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NORMANBY ISLAND, T.P.N.G. - RECONNAISSANCE GEOLOGY.

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CONTENTS

SUMMARY

Normanby Island (750 square miles) lies off the eastern tip of the Papuan mainland; it is made up of fault-bounded blocks of metamorphic, ultramafic, and granitic rocks, locally overlain by Miocene? sediments and Quaternary volcanics, raised coral, and alluvium.

The two main groups of metamorphics are

(a) the Prevost Metasediments, layered gneiss and schist equivalent to the metamorphics of Fergusson and Goodenough Islands, and

(b) the Kurada Metavolcanics, chloritic basic schists derived from dolerite and basalt, possibly equivalent to the Cretaceous? metabasalts of the eastern Papuan mainland. A third group of metamorphics, the chlorite-biotite basic schist, is probably a local variant of one of the two main groups.

The ultramafic rocks are similar to those of the Papuan Ultramafic Belt and are predominantly dunite, enstatite olivinite and pyroxenite, with minor gabbro and norite. The two granites in the north-western part of the island are probably related to the granodiorites of Fergusson and Goodenough Islands.

The younger rocks include Miocene? grit, limestone, and agglomerate, and Quaternary (may include some Pliocene) volcanics of intermediate and acid composition. Two small hot springs are active at Bwasiaiai on the south-western tip of the island.

Fault trends are north-west, east, and north-north-east, and the metasediments are folded on a north-north-easterly axis. The Bwebweso ultramafic body may have been thrust south-eastward over the Kurada Metavolcanics.

A small amount of gold and reportedly platinum has been won from gravels in central and north-eastern Normanby.

INTRODUCTION

On 4th March, 1967, J.S. Milsom of the Bureau of Mineral Resources commenced a ten-week helicopter gravity survey of eastern Papua and particularly the islands of the Milne Bay District. The writer accompanied Mr Milsom for the first two weeks of the survey; he was able to make scattered geological observations around Milne Bay, collect specimens for isotopic age determination from Goodenough and Fergusson Islands, and carry out a geological reconnaissance of Normanby Island. This report discusses Normanby Island field data only; a more comprehensive report will be written when rock specimens have been examined in more detail.

The mapping of Normanby occupied four days and included use of the helicopter for about eight hours. An outline of the geology of the island was obtained but a further two to four weeks of ground traverses will be necessary before a reliable geological map can be produced. The main questions posed by the present survey are: the origin of layering in the metasediments; the relationships between the three groups of metamorphics; the possible overthrusting of the ultramafics; the age of the granites and their relationship to the Miocene? sediments; and the nature of the Quaternary volcanics.

The writer thanks Mr Milsom and Captain Bruce Evans, helicopter pilot with Crowley Airways, for their good-humoured co-operation which made the survey possible and enjoyable. He thanks particularly Mr and Mrs Hendrik Bruyn of Esa-ala, and Fr Jim Moore of Kurada for their hospitality, the Acting Assistant District Commissioner Mr Ron Gibbs for his help and advice, and Mr Merv. Preece for the use of his launch and an exciting race against time and bad weather from Esa-ala to the airstrip at Vivigani.

PHYSIOGRAPHY, POPULATION AND ACCESS

The island covers about 750 square miles; it is made up of two arms, one trending north-westerly and the other north-north-easterly; these join to enclose Sewataitai Bay. The north-westerly arm is about 35 miles long and averages about five miles across; the watershed has peaks up to 3000 feet high and saddles as low as 400 feet above sea level. The north-north-easterly arm is 18 miles long and nine miles across and is made up of a series of parallel strike ridges separated by long straight streams; the ridges are generally 2500 to 3500 feet high.

Vegetation is mostly rain forest, grass, and secondary growth. Some of the rocky volcanic hills are covered by open eucalypt forest and grassland, and the ultramafic areas are covered by low scrub and bare red clay.

Rainfall is probably spread throughout the year (Davies & Ives, 1961, p. 4) except on the south and south-east coast where heaviest falls are in the south-east season, May to October. Fr Moore at Kurada on the south coast recorded 300 inches of rain in one year; for most places the annual average is probably 100-150 inches.

The island is administered from the Subdistrict Headquarters at Esa-ala and a patrol post at Sehulea. There are a number of missions, plantations, and trading posts around the island, as shown on Plate 1. The native population is about 10,000. Many of these people speak English, probably all speak Dobuan and the language of their own village area, and most of the men speak Police Motu. Most live by subsistence agriculture, with a little cash income from copra.

Quickest access to the island is by weekly air service from Port Moresby to Vivigani on Goodenough Island, and launch from Vivigani to Esa-ala. An airstrip will be constructed on Normanby Island within the next few years.

BASE MAPS AND AERIAL PHOTOGRAPHS

Normanby Island is covered by the Dawson Strait, Sewa Bay, and Normanby Island East Military One-mile Sheets; these sheets provided the topographic base for the geological map which accompanies this report. The island is also covered by the Fergusson Island (SC56-5) and Samarai (SC56-9) 1:250,000 sheets.

The only known aerial photographs of the island are two trimetrogon runs flown for the armed forces in February and March 1943. Prints of these were made available by R.A.A.F. Central Photographic Establishment and these are stored in the Bureau of Mineral Resources, Canberra. Details of the airphotos are:

Mission 36X - Strip Normanby to Fergusson Island - 6th Feb., 1943 - 8 P.S. Numbers 108-134 L, V, R.

Mission 81XX - South coast Normanby Island - 23rd Mar., 1943 - 8 P.S. Numbers 4-19 L, V, R.

PREVIOUS WORK

E.R. Stanley, Government Geologist for Papua, produced a typescript report on the geology of Normanby Island in 1916; a copy is held in the Geological Office, Port Moresby. J.E. Thompson of the Bureau of Mineral Resources, visited the island in 1959 to investigate nickel enrichment in soil over peridotite; he reported no economic potential (Thompson, 1962). Company geologists are thought to have reconnoitred the Mount Bwebweso area for lateritic nickel possibilities but the writer saw no signs of old drill holes or test pits (see Economic Geology).

The writer published an interpretive geological map of Normanby Island at 1:250,000 scale in 1965 (Davies & Ives, 1965); this was partly based on Thompson's unpublished information.

GEOLOGY

The main rock groups are metamorphics, ultramafics, and granite. These are overlain by Tertiary marine sediments (Sewa Beds) and Quaternary volcanics, raised coral, and alluvium.

METAMORPHICS

There are two distinct groups of metamorphics. One, the Prevost Metasediments, consists of high-grade gneiss, schist, and amphibolite of probable sedimentary and volcanic origin. The other, the Kurada Metavolcanics, consists of low-grade chloritic basic schist which commonly shows igneous texture. A third group of metamorphics, the chlorite-biotite schist (here abbreviated to "cbs") has been mapped at the contact between the two main groups; this may be a transition between the two, or a local modification of one or the other, perhaps due to shearing.

Prevost Metasediments (New name)

This name is given to the gneiss and schist which form the Prevost Range and thus make up the north-north-easterly arm of the island. Typical rocks are granitic gneiss, biotite and hornblende-biotite schist, amphibolite, and marble. Quartz veining is common.

The metasediments are layered and the layers broadly folded in a way that suggests the preservation of original sedimentary bedding (Figs. 1-4). In some sequences the more felsic layers have been mobilized and injected through the more mafic layers. The best layering is seen in the mafic and calcic parts of the sequence; the layering is less marked where the gneiss is predominantly felsic.

The Prevost Metasediments also crop out on the north-western arm of the island, where they form the Mount Solomonai range behind Esa-ala. In this area leucocratic poorly layered gneiss predominantes; mafic and calcic gneiss are rare or absent.

The Prevost Metasediments can probably be correlated with the high-grade metamorphics of Fergusson and Goodenough Islands.

Kurada Metavolcanics (New name)

The Kurada Metavolcanics make up the south-central part of the island around Kurada Catholic Mission. The predominant rock type is a chloritic and epidotic basic schist; this commonly shows relict igneous texture and is probably derived from dolerite and basalt. Less common rock types are a porphyritic hornblende andesite, a grey limestone with contorted laminae, and a mylonite which consists of rounded rock fragments (commonly of hornblende andesite) in a schistose matrix.

The Kurada Metavolcanics are thought to be derived from a submarine basaltic lava pile which included minor limestone and some intrusive andesite. These rocks have been subjected to severe dynamic metamorphism associated with faulting (see Structure). The rocks have no equivalent on Fergusson and Goodenough Islands, but they may be related to either the

Cretaceous basalts which overlie the northern part of the Papuan Ultramafic Belt, or to the Cretaceous? metabasalts of the Mount Suckling-Mount Orian area, 120 miles west of Normanby.

Chlorite-biotite schist ("cbs")

Chlorite-biotite schist crops out between the Prevost Metasediments and the Kurada Metavolcanics, and is intermediate in metamorphic grade between the two. Later mapping will probably show that it is a local variant of one of the two major metamorphic groups and for this reason it has not been given a formal name.

The "cbs", like the Kurada Metavolcanics, has an overall basic composition. However, it differs from the Kurada rocks in the presence of biotite, the stronger schistosity and lack of relict igneous textures, the prevalence of quartz stringers, and the absence of associated limestone and hornblende andesite. It is distinguished from the Prevost Metasediments by the presence of chlorite and the apparent absence of compositional variation.

Interpreted dip slopes in the "cbs" (see Plate 1) indicate that it may be part of the layered sequence of the Prevost Metasediments.

ULTRAMAFIC - MAFIC COMPLEXES

Large bodies of ultramafic and mafic plutonic rock crop out around Mount Bwebweso in the centre of the island, and Bawudaduno Hill and Ubuia Island in the north-west. Ultramafic rocks predominate over mafic in the approximate proportions 4:1. The most common ultramafic rocks are dunite and enstatite olivinite (harzburgite) with minor enstatite pyroxenite veinlets. Green chrome diopside occurs locally in the peridotite, apparently as alteration veinlets. The mafic rock types are medium-grained gabbro and norite composed of plagioclase, brown hypersthene, and green diopside in varying proportions.

The areas of ultramafic rock are covered by a thin mantle of red ferruginous clay soil which supports a very poor scrubby vegetation (Fig. 5). On Mount Bwebweso limonite coatings have developed on exposed rock faces and in joints (Fig. 6) and there are limonitic nodules in the soil. This concentration of iron indicates rapid removal of silica and magnesium in solution. In the north-eastern foothills of Bwebweso magnesium has accumulated as magnesite in jointed weathered peridotite.

The ultramafic-mafic complexes are fault-bounded except perhaps north of Ubuia Island where there may be an intrusive granite contact. The Bwebweso complex may have been thrust south-eastward over the Kurada Metavolcanics (see Structure).

The ultramafic-mafic complexes are similar in tectonic style and in their suite of rock types to the Papuan Ultramafic Belt of the eastern Papuan mainland. The Papuan Ultramafic Belt is thought to be a segment of oceanic Upper Mantle brought to the surface by faulting and this same hypothesis is here proposed to explain the Normanby ultramafics. Stanley (1916) records

serpentinite in north-eastern Normanby; this was not found on the current survey. Anthropologist R.F. Fortune (1963) erroneously describes Bwebweso as an old volcano; he records that the Dobuan people regard the mountain as the home of the spirits of the dead.

GRANITE

Granite crops out as two large stocks in the north-western part of the island; these are here named the Gidogidora and Observation Island Granites. In addition to these two main bodies there are small granitic intrusives in the Prevost Metasediments, and J.E. Thompson (pers. comm.) has found granite boulders east of J. Wilkinson's homestead on Sewa Bay.

The Observation Island Granite is a coarse-grained (av. gr. size 1 cm) leucocratic granite composed predominantly of quartz and feldspar. It has been mapped in the area around Observation Island and is thought to extend as far south as the Ubuia Island ultramafics.

The Gidogidora Granite is exposed in Gidogidora Creek eight miles south-east of Esa-ala. It is a medium-grained biotite granite in which feldspar is commonly saussuritized and the biotite altered to epidote. This alteration may be related to Quaternary vulcanism. Near Esa-ala, in Baicubaioul Creek, a similarly altered granite is intruded by hornblende leucodiorite.

The granites are probably related to the granodiorites of Fergusson and Goodenough Islands; samples have been collected for isotopic age determination.

MIOCENE? SEDIMENTS

Grey fossiliferous limestone, grit, lava and volcanic agglomerate form a steep line of hills immediately north-east of Sewa Bay. The limestone has not been checked for diagnostic fossils at time of writing; a Miocene age is suspected.

These rocks have no equivalent on the other islands of the D'Entrecasteaux group, but there are Miocene tuffs, agglomerate, and limestone on the eastern Papuan mainland.

QUATERNARY VOLCANICS

Quaternary and possibly Pliocene volcanic products cover much of the island. Composition is intermediate to acid and the most common rock type is a buff or pink flow banded lava. Andesitic? agglomerate forms dip slopes near Darubia, north-west of Sewataitai Bay, and agglomerate also crops out near Bwasiaiai in the south-west and on Duchess Island in the west. No old eruptive centres have been positively identified but some peaks, such as Baldhead on Sewa Bay, may represent necks or plugs.

Dobu Island, off north-eastern Normanby, is a pumiceous ash cone with several large craters; it appears to be built on a foundation of flow-banded buff-coloured lava and older steeply dipping rhyolitic obsidian.

RAISED CORAL

Raised coral forms benches 120-130 feet above sea level at Silitau Point on the north-eastern tip of the island, and near Ganawe on the western side of Sewataitai Bay. Six miles north-west of Ganawe there is a small bench six feet above sea level.

ALLUVIUM

Alluvial plains up to two miles wide form the southern and western sides of Sewataitai Bay and smaller alluvial plains are present in the lower reaches of most of the large rivers.

THERMAL ACTIVITY

The only known thermal activity on Normanby Island is at Bwasiaiai ("bwasi" - water, "aiai" - hot, in the local language) on the south-western tip of the island; the area is illustrated in Figures 7 and 8. Steam and hot water issue from the ground at two localities about 100 feet apart on the alluvial plain at the mouth of Bwasiaiai Creek. The north-easternmost locality is a small pool of clear water at 70-80°C; steam and hot water issue from fissures between the white sinter-coated boulders which form the pool, and this feeds a stream of warm water filled with green algae.

The south-western locality is a tidal pool of clear water; steam issues intermittently between alluvial boulders on the south-eastern edge of the pool.

The thermal area is more or less on the line of a fault which separates the Bwebweso ultramafic complex from the Kurada Metavolcanics. It does not appear to be related to any recent volcanic activity.

STRUCTURE

The island is remarkable for the degree and diversity of Cainozoic faulting. The southern and western parts owe their present outline to Quaternary vertical movements on easterly and north-westerly faults and the eastern half of the island is anomalous in eastern Papua for its north-north-easterly trending faults and folds.

In addition to the three main sets of faults there is a probable thrust fault striking north-east from Bwasiaiai, along which the Bwebweso ultramafics have ridden south-eastward over the Kurada Metavolcanics. Reconnaissance mapping of this contact indicates that the probable fault plane dips about 20° to north-west.

If this is indeed a thrust fault it would explain the northern cut-off of the Prevost Metasediments (see Figure 9), and the compressive forces behind the thrust might explain the north-north-easterly faults and folds of eastern Normanby. The easterly and north-westerly trending vertical adjustments probably took place later, after compression had given way to tension.

Sialic core of Papua - New Guinea

The sialic core of Papua - New Guinea extends south-east through eastern Papua as far as Mount Obree (148°E. longitude) or possibly the Goropu Mountains (149°E. longitude). Here it is offset between 70 and 130 miles to the north-east to the D'Entrecasteaux Islands (Davies & Ives, 1965, p. 53). South-eastward of the D'Entrecasteaux Islands its trace is broken by 95 miles of ocean with scattered volcanic and coralline islands. This outcrop hiatus may indicate a major crustal break east of Normanby Island which may be related to the anomalous north-north-easterly trend of eastern Normanby.

ECONOMIC GEOLOGY

Gold and reportedly platinum have been won from gravels in rivers draining the Prevost Metasediments north-west of Mwalakwasia (see Plate 1); at present the area is being worked on a small scale by local natives. An old prospector, Mr Jim Bird, lives at Mwalakwasia and might be able to provide more details of the old workings. Thompson (1962) records unsuccessful attempts to mine alluvial gold and platinum from gravels north of Mount Bwebweso.

Lateritic concentrations of nickel are probably present in soils over peridotite on Mount Bwebweso (Bubuessa in Thompson, 1962). However soil cover is not deep, probably rarely deeper than ten feet, and it seems unlikely that there would be an exploitable quantity even if all were ore grade. Thompson (op. cit.) found nickel values up to 1.0 per cent in red soil over peridotite talus south-west of Bwebweso; he too concluded that the quantity of soil was not great enough to be of interest, but noted that the possibility of nickel magnesium silicates in the rock fracture zone below the soil has not been investigated.

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STANLEY, E.R., 1916 - The geology of Normanby Island. Unpublished typescript in Geological Office, Port Moresby.

THOMPSON, J.E., 1962 - Nickel and associated mineralization in the Territory of Papua and New Guinea. Bur. Min. Resour. Aust. Records 1962/157 (unpubl.).

Figure 1 to 4: The Prevost Metasediments of Normanby Island consist of gneiss, schist, and amphibolite which are similar to the metamorphics of Fergusson and Goodenough Islands. These recent photographs show typical gneiss and amphibolite boulders in Wauna Creek on northern Goodenough Island. Note the alternation of dark and light layers and the apparent mobilization of the lighter layers. The photographs were taken during the B.M.R. helicopter gravity survey of eastern Papua in March 1967; geophysicist-in-charge, John Milsom, is seen in Photograph 2.

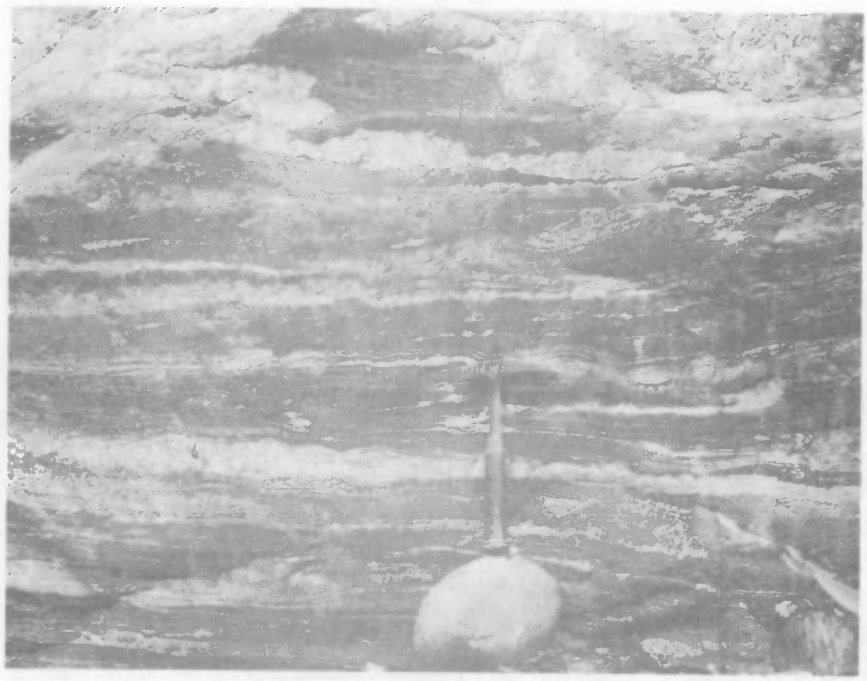


Figure 1

Figure 2

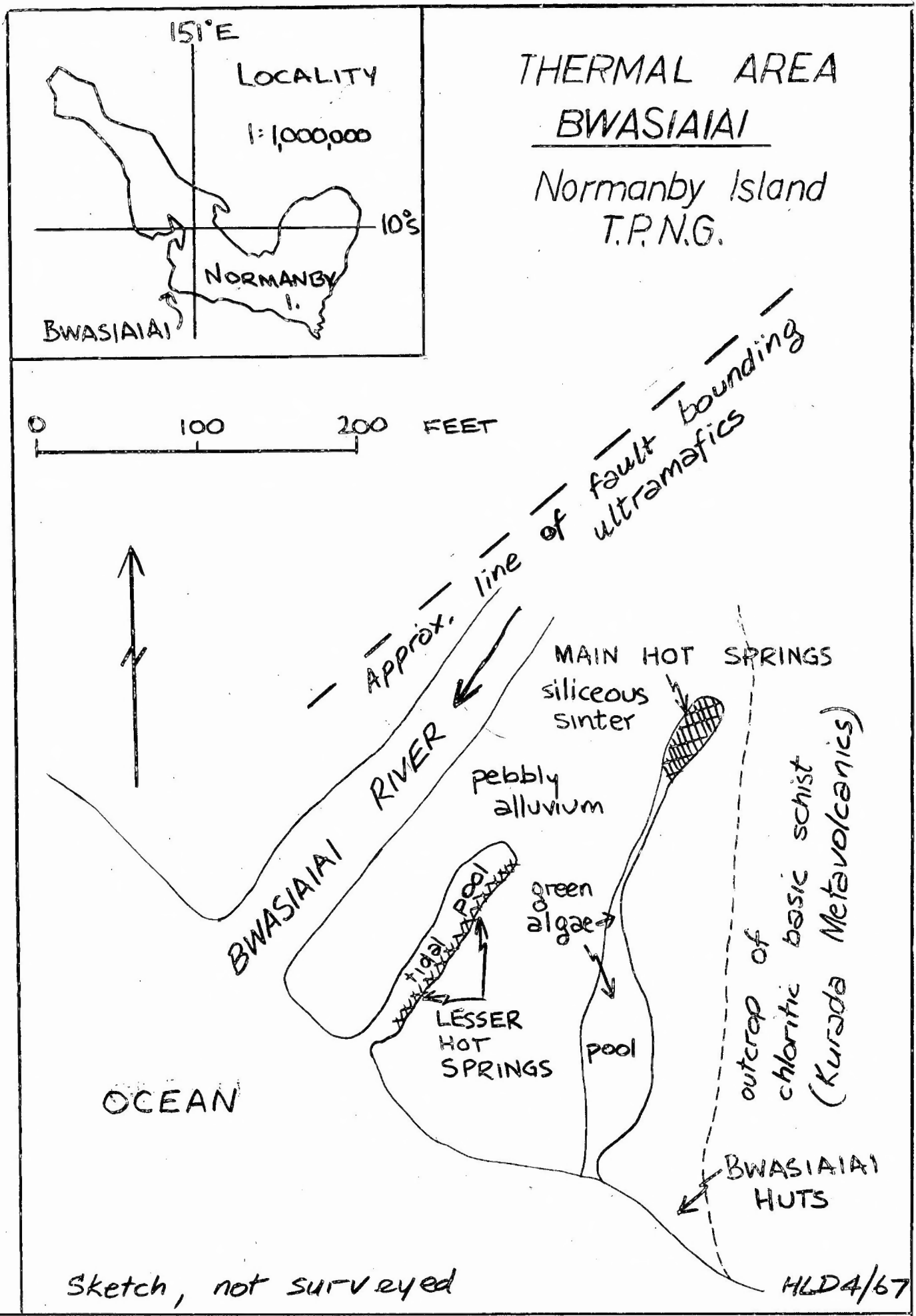
Figure 3

Figure 4

Figure 5. A view of Mount Bwebweso (2,600 feet approx.) from the south. Bwebweso and the area in the foreground are made up of ultramafic rocks; the photograph shows the low scrub and bracken which grow in the iron and nickel-enriched soil over the ultramafics.

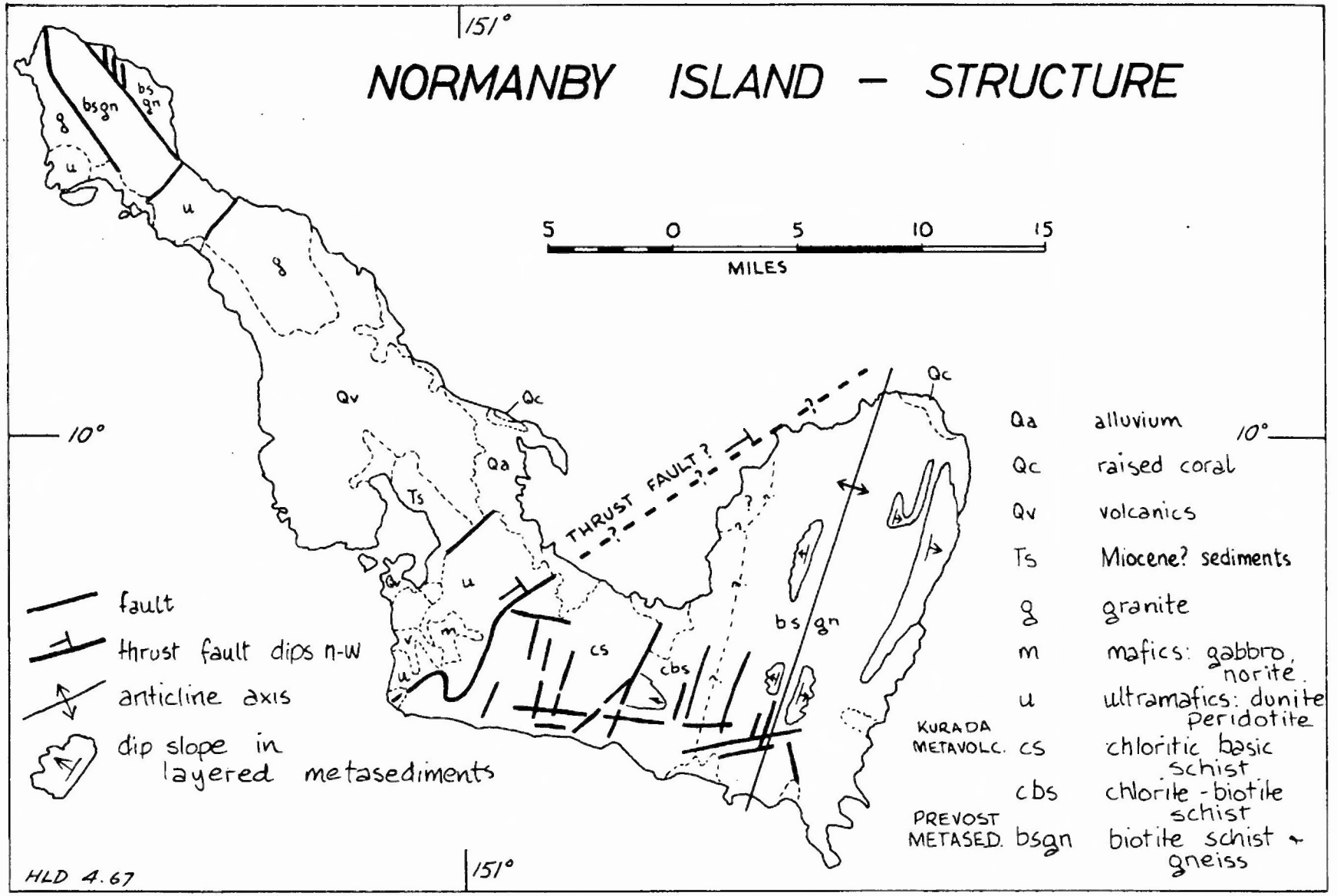
Figure 6. Limonite coating on residual boulder of peridotite on Mount Bwebweso.

Figure 7. Bwasiaiai thermal area viewed from south-west.



To accompany B.M.R. Records 1967/50 — Figure 8

Figure 9



To accompany Record 1967/50.

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PLATE I.

HLD 4.67

To accompany Record 1967/50.

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