DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/67

LATE CAINOZOIC VOLCANISM IN THE SOUTHEAST PAPUAN ISLANDS

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CONTENTS

SUMMARY

Late Cainozoic volcanic rocks are widespread on the islands to the north and east of the southeast Papuan mainland. Volcanic products forming islands in the western part of the Louisiade Archipelago are upper Miocene. Plio-Pleistocene volcanic rocks crop out on Goodenough, Fergusson, Normanby, and the Amphlett Islands in the D'Entrecasteaux Group, and also form small islands on Egum Atoll and in the Lusancay Group. Young volcanic landforms and ash deposits on Goodenough and Fergusson Islands show that volcanic activity has continued into very recent geological time. Extensive thermal fields in southeastern and western Fergusson Island suggest that further volcanic activity may take place in the future.

Petrographically the volcanic rocks mostly range from olivine-bearing basic types to hornblende-bearing intermediate types, but in some areas acid lavas and ash deposits predominate.

INTRODUCTION

Late Cainozoic volcanic rocks are a widespread, but relatively minor, part of the geology in the islands north and east of the Papuan mainland. The main areas of volcanism are in the D'Entrecasteaux Islands, but outcrops of Late Cainozoic volcanic rocks are also found in the Lusancay Islands, at Egum Atoll, and in the Louisiade Archipelago (Fig. 1). This report is an account of the field occurrence and petrography of the Late Cainozoic volcanic rocks in the offshore islands, and is based on field trips during April-May 1969 and August-October 1971. The petrographic descriptions are based on an examination of over 300 thin sections including 15 of specimens collected by Davies & Ives (1965) and 3 of specimens collected by Davies (1969). New K-Ar dates from specimens of the volcanic rocks are presented in this report (Appendix I) and provide the framework for a discussion on the age of volcanism in the islands.

Previous geological work in the islands has been concerned with regional mapping (cf. Pritchard, 1963; Davies & Ives, 1965; Davies 1967, 1969; Trail, 1967; Smith & Pieters, 1969), and locally with volcanic surveillance (Taylor, 1955; Reynolds, 1956) and thermal spring activity (Heming, 1969). Baker & Coulson (1948) described metamorphic and volcanic rocks in the D'Entrecasteaux Islands, and Morgan (1966) discussed briefly the chemistry of volcanic rocks in the Dawson Strait area.

Volcanic and seismic activity in the D'Entrecasteaux Islands is being continuously monitored by staff of the volcanological observatory at Esa'ala in conjunction with the Central Volcanological Observatory at Rabaul, New Britain. The writer is currently engaged in a detailed petrochemical study of the Late Cainozoic volcanic rocks of eastern Papua as part of a BMR project dealing with the distribution and chemistry of Late Cainozoic volcanoes in Papua New Guinea (cf. Johnson et al., in press).

GEOLOGICAL SETTING

Pre-Miocene rocks in the islands are known only from the D'Entrecasteaux Group, Louisiade Archipelago, and Woodlark Island. The dominant geological feature in the area occupied by these islands is a southeast-trending belt of Mesozoic metamorphic rocks which is block-faulted, and which appears to be absent between 151°15'E and 152°20'E. The islands to the north of this metamorphic belt are made up of reef limestone, and on some a volcanic basement is exposed; only on Woodlark Island is this volcanic basement older than Late Cainozoic.

Goodenough, Fergusson, and Normanby Islands in the D'Entrecasteaux Group all have cores of metamorphic rock forming fault-bounded domes, or 'blocks', which have been uplifted to form mountain ranges 1000 m to 3000 m high; the metamorphic grade is amphibolite and locally granulite facies, except on the south-eastern part of Normanby Island, where the metamorphic rocks are greenschist facies (Davies & Ives, 1965; Davies, 1967, 1969). Late Pliocene granodiorite intrudes the cores of the metamorphic domes. Gabbro and peridotite of Mesozoic age form fault-bounded blocks on Normanby and Fergusson Islands, and peridotite is

4

present as thin fault slices on the northeastern side of the Goodenough Block. Late Cainozoic volcanic rocks crop out at the margins of the Goodenough Block, in western and southeastern Fergusson Island, and in northwestern Normanby Island, and they also form the Amphlett Islands and several small islands east and southeast of Fergusson Island.

The islands of the Louisiade Archipelago are mostly made up of low-grade fine-grained micaceous schist. On Misima Island, low-grade schist and high-grade gneiss are present. Tertiary andesite and dacite porphyries intrude schist on Misima Island (de Keyser, 1961) and on islands at the western end of the Calvados Chain (Smith, in press). Lower Miocene limestone and upper Miocene volcanic rocks form small islands at the western end of the Calvados Chain.

Woodlark Island (Trail, 1967) has a basement of Lower Tertiary submarine volcanics overlain by lower Miocene limestone with interbedded basaltic and andesitic volcanic rocks. Most of the island is covered by Quaternary coral limestone interbedded with subordinate marine clay and conglomerate. Dolerite sills intrude the lower part of the succession, granite dykes intrude almost the entire Tertiary succession, and in places basic and intermediate dykes intrude the Tertiary rocks.

Some of the Lusancay Islands have a basement of Quaternary volcanic rock, and similar rock has been reported from two islands on the western side of the Trobriand Group (Glen E. Steen, pers. comm.). A group of small islands in the centre of Egum Atoll is composed of Quaternary volcanic rocks. The remaining islands in the area north and northeast of the D'Entrecasteaux Islands are composed entirely of coral limestone or coral sand, or both. A line of aeromagnetic highs trending roughly parallel to the southern margin of the Solomon Sea and underlying the Lusancay, Trobriand, and Marshall Bennett Island Groups (CGG, 1971) suggests that volcanic basement underlies many of the islands.

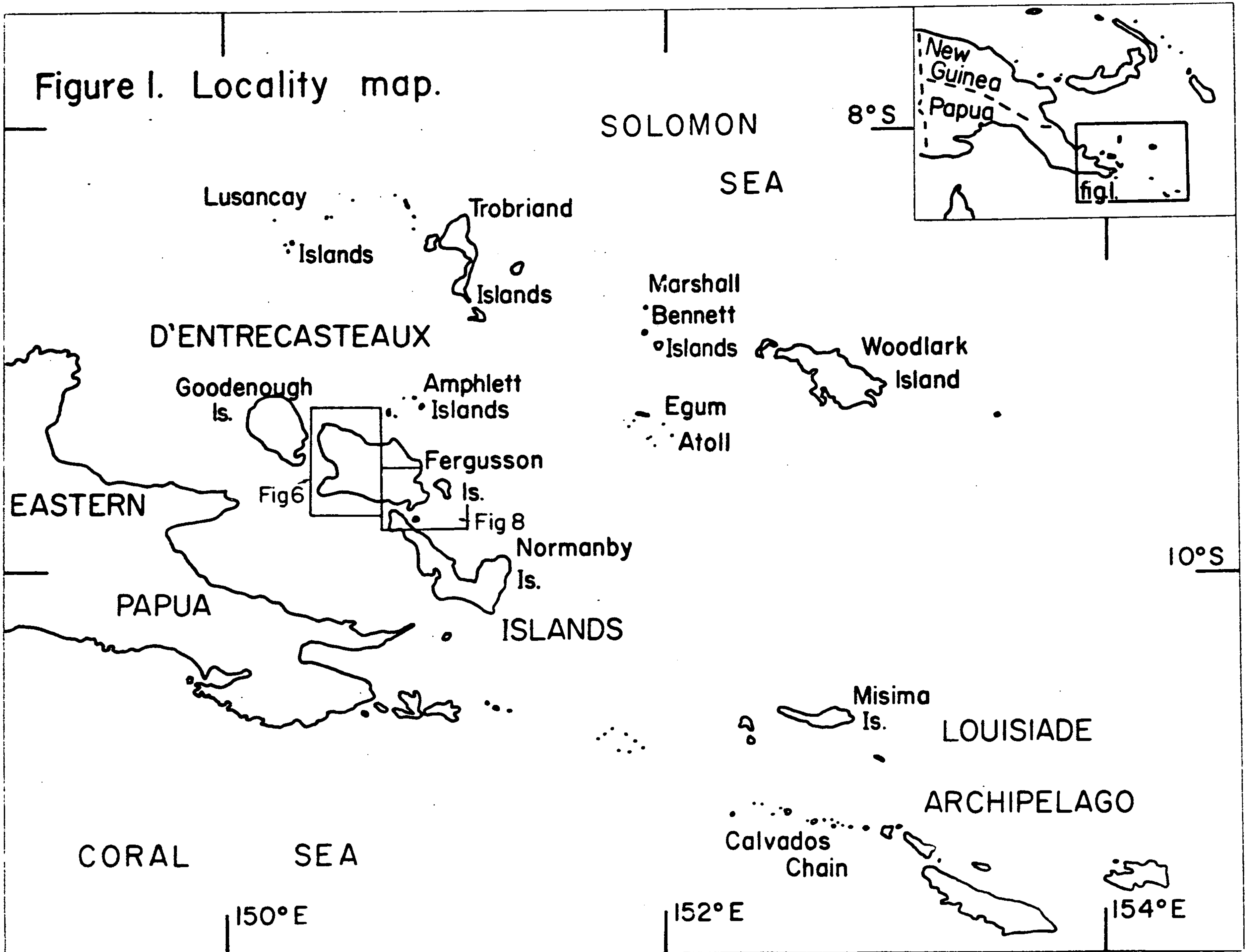
CALVADOS CHAIN

Volcanic rocks have been mapped on several of the islands at the western end of the Calvados Chain in the Louisiade Archipelago (Fig. 2) (Smith & Pieters, 1969; Smith, in press). The volcanic products form Panarora, Utain, Panaroba, Panaudiudi, Guleva, Tobaium, Venariwa, and Ululina Islands and part of Moturina Island (Fig. 2) and were named the Panarora Volcanics by Smith & Pieters (1969).

