pocklington Reef (lat. $10^{o}50'$; long. $155^{o}45'$) and the Louisiade Archipelago to join major north-east trending structures in Eastern Papua; he has named this fault the Pocklington Fault.

The proposed fault which separates Misima Island from the remainder of the archipelgo is probably either a major off-shoot or a bifurcation of the Pocklington Fault and the inferred fault separating Rossel Island from Sudest Island is probably a splay fault from the major fault zone. Movement along the Pocklington Fault is thought to be left lateral (Krause op. cit.).

GEOMORPHOLOGY

Rossel Island

Rossel Island is a steep mountainous island surrounded by an extensive barrier reef; flat lying areas are confined to narrow coastal strips and small areas of alluvium in the estuaries of the larger streams. The predominating Calvados Schist forms steep sided ridges rising to 850 meters (Mount Rossel). In contrast the basic intrusives on the island form relatively depressed areas with an intricate drainage pattern.

No unusual geomorphological features were noted on Rossel Island.

Sudest Island

On Sudest Island a central sinusoidal mountain range up to 810 meters high (Mount Riu) is flanked on either side by a gently sloping platform rising inland to a maximum of approximately 120 metres, there is generally an abrupt drop from the platform to the beach. This platform is continuous along the northern and south-eastern coasts of Sudest Island (Fig. 4); it has a low relief and an intricate drainage pattern. Its greatest extent is in the south east where French (1966) named it the Siri Peneplain, on the north coast it is named the Feori Level to the west and the Manbari Level to the east.

There is an abrupt change in slope between the central dividing range and the platform (see profiles in Fig. 4). Streams which in their upper, mountain, tracts are swiftly flowing, change their character on the platform and generally consist of long slowly flowing reaches separated by short rapids or cateract tracts, this is particularly marked along the north coast. The major streams are usually deeply entrenched into the platform. A Cateract or a bar up to twelve metres high commonly occurs where the streams enter the sea at the edge of the platform (see plate 3b).

The origin of the platform poses a problem. Fault control is ruled out because of the sinuous boundary between the mountain range and the platform and field observations show that the feature is not due to lithological differences. One theory which appears to fit the facts is that the platform is the result of marine erosion. No reefal deposits have been observed on the platform. This is difficult to explain unless the platform developed at a uniform rate in an environment unfavourable to reef building organisms or in other words in an environment significantly different from that in the archipelago at the present time. The authors do not wish to postulate dramatic environmental changes in the area during the recent geological past, however prolonged marine erosion followed by gradual emergence does explain the observed character of the platform.

If the platform is in fact wave cut then a relative uplift of the order of 120 metres is indicated. No evidence of a similar uplift has been observed on Rossel Island, in the Calvados Chain or in the Deboyne Group.

Calvados Chain

In the Calvados Chain the Calvados Schist, and in the west the Pana rora Volcanics and the Panasia Limestone form steep hilly islands commonly with precipitous coasts. They also have steep underwater slopes.

At the eastern end of the Calvados Chain, Yenia and Hemenahei Islands are both low lying; they differ from the other islands in the chain in that the constituent schists are deeply weathered.

Deboyne Group

Panapompom and Nivani Islands in the Deboyne Group are steep hilly islands after the style of the Calvados Islands. Pannaete Island has a broad flat area of raised coral reef surrounding a single steep hill of metavolcanics.

In the remainder of the archipelago, raised coral reef forms small islands which are less than 17 metres above sea level with the exception of Sabari Island which rises to 55 metres above sea level.

The geomorphological features observed in the archipelago suggest that there has been some differential movement between the islands and in particular between Sudest Island and Rossel Island.

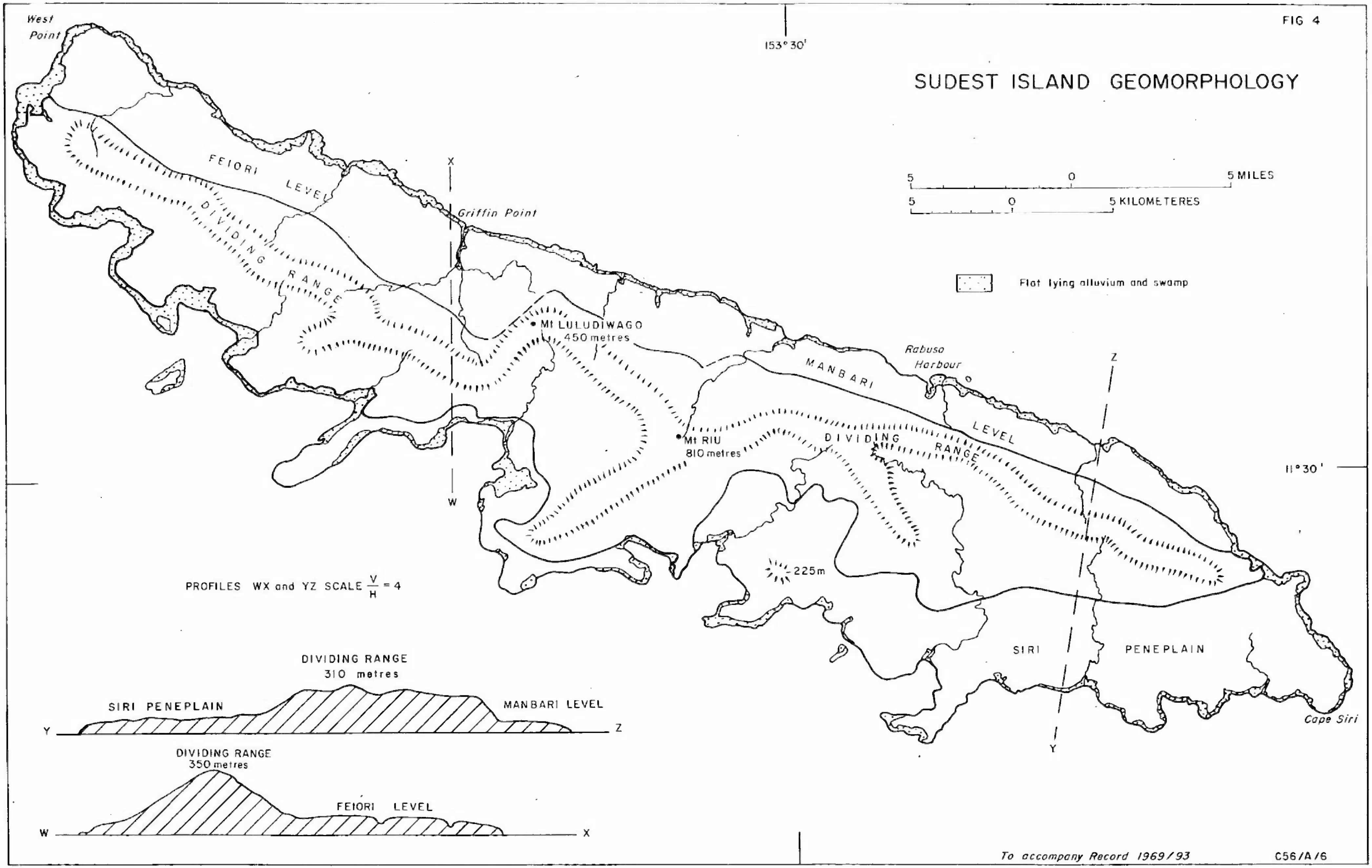
FIG 4
SUDEST ISLAND GEOMORPHOLOGY
153° 30'
11° 30'
5 0 5 MILES
5 0 5 KILOMETERES
Flat lying alluvium and swamp
West Point
Griffin Point
Rabusa Harbour
Cape Siri
FEIORI LEVEL
DIVIDING RANGE
MANBARI LEVEL
SIRI PENEPLAIN
Mt LULUDIWAGO 450 metres
Mt RIU 810 metres
225m
PROFILES WX and YZ SCALE V/H = 4
DIVIDING RANGE 310 metres
SIRI PENEPLAIN
MANBARI LEVEL
DIVIDING RANGE 350 metres
FEIORI LEVEL
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GEOLOGICAL HISTORY

In an area with relatively little outcrop and a consequently discontinuous stratigraphy, any attempt to construct a geological history is to some extent speculative. Geological history in the Louisiade Archipelago commenced with deposition of sediments in a south-east trending trough in the late Mesozoic. Gabbro and basalt, were intruded and interbedded with the sediments during the latter stages in development of the sedimentary trough.

A metamorphic episode during lower Tertiary times converted the sedimentary and igneous pile into low grade schist, metagabbro and metabasalt (Calvados Schist; Deboyne Metavolcanics). This was followed by intrusion of basic and later, intermediate and acid dykes and stocks.

In middle Tertiary times the area was probably one of shallow tropical seas with consequent development of coral reefs (Panasia Limestone). In late Tertiary times, large scale tectonic movements arched up the metamorphics, to form a broad anticline the crest of which now forms Rossel Island, Sudest Island and the Calvados Chain. A localised episode of volcanism in Pliocene through to Quaternary times gave rise to the Pana rora Volcanics. Quaternary faulting caused dislocation of the anticline with consequent small differential vertical movements. To the north uplift along a major north east-trending fault zone produced the spectacular uplifts observed on Misima Island.

ECONOMIC GEOLOGY

Gold

Gold occurs associated with quartz veins on Sudest Island, Yenia Island and possibly on some of the eastern islands of the Calvados Chain. Elsewhere in the Louisiade Archipelago (excluding Misima) quartz veining is relatively scarce and gold is correspondingly rare. Alluvial, eluvial and reef mining have all been undertaken with some success on Sudest Island and the Sudest gold field has by no means been worked out.

Alluvial mining probably offers the best prospects of the present time. Alluvial gold occurs in many of the streams draining the central western mountains of Sudest Island and this is worked on a small scale by local natives. The streams are ungraded and short, and much of the gold bearing alluvium reaches the coast so that alluvial mining of the deposits at river mouths and estuaries of known gold bearing streams could be an economic proposition if undertaken on a sufficiently large scale.

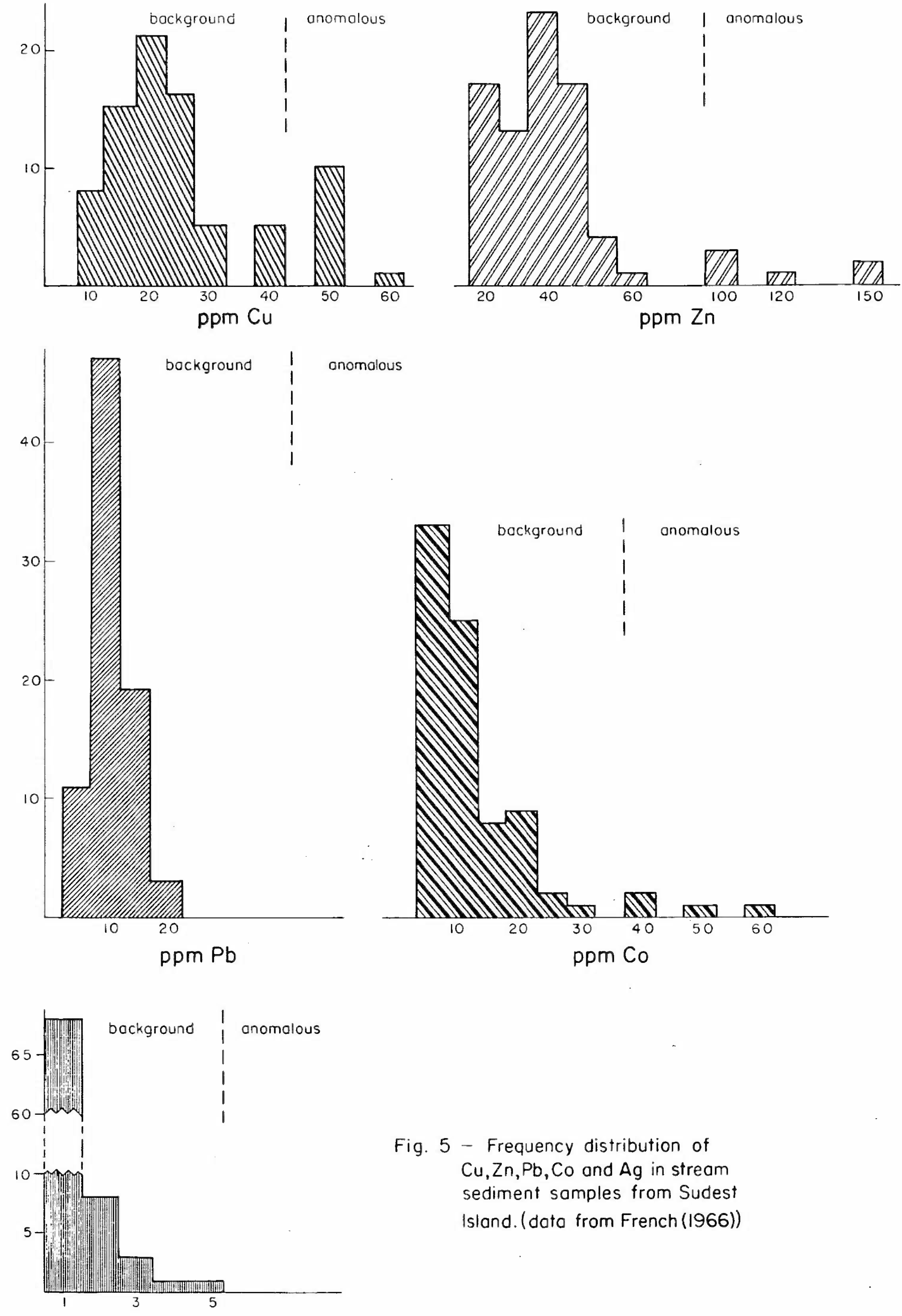

Fig. 5 – Frequency distribution of Cu, Zn, Pb, Co and Ag in stream sediment samples from Sudest Island. (data from French (1966))

The possibilities of reef mining have not been fully investigated on Sudest Island (see Mining History below). The Mount Adelaide mine was closed by gale damage before the full potential of the mine could be determined and it is possible that an exhaustive survey of the island would uncover further gold bearing reefs.

Eluvial gold occurs on the northern watershed of western Sudest Island. It is associated with areas of abundant surface quartz remaining after weathering of the host schist.

Total production from the Sudest Gold field has been estimated at 10,000 ounces (Davies 1959), the actual figure is probably higher than this.

Other Metals

Minor pyrite and rare manganese are associated with gold bearing quartz veins on Sudest Island. The pyrite is usually altered to limonite. Chromite occurs with gold in sluice box tailings from Four Mile Creek; no ultrabasic bodies are known on Sudest Island and the source of the chromite is unknown.

In connection with his geological mapping programme D.J. French (1966) collected stream sediment samples from most of the major streams on Sudest Island. Eighty two samples were collected with an average sample density of oneevery four square miles. The samples were spectrographically analysed by A.M.D.L. for copper, zinc, lead, cobalt, and silver, the results are shown in Figure 5.

Anomalous values occur for all of these metals but none are significantly greater than the background values. Most of the anomalies are concentrated in a small elliptical area centring on Mount Riu. French (1966) is of the opinion that the anomalies are unrelated to the occurrence of gold on Sudest Island and are probably associated with minor basic intrusives.

Small grains of native copper were observed on joint surfaces in metavolcanics on Panapompom Island and minor pyrite is associated with intermediate intrusives on Moturina Island. Neither of these occurrences is significant.

Mining History

News of the discovery of gold on Sudest Island first reached Port Moresby late in 1888. By October of that year there were two hundred miners in the Griffin Point area and within a year there were four hundred (Ann. Rept 1888-9). Only thirty eight men were engaged in mining on the Sudest field by 1890 and by 1896 alluvial mining had practically ceased.

The first auriferous reef was discovered at the western end of the island and was known as the Caledonian Reef; it was worked on a small scale by Messrs McLean and Samuelson. The Caledonian claim was abandoned in 1893 but toward the end of that year a Mr McCord discovered the Mount Adelaide Lode, on the main divide, southwest of Griffin Point. By 1897, four miles of waggon road had been constructed from Hula on the south coast to the Mount Adelaide claim. A ten stamp battery operated by the British New Guinea Gold Pty Ltd under the management of a Mr Hancock started crushing ore in September 1897. The mine was closed down in April 1899 as a result of gale damage having yielded a large quantity of auriferous quartz for unknown returns (Davies 1959).

Local natives continued alluvial mining on a small scale and in the 1930's there were also several Europeans working on the field. The finding of the Cornucopia leases on the northern slopes of the main dividing range in 1937, aroused some interest but values were too erratic and the leases were abandoned in 1938 (Davies 1958).

In 1941 Messrs Pierce and Craig made an attempt at working eluvial gold in the area behind Griffin Point. They were interrupted by the war but Pierce returned again after the war and worked the field for a number of years. At the present time mining is confined to the activities of a few local natives.

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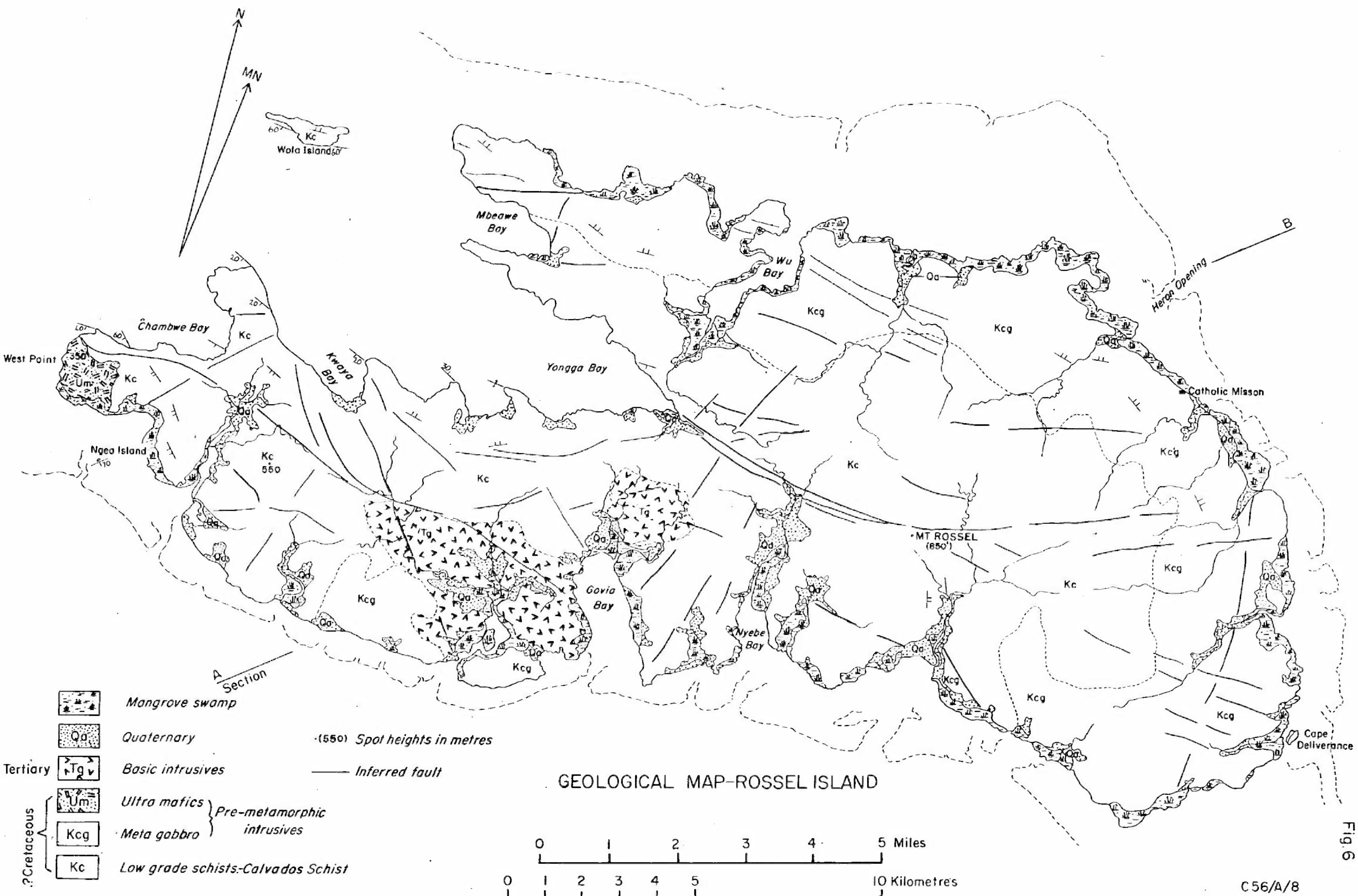

GEOLOGICAL MAP-ROSSEL ISLAND

Fig. 6

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To accompany Record 1969/93

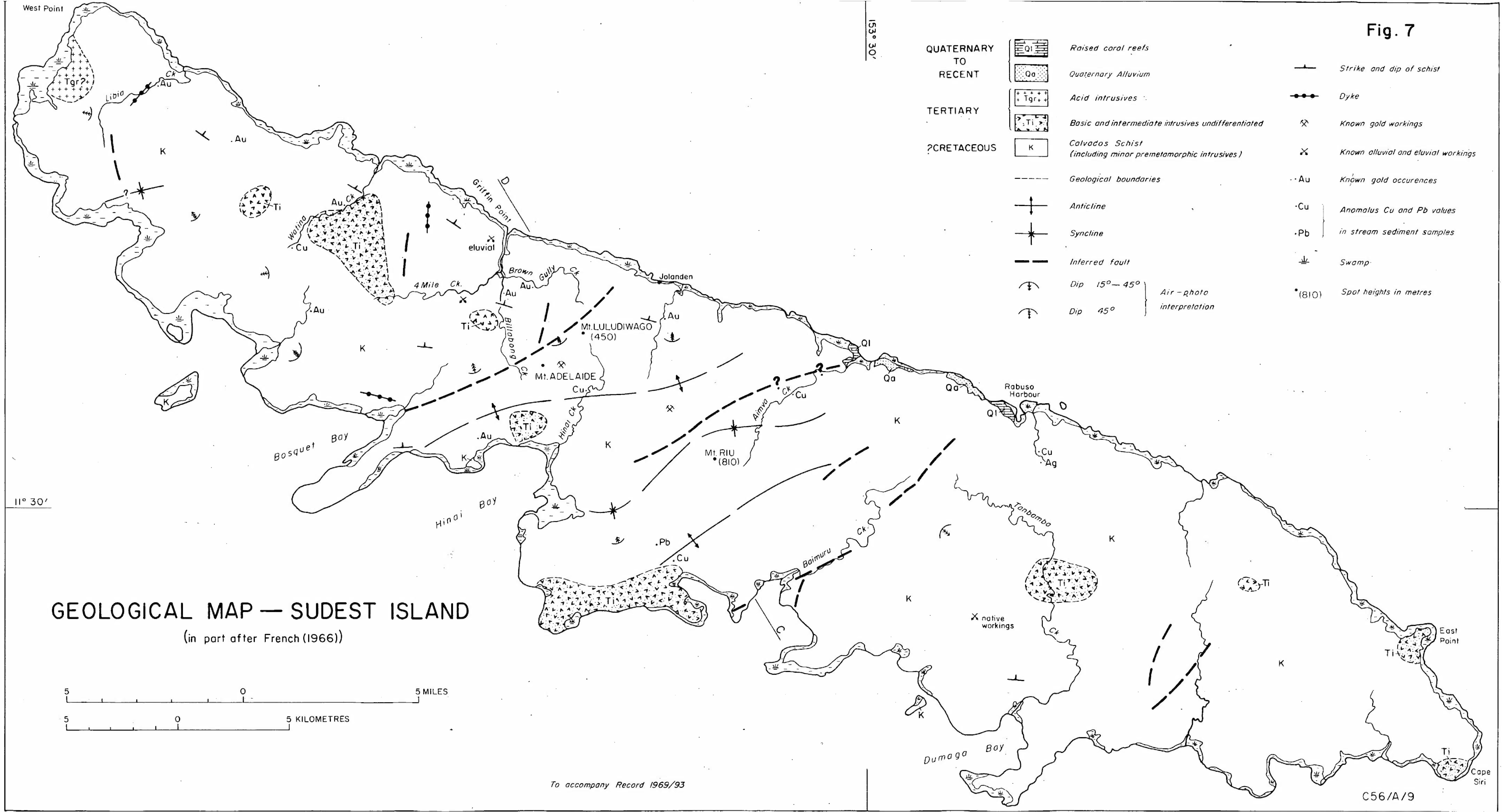

Fig. 7

GEOLOGICAL MAP — SUDEST ISLAND

(in part after French (1966))

Fig. 8

LOUISIADE ARCHIPELAGO — GEOLOGY AND STRUCTURE

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