Lavas and consolidated ash are recorded from Utian Island (Gibb Maitland, 1892), but elsewhere the volcanics consist almost entirely of bedded agglomerate and minor tuff. On the western side of Moturina Island, agglomerate forms a sheet dipping southward over schists and intermediate intrusives. On Venuriwa Island, massive, medium to coarse, moderately well sorted volcanigenic conglomerate forms southward-dipping beds 1-10 m thick. Panarora Island is made up of over 200 m of bedded, coarse, unconsolidated agglomerate which also dips southward.

A K-Ar age of 11.4 m.y. on a specimen collected from the agglomerate on Panarora Island indicates that the Panarora Volcanics are upper Miocene (Smith, in press). Specimens of lava clasts from the volcanigenic conglomerate on Venuriwa Island and the agglomerate on Moturina Island are fine-grained; as they have an altered appearance they

Figure 1. Locality map.



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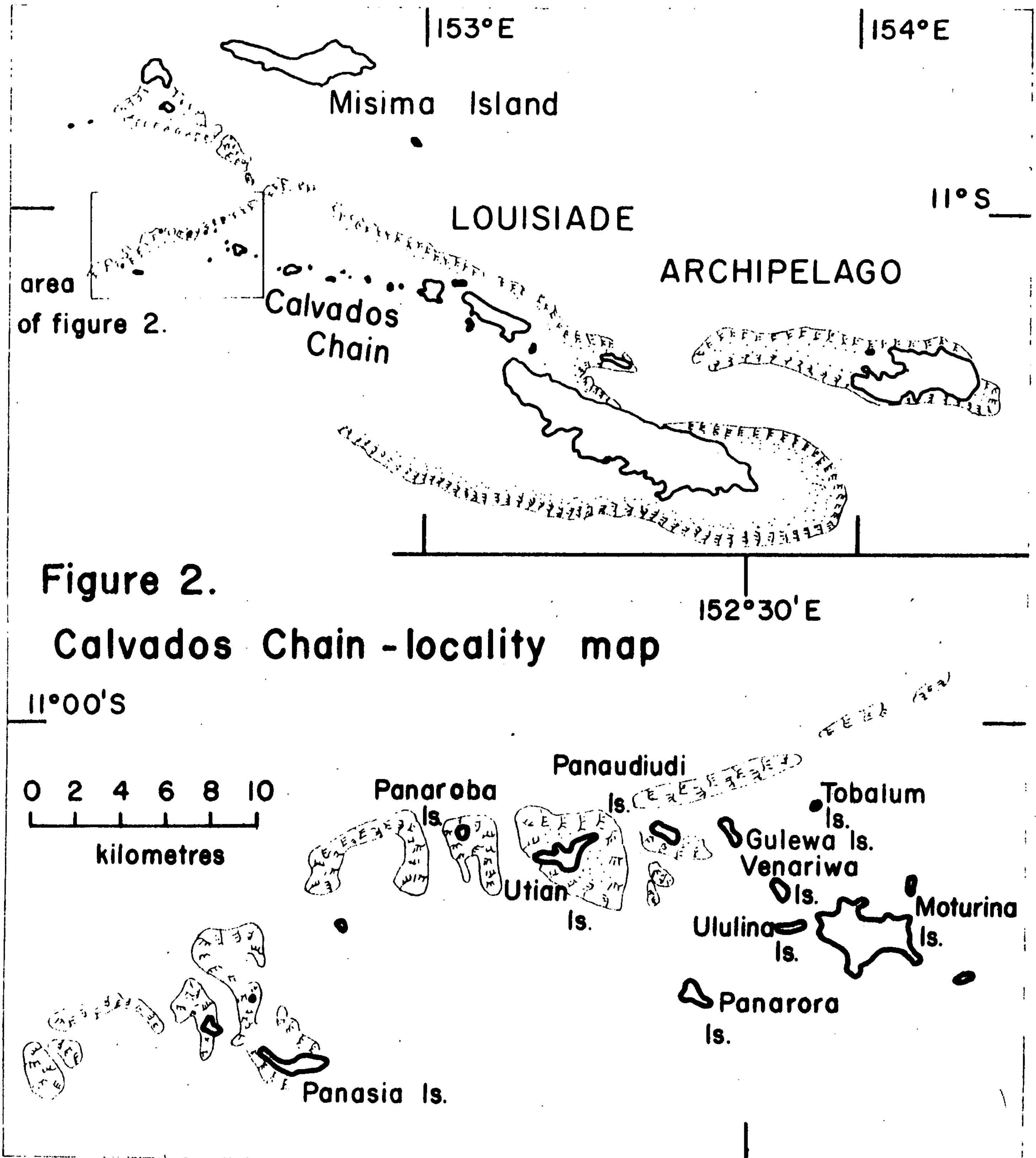

Figure 2.
Calvados Chain - locality map

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are assumed to be older than the fresh agglomerate on Panarora Island, and they may represent an early phase of volcanic activity in the area. Microdiorite dykes which crop out on Moturina Island and elsewhere in the Calvados Chain (Smith & Pieters, 1969) may be feeder dykes to the Panarora Volcanics.

Petrography

Specimens from the volcanic conglomerate on Venuriwa Island are fine-grained to slightly porphyritic, and consist of augite, plagioclase, iron-titanium oxides, and green interstitial mesostasis; some contain iddingsite after olivine. In porphyritic specimens the phenocrysts are clinopyroxene.

Components of the Panarora Island agglomerate are porphyritic rocks containing phenocrysts of andesine and clinopyroxene with, less commonly, iron-titanium oxides, hornblende and biotite, and rarely, iddingsite pseudomorphs after olivine. The fine-grained groundmass is mostly plagioclase, pyroxene, iron-titanium oxides, and in some specimens hornblende, biotite, and interstitial glass.

The dyke-rocks on Moturina Island are medium-grained to strongly porphyritic, and consist of plagioclase (andesine to labradorite), hornblende, and minor iron-titanium oxides. Orthoclase and minor biotite and augite are present in some specimens. Andesine, hornblende, and biotite form phenocrysts in the porphyritic specimens. Chlorite, calcite, sericite, and fine-grained secondary material are common in some altered specimens.

GOODENOUGH ISLAND

Volcanic rocks crop out at the margins of the Goodenough Metamorphic Block, and are most extensively developed on Bwaido Peninsula in the southeast and to the north of Mud Bay in the east (Fig. 3).

Bwaido Peninsula is made up of lava and subordinate agglomerate. The northern and western part of the peninsula is a plateau, 150-300 m above sea level, which is divided by the valley of Niubula Creek, and bounded by a steep scarp on the Mud Bay side. To the south of the plateau the peninsula is moderately dissected, and has a relief of over 600 m. Davies & Ives (1965) suggest that some of the peaks in the southern part of the peninsula may represent volcanic plugs and necks.

On the northeastern side of Bwaido Peninsula there is a group of three small cones which are here called the Wailagi Cones (Figs 3 and 4). The cones are built on an undulating platform of lava and fragmental material which forms a peninsula to the east of Wailagi Mission. The main cone (Fig. 4) is about 100 m high, and rises to an altitude of 150 m above sea level; it is steep-sided, and has a shallow, poorly defined summit crater. A lava flow extends from the crater down the southeastern slopes of the cone. On the northeastern side of the main cone is a smaller cone about 50 m high, which has a moderately well defined crater open to the northeast. A third cone, on the northwestern side of the main cone, is a semicircular ring, about 50 m high, open towards the northwest. The Wailagi Cones are made up of fragmental material with some blocky lava. A thin soil cover is developed over much of the area.

Wagipa Island is a small volcano immediately east of Bwaido Peninsula, and 3 km southeast of the Wailagi Cones (Fig. 4). The main feature of the island is a well formed steep-sided cone, rising to 180 m above sea level, which is made up mainly of fragmental material. The southwestern slopes of the cone are smooth, in contrast to the northeastern slopes which are covered by lava flows; these flows originated from a shallow, poorly defined summit crater open to the northeast; and they are the result of the most recent activity from the cone. The lava flows have a blocky surface, and virtually no soil has been formed on them.

On the western side of the cone is an arcuate ridge, 10-15 m high, composed of agglomerate and tuff. The ridge has a steep inner slope and a more gently dipping outer slope; a shallow marshy lagoon lies between the cone and the ridge. This ridge is probably the remnant of an early eruptive centre to the west of the present cone. A low arcuate island on the northwest side of Wagipa Island may be a remnant of the same eruptive cycle. Tuffaceous and other fragmental materials forming a peninsula and an islet on the southwestern side of Wagipa Island are probably also remnants of early activity.

The history of the Wagipa Island volcano probably began with submarine eruptions which built up a low island of fragmental materials which may have originated from more than one eruptive centre. A period of cone building followed, during which more fragmental material was erupted. In the final stages of cone building lava was extruded, and flowed down the northeastern slopes of the cone.

On the northern side of Mud Bay volcanic rocks cover an area of about 18 km^2 (Fig. 3). The most prominent feature of this area is a large fan-shaped flow of olivine-bearing basalt. The source of the lava was apparently a small cone (50 m high) about 220 m above sea level at the western end of the flow. Pritchard (1963) referred to the cone as the Miwaiaukala Cone, and the flow is here referred to as the Miwaiaukala flow (Fig. 5). The Miwaiaukala flow is for the most part probably less than 10 m thick, but it covers an area of about 11 km^2, and is thus the most extensive lava flow on Goodenough Island. A thin soil cover is developed over much of the flow surface.

The Miwaiaukala flow is underlain by red-black vesicular basaltic rocks up to 150 m thick which overlie (?)dacite (Davies & Ives, 1965, p. 43). Davies & Ives also reported an outcrop of pinkish white dacite on Gunawala Creek 5 km to the southwest. A fine-grained rhyolitic rock collected from a large boulder on the track immediately north of Mataita during 1970 fieldwork is probably a representative of this early period of volcanism.

About 5 km north-northwest from the Miwaiaukala area, to the south of Bilolo Creek, is a fan-shaped flow of silicified and carbonated volcanic breccia; this appears to have issued from the fault which bounds the northern side of the Goodenough block (Davies & Ives, 1965). On the north side of Bilolo Creek is an area of dissected volcanic rocks which may be the remnants of a cone; the highest peak is known as Wakala Hill. A porphyritic basaltic rock was collected from a large lava block on the lower slopes of Wakala Hill during the 1970 fieldwork, and Davies & Ives reported boulders of vesicular basalt north of Dakala Creek, about 6 km northwest of Wakala Hill.

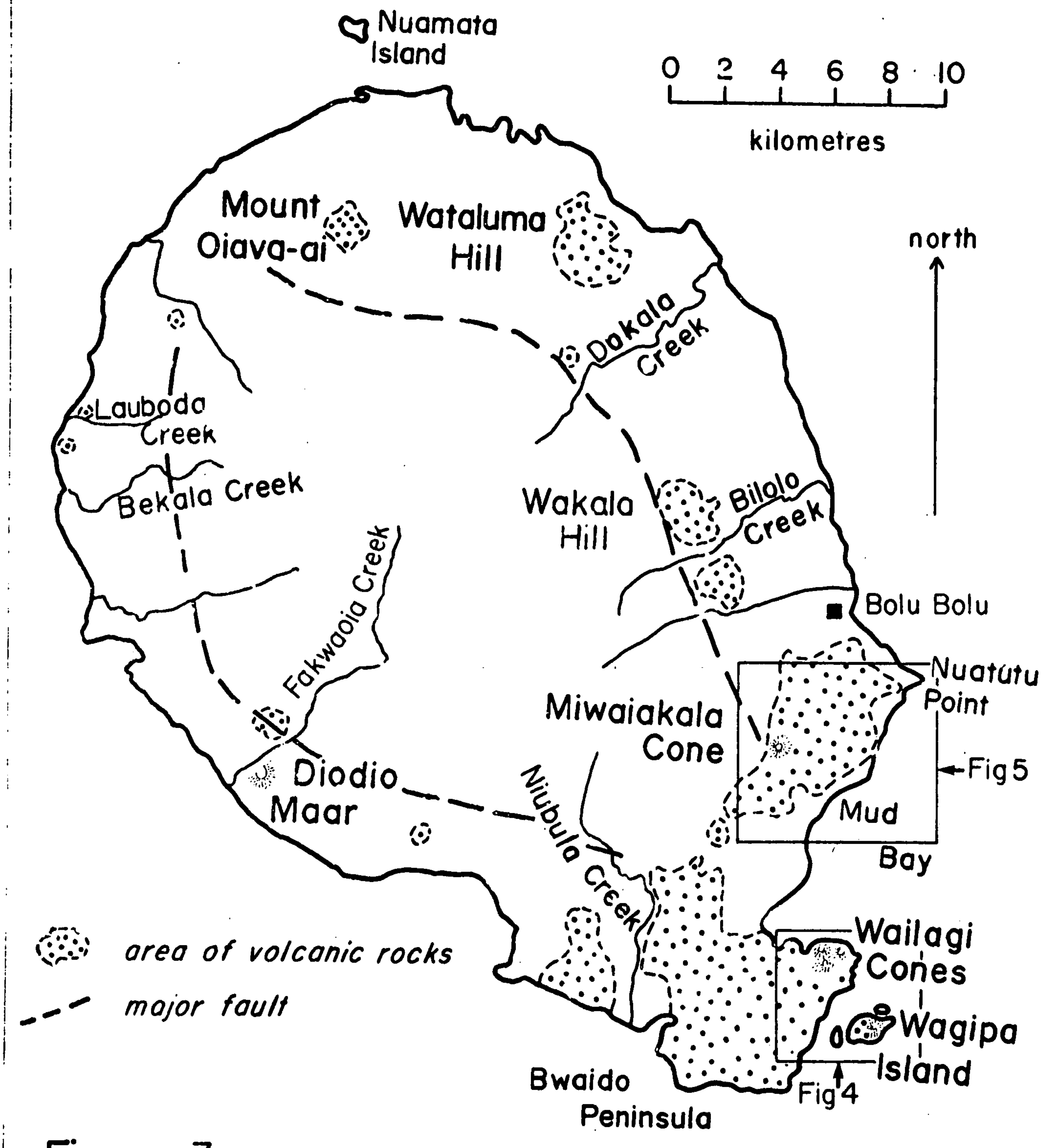

Figure 3.

Distribution of volcanic rocks on Goodenough Island

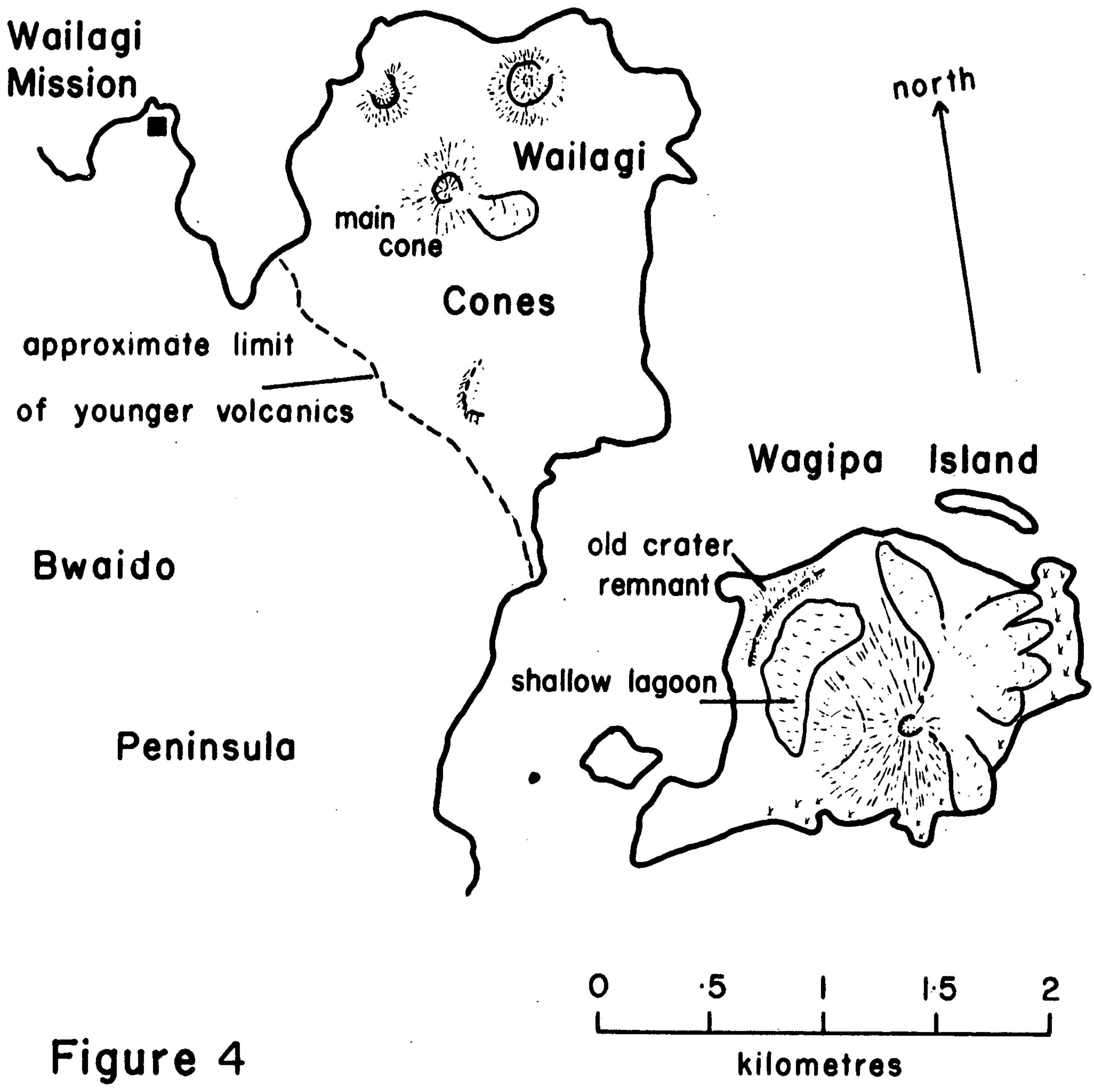

Figure 4

Sketch map of Wagipa Island and the Wailagi Cones, Goodenough Island.
(based on air photos.)

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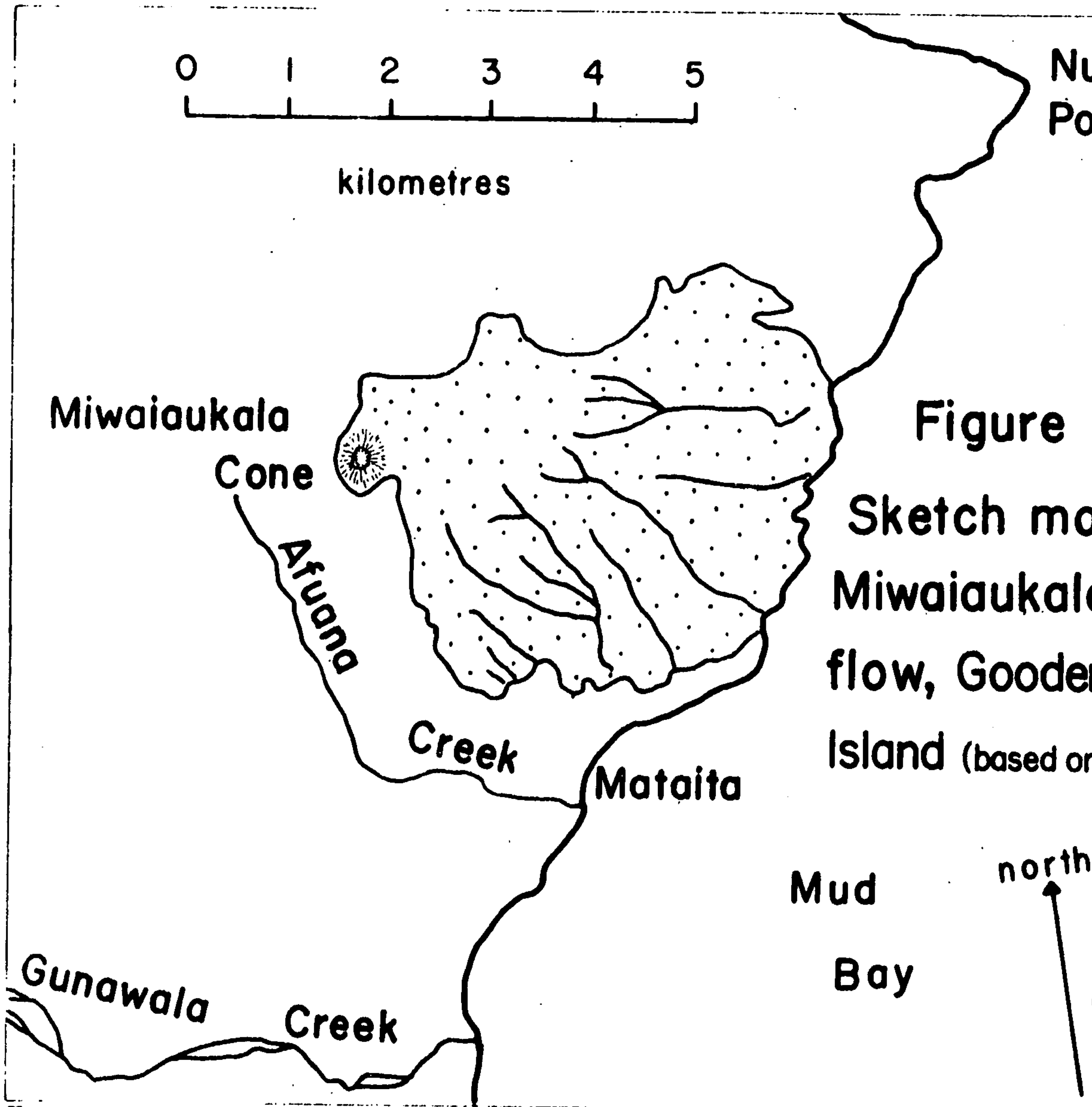

Figure 5

Sketch map of the Miwaiaukala lava flow, Goodenough Island (based on air photos.)

To accompany Record 1973/67

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Wataluma Hill is the highest point in a group of low volcanic hills which project from the alluvial plain north of the Goodenough Block (Fig. 3). Davies & Ives (1965) recognized three small cones in the eastern part of the group of hills from aerial photographs, and reported a purplish (?)trachyte from the western end of the hills.

Mount Oiava-ai, in the northwestern part of Goodenough Island, is a steep-sided hill rising over 300 m from the alluvial plain to an altitude of 420 m above sea level. Baker & Coulson (1948) referred to Mount Oiava-ai as a volcanic cone, but the absence of a summit crater and the steep sides and rounded outline suggest that it is in fact a cumulodome. The hill is composed of porphyritic lava which is characteristically massive, although Baker & Coulson describe a band of vesicular lava up to 1.5 m thick at an altitude of 150 m above sea level.

On Nuamata Island off the northwest coast of Goodenough Island, grey flow-banded lava is exposed; the flow-banding dips 55° to the west (Davies & Ives, 1965).

Davies & Ives report several small areas of volcanic rocks on the northwest side of the Goodenough block in the vicinity of Lauboda Creek, and to the south in the vicinity of Fakwaoia Creek. On the alluvial flats immediately east of Fakwaoia Creek is a crescentic lake bordered to the east and south by a low ridge of predominantly alluvial material. Amongst the surface alluvial materials are small pebbles (2-5 cm in diameter) of superficially weathered scoriaceous basalt. This feature is thought to be an explosion vent, or maar, and has been named the Diodio Maar after nearby Diodio Village (Davies & Ives, 1965; Davies, 1969).

Thermal areas on Goodenough Island

Taylor (1955) reported a warm spring and gas ebullition point on the beach east of Bolu Bolu; it is covered at high tide. Davies & Ives (1965) also reported a hot spring on the coast about 3 km north of Bolu Bolu. No thermal activity has been noted in the vicinity of the young lava flows in eastern and southeastern Goodenough Island.

None of the Goodenough Island volcanic rocks have been dated isotopically, and the age of volcanic activity on the island can only be estimated. The lack of an appreciable soil cover on the lava flows on Wagipa Island suggests that these flows were probably extruded within the last 500 years, and are the products of the most recent volcanic activity in the Goodenough Island area. On the other hand, the lack of volcanic land forms and the depth of dissection of the volcanic rocks on Bwaido Peninsula suggests that they may be as old as Pleistocene. Other areas of volcanic rocks on Goodenough show varying degrees of development and dissection of volcanic landforms, and are probably intermediate in age between these two extremes.

Petrography

The volcanic rocks of Goodenough Island are mainly medium to dark grey, porphyritic, and vesicular. Phenocryst assemblages are labradorite, olivine, and pyroxene; less commonly, olivine and pyroxene; and rarely, olivine alone. In addition, small phenocrysts of iron-titanium oxides are present in some specimens. Orthopyroxene forms phenocrysts in a few of the lavas. Labradorite phenocrysts (An_{50-75}) commonly show normal zoning; they are generally fresh, but in some specimens they contain irregular inclusions of altered groundmass material. Olivine phenocrysts commonly show some alteration to iddingsite, and in some specimens fresh olivine is present only as a relic core. The groundmass in these rocks consists of labradorite, clinopyroxene, iron-titanium oxides, and in some specimens olivine. Turbid interstitial mesostasis or glass is present in some specimens.

In an olivine- and clinopyroxene-bearing lava collected west of Abolu River on Bwaido Peninsula by Davies & Ives, there are rare phenocrysts and small groundmass crystals of a light brown mica, possibly phlogopite. Wise (1970) interpreted phlogopite in the groundmass of an olivine basalt from the Cascade Mountains (U.S.A.) as a reaction product between olivine and magnetite. However, as there is no evidence for a reaction in the mica grains in the sample from Bwaido Peninsula, it is assumed that this mica is in equilibrium with the coexisting minerals.

Specimens of hornblende-bearing lavas were collected from the south coast of Bwaido Peninsula, and on the eastern side of the bay immediately south of Wailagi Mission. These rocks are dark to light grey, and some have a pink hue; they are porphyritic, and contain conspicuous crystals of plagioclase and hornblende. Phenocrysts are plagioclase (An_{30-60}), brown hornblende, biotite, iron-titanium oxides, less commonly olivine and clinopyroxene, and rarely orthopyroxene. Iron-titanium oxides commonly rim and replace both hornblende and biotite, especially where they coexist with phenocrysts of olivine and clinopyroxene. The groundmass in these rocks is made up of plagioclase, hornblende, biotite, iron-titanium oxides, clinopyroxene, and in some specimens minor interstitial glass.

A dacite from near Bolu Bolu was described by Baker & Coulson (1948). It is a pink porphyritic rock containing phenocrysts of rounded embayed quartz, zoned oligoclase, rare alkali-feldspar and green to yellow-brown biotite in a fine groundmass of quartz, feldspar, and some apatite. A similar specimen of light grey porphyritic rock collected from a rounded boulder near Mataita Village contains phenocrysts of sodic oligoclase, brown biotite, and small opaque grains in a groundmass of alkali-feldspar, plagioclase, minor biotite and iron-titanium oxides, and a fine mesostasis.

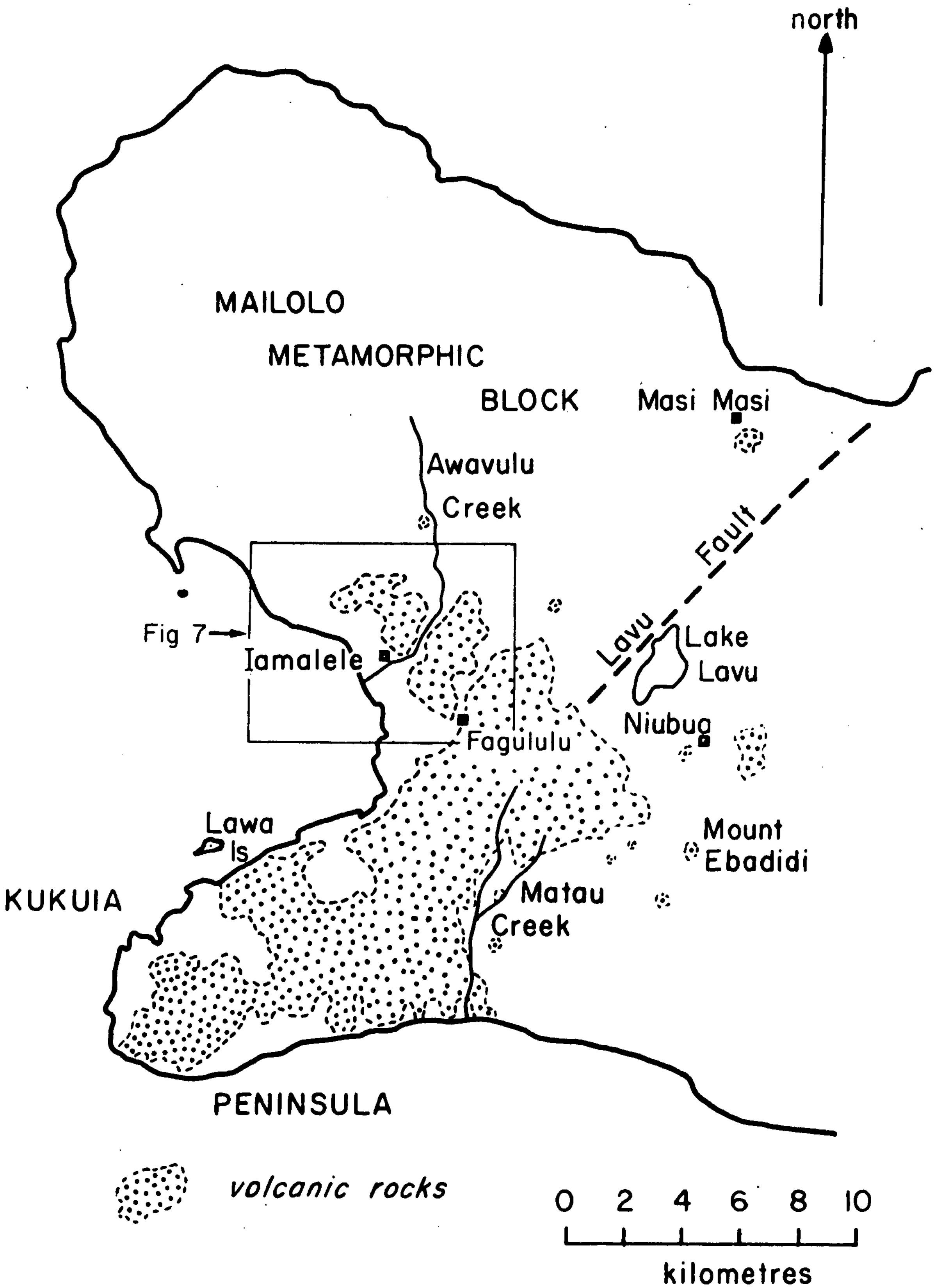
SOUTHWEST AND CENTRAL FERGUSSON ISLAND

Volcanic rocks are widespread on Kukuia Peninsula in the southwest of Fergusson Island. They form cumulodomes, flows, and plateaux in the Iamalele-Fagululu area north of the peninsula, and they are present in small isolated areas in the centre of the island (Fig. 6).

Kukuia Peninsula is composed mainly of volcanic rocks with a few inliers of metamorphic basement, and a fringe of reef limestone at its western tip. At the eastern end of the peninsula flat-lying volcanic rocks form a plateau about 11 km^2 in area, between 460 and 600 m above sea level; the volcanics forming the plateau have an estimated thickness of 90 to 150 m (Davies & Ives, 1965). The northern margin of the plateau coincides approximately with a line extending to the southwest of the Lavu Fault, and the southern margin is marked by steep cliffs above

14

Figure 6 Distribution of volcanic rocks in southwestern Fergusson Island



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the valley of Matau Creek. Outliers of volcanic rock cap some of the peaks east of the plateau. In the western part of the peninsula the volcanics are folded and show dips of up to 50°; they form rugged mountainous terrain. No volcanic land-forms have been recognized on Kukuia Peninsula, but some of the peaks in the western part may represent volcanic plugs or necks (Davies & Ives, 1965).

Davies & Ives suggested that, as some of the lavas on Kukuia Peninsula are folded, they may be of Pliocene age. K-Ar dating of a specimen thought to be representative of the older lavas at the western end of Kukuia Peninsula yielded an age of 1.0 m.y. A specimen from the central part of the peninsula, thought to represent the younger lavas on the peninsula, gave a K-Ar age of 0.4 m.y. Clearly, these two K-Ar ages (see Appendix I) give no more than an indication of the age of the volcanics on Kukuia Peninsula, and it is probable that volcanic activity in the area continued throughout most of the Quaternary.

The Iamalele-Fagululu area (Fig. 7) lies between the Kukuia Peninsula in the south and the Mailolo Metamorphic Block in the north. The area is low-lying except for a number of small steep-sided cumulodomes and volcanic plateaux, and it contains numerous thermal areas which are among the most active in eastern Papua. The cumulodomes are found on both sides of the Iamalele-Fagululu area. The largest of the cumulodomes (over 150 m high, base diameter 1 km), west of Fagululu Village, is composed of acid lava and obsidian. Extensive thermal areas are present on the southern flanks of the cumulodome, and in hummocky country immediately to the south. A smaller cumulodome lies to the north of Fagululu Village, but its composition is unknown.

In the west, six cumulodomes cluster around a small lake known as Salt Lake. The largest of these cumulodomes is the southernmost; it is about 150 m high, and the diameter of its base is about 0.8 km. The easternmost cumulodome has extensive thermal areas on its flanks. The composition of the six cumulodomes is not known; a basaltic sample was collected from a large block below one of them, but this may have come from an adjacent lava flow. On the northeastern side of this cluster of cumulodomes there is an undulating platform, up to 30 m high; the margins of the platform rise steeply from the surrounding alluvial plain. Lava blocks on the surface of the platform are basaltic, and the platform is thought to be made up of one or more lava flows which were erupted from a source on the northeastern side of the cumulodomes.

Two small volcanic plateaux about 30 m high and covering a total area of about 4 km^2 are present on either side of Awavula Creek northeast of Iamalele Village. They are made up of volcanics which are apparently flat-lying; Davies & Ives (1965) reported massive hornblende andesite and welded ashflow tuff of intermediate composition from the eastern plateau, and the author collected massive rhyolitic lava from the plateau on the western side of Awavula Creek. The source of the rocks forming the plateaux has not been identified.

The age of the volcanic rocks in the Iamalele-Fegululu area is not definitely known, but because of the youthful volcanic landforms and present high level of solfataric activity they are considered to be Recent.

Thermal areas

Thermal activity in the Iamalele-Fagululu area is found in a belt, 7 km long by 1.5 km wide, which trends north-northwest. The most active areas are associated with the large cumulodome in the southeast, and with the easternmost cumulodome of the cluster in the west, but there are also numerous small areas within the cluster. A large area about 1 km southeast of Iamalele Village is known as Debawala thermal area. It has hot springs, mud pools, and numerous solfataras surrounded by mounds of sulphur and siliceous sinter; temperatures do not exceed 100°C. On the southern flanks of the southeastern cumulodome is a large field containing boiling springs, mud pools, and steam vents.

Northwest of Iamalele Village solfataric activity is found in the vicinity of a small lake known as Sulphur Lake. Farther northwest, there are extensive areas of thermal activity on the flanks of the cumulodome southeast of Salt Lake. The cumulodome is almost completely mantled by siliceous sinter and decomposed lava formed as a result of the solfataric activity. Thermal manifestations in these areas are steam vents, fumaroles, and hot springs.

Sulphur is common around many of the fumaroles in the Iamalele-Fagululu area. The economic potential of this sulphur was investigated by Edwards (1950), who estimated that there were 1000 tons of clean sulphur, and 3000 tons of sulphur contaminated with quartz sand, mica, and clay in the Iamalele area.

Davies & Ives (1965) mapped a number of small areas of volcanic rocks in the low-lying north-central part of Fergusson Island. Mount Ebadidi is a plug or sub-elliptical dyke about 1 km by 0.5 km which rises almost sheer for about 100 m above the surrounding metamorphic terrain to an altitude of about 490 m above sea level. Three kilometres north of Mount Ebadidi, near Niubuo Village, a smaller 'plug' several hundred metres across stands about 60 m above the alluvial plain. On the eastern side of the Mailolo Block, south of Masi Masi Village, is a dissected cone made up of basaltic lava which rises to about 100 m from the alluvial plain.

Petrography

Rocks of basic and intermediate composition crop out extensively in the central part of Kukuia Peninsula; they form lava flows associated with cumulodomes west of Iamalele, and are present in isolated outcrops in central Fergusson Island.

These rocks are for the most part strongly porphyritic, containing abundant phenocrysts of labradorite (An_{60-70}), clinopyroxene, and olivine in a fine-grained groundmass. In one specimen collected from a creek near the western end of Kukuia Peninsula olivine is the dominant phenocryst mineral, and plagioclase, clinopyroxene, and iron-titanium oxides form small sparse phenocrysts. The lavas in the Iamalele area are characteristically less porphyritic than those on Kukuia Peninsula; they contain sparse phenocrysts of olivine, clinopyroxene, some plagioclase, and rare iron-titanium oxides in a fine-grained groundmass. A porphyritic volcanic rock collected from Awavula Creek in the Iamalele area contains phenocrysts of olivine and clinopyroxene in a groundmass of flow-oriented plagioclase microlites, iron-titanium oxides, and interstitial semi-opaque brown material. The Mount Ebadidi plug is a porphyritic rock containing olivine

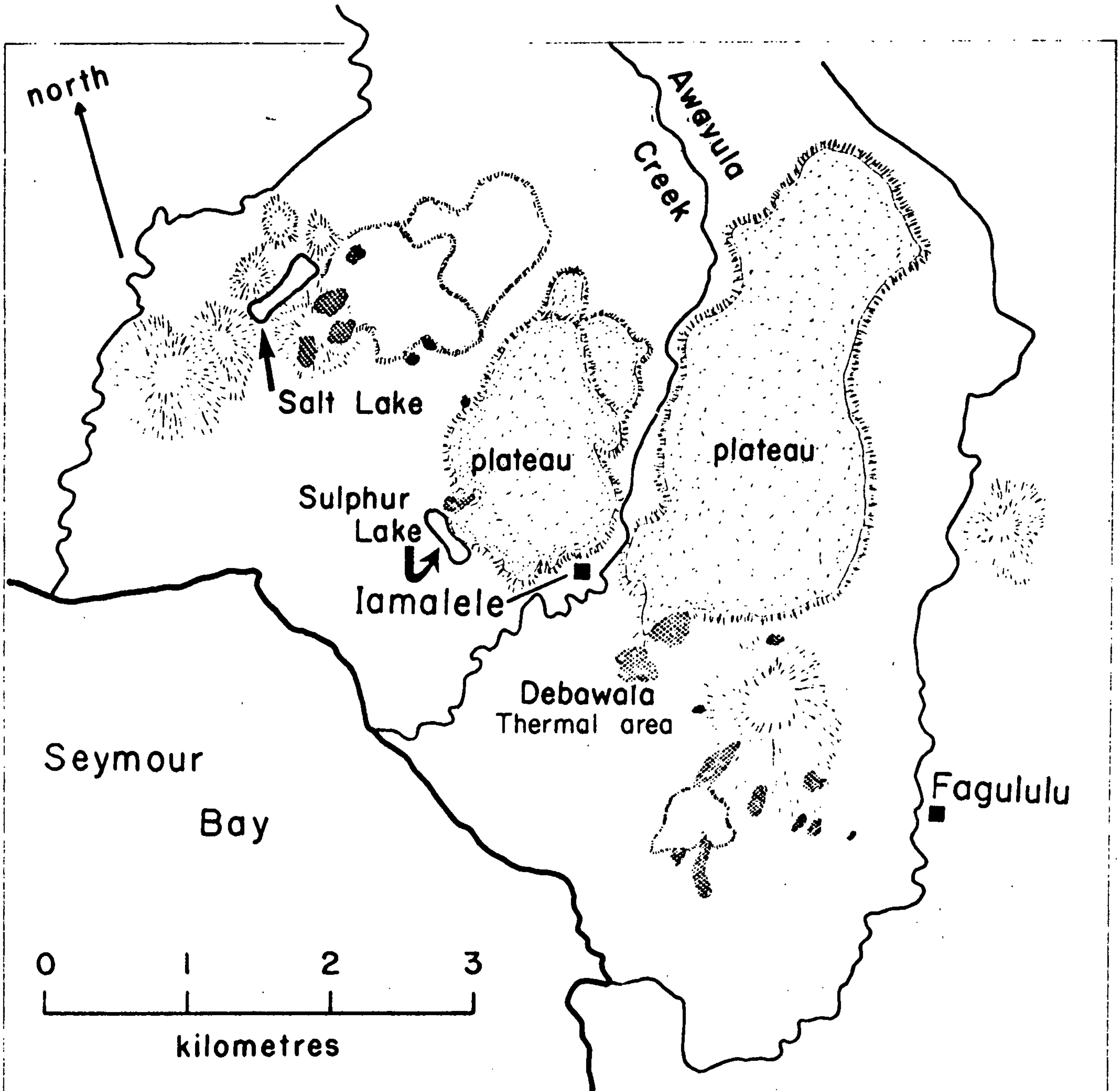

Figure 7 Sketch map of the Iamalele Fagululu area (based on air photos.).
(Thermal areas shaded)

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and clinopyroxene phenocrysts in a fine-grained groundmass. The groundmass in these basic and intermediate lavas typically consists of plagioclase, clinopyroxene, iron-titanium oxides, minor olivine, and interstitial brown glass or brown semi-opaque mesostasis.

Hornblende-bearing lavas are a minor part of the volcanic rocks forming Kukuia Peninsula. They are typically porphyritic, containing phenocrysts of plagioclase (An_{35-55}), hornblende, biotite, iron-titanium oxides, less common clinopyroxene and orthopyroxene, and rare quartz in a fine-grained groundmass. Iron-titanium oxides rim or completely pseudomorph hornblende and biotite phenocrysts. The groundmass in these rocks consists of plagioclase, pyroxene, and iron-titanium oxides.

Rhyolitic rocks are widespread on Kukuia Peninsula, and they form lava domes between Iamalele and Fagululu on the northern side of the peninsula. These rocks are fine-grained or sparsely porphyritic. Phenocrysts, where present, are oligoclase, biotite, less commonly hornblende, and rarely quartz. The fine-grained rhyolitic rocks and the groundmass in the porphyritic types consist mainly of plagioclase and probably alkali-feldspar with quartz, and minor biotite, hornblende, and iron-titanium oxides. Obsidian crops out on the northern and southern flanks of Kukuia Peninsula, where it commonly is associated with the rhyolitic lavas. The obsidians are sparsely porphyritic, and contain phenocrysts of oligoclase, biotite, and hornblende in a groundmass of colourless glass containing flow-oriented feldspar microlites.

SOUTHEASTERN FERGUSSON ISLAND AND ADJACENT ISLANDS

Volcanic products form the southeastern part of Fergusson Island, the neighbouring island of Dobu, and a large part of Sanaroa Island (Fig. 8). There are three main volcanic centres in the area: Mount Lamonai and Mount Oiau (both on Fergusson Island) and Dobu Island. The cones are between 300 and 500 m high; they are roughly aligned north-south, and are spaced 6 and 10 km apart. Stanley (1920) reported another major cone, Mount Masai'ia between Mounts Lamonai and Oiau, and several other small vents southeast of Masai'ia. However, no definite volcanic features are observed on aerial photographs of the area, and, as Davies & Ives (1965) have suggested, Stanley's 'cones' are probably small peaks; the area is composed entirely of volcanic products, and the peaks may well be plugs or crater rim remnants. A near-circular bay 5 km southeast of Mount Lamonai has the appearance of a former volcanic centre (Fig. 9). An arcuate shape, steep cliffs, and thermal areas suggest that the northern part of Numanuma Bay was also a volcanic centre.

A low-lying area west of Mount Lamonai extends from Gomwa Bay in the south to Sebutuia Bay in the north. Exposure is poor, but according to Davies & Ives (1965) the area is made up of flat-lying volcanic deposits which include welded dacitic ashflow tuff. Welding is more complete in a tuff outcrop in Sebutuia Bay than in outcrops in the Salamo River to the southwest, and Davies & Ives therefore suggested the source was in the north, and may have been Mount Lamonai.

No isotopic dating has been carried out on the volcanic rocks from southeastern Fergusson Island or the adjacent islands. However, the presence of youthful volcanic landforms and abundant solfataric activity suggest that volcanic activity in the area has been widespread during Recent times. The appearance of lava flows on Dobu Island and in the crater of Mount Oiau suggests that they have been erupted within the past 100-200 years, and that these centres at least should be considered to be active.

Mount Lamonai

Lamonai cone (Fig. 9) is about 4 km wide at the base and rises to a height of 487 m above sea level on the northeastern side. The slopes are relatively smooth, except on the western side, where they are deeply gullied. This difference is probably due to the presence of different rock types; the western and northwestern slopes are composed mainly of ash, whereas the northern, eastern, and southern slopes are covered mainly by lava flows. The upper southeastern slopes of the cone are made up of fragmental material (Taylor, 1955).

The crater of Mount Lamonai lies to the south-southeast of the summit (Fig. 9), and was described by Taylor (1955) as 'a sheer-sided, almost circular cavity dominated by the northern and northwestern walls which are several hundred feet higher than the southeast rim ... the vertical walls facing the southeast rim have a curious massive unbedded appearance as if they were composed of homogeneous rock. This structure suggests that the present crater may have been formed by a powerful explosive eruption slightly eccentric to a massive plug which has completely sealed up the original crater of the volcano. The crater is about 700 ft (210 m) deep and has almost vertical walls to the west, north and east. The crater floor is covered with dense vegetation, mainly rain forest, but the base of the southeast wall there is an open swampy area'.

An arcuate steep-sided valley on the northeastern side of the cone has the appearance of a volcanic vent, and is apparently a flank crater open to the northwest.

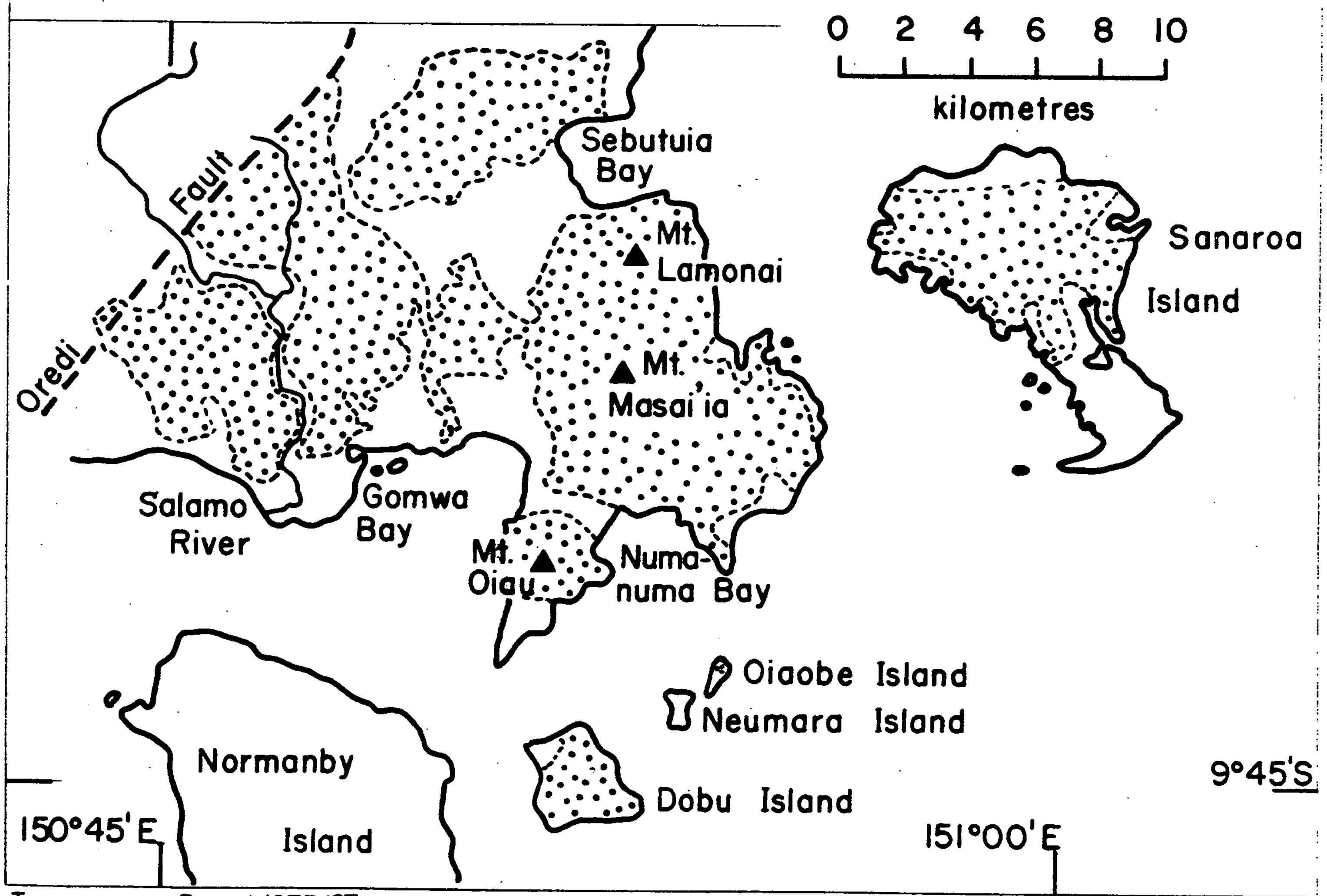
Glassy lava flows and weathered pumiceous ash crop out in coastal sections on the northeastern side of the cone, and ash is exposed on the northwestern side along the shore at Sebutuia Bay. The eastern and southern slopes of the cone appear from aerial photographs to be composed of lava flows, and the western part of the cone appears to be mainly ash. Taylor (1955) reported 'trachyte' as blocks on the southeast crater rim, and also forming the walls of the crater.

Thermal activity on Lamonai is confined to hot springs at sea level on the northeastern side of the cone.

Mount Oiau

Mount Oiau (Fig. 10), on Bwaioa Peninsula, is 10 km south-southwest of Mount Lamonai. The volcano is a dissected area of varying relief, with a low-lying, poorly defined central crater area. Regular radially incised slopes on the southeast side of the cone give a misleading impression of symmetry when Oiau is viewed from the southern side. Mount Oiau is composed mainly of fragmental material ranging from

Figure 8 Distribution of volcanic rocks on south-eastern Fergusson and adjacent islands.



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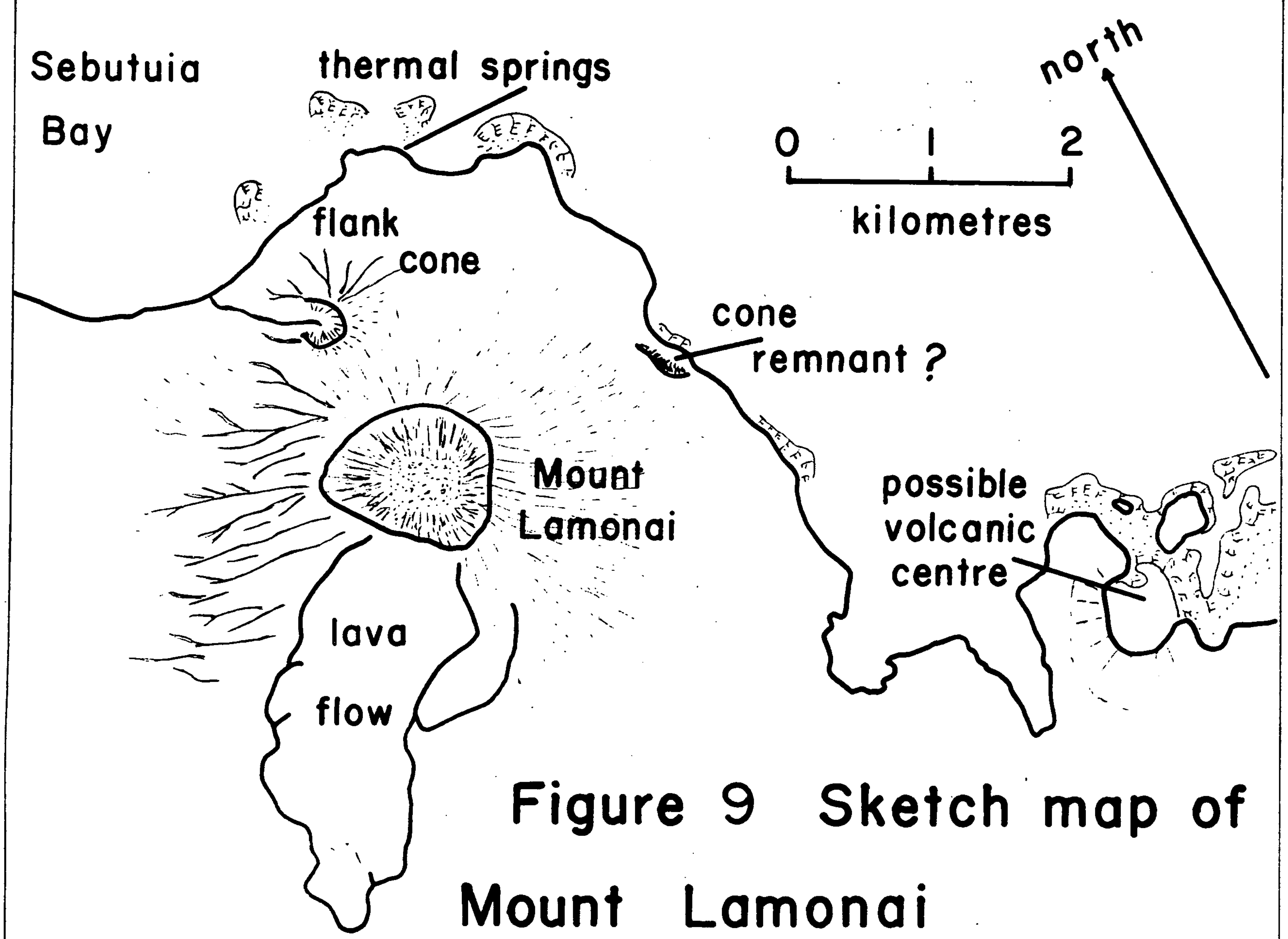
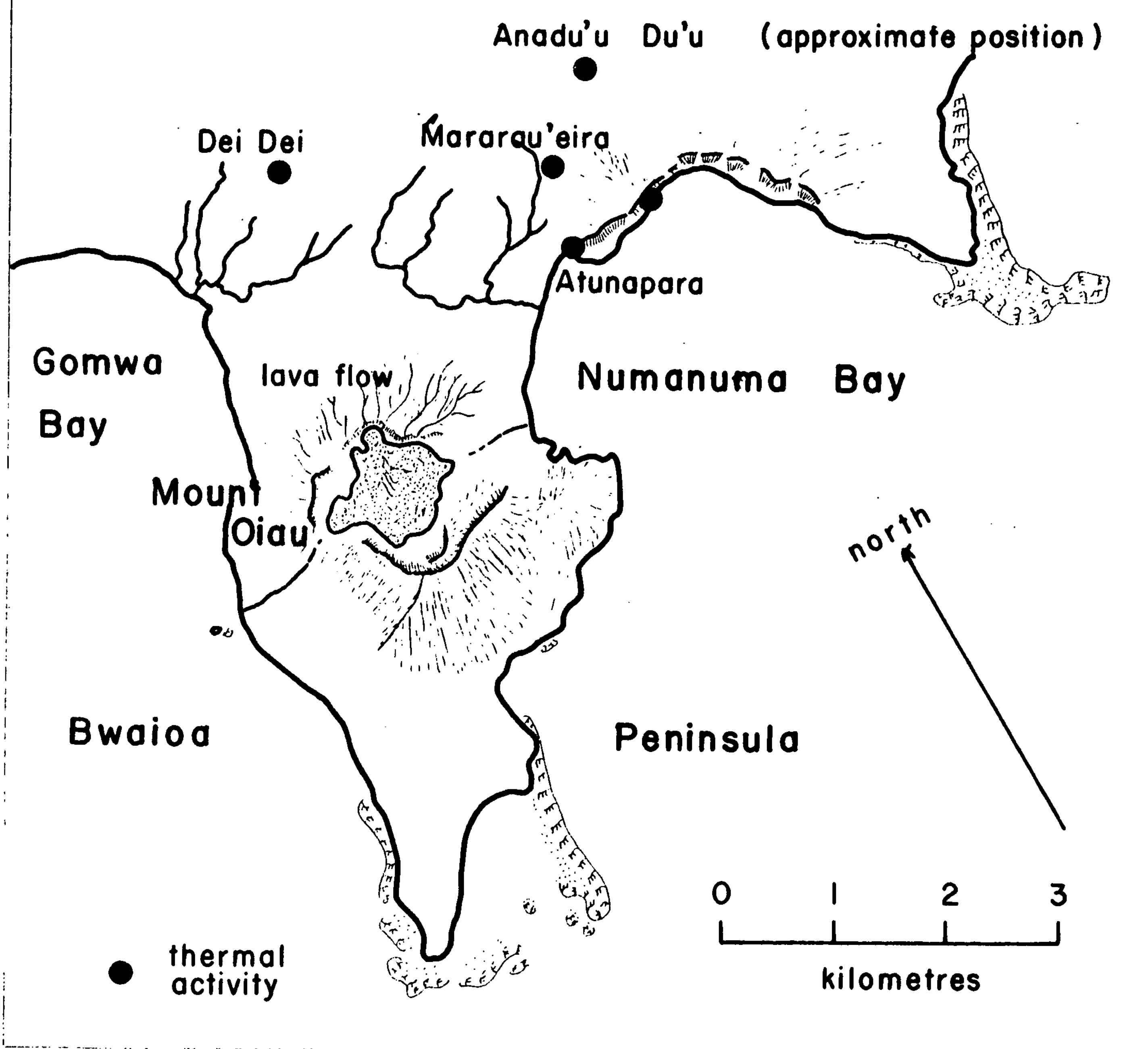


Figure 9 Sketch map of Mount Lamonai

(based on air photos.).

Figure 10 Sketch map of Mount Oiau and adjacent areas (based on air photos.).



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fine ash to agglomerate. Pumice is the major constituent but obsidian and silicic lava fragments are also present. Obsidian flows are present on the eastern side of the volcano, and are exposed along the coast immediately to the south of Numanuma Bay. The source of these flows is not clear, but was probably in the crater area.

The crater is a poorly defined, low-lying area in the centre of the cone. An arcuate crater rim and steep walls define the southern side of the crater; to the east and west the crater rim is breached by creeks; the northern side of the crater is defined by a series of irregular ridges. The southern crater wall rises to a height of over 300 m above sea level, and on the northern side of the crater the ridges rise to about 100 m above sea level.

A thick lobate lava flow fills much of the crater area. It extends into the heads of the valleys trending northeast and southwest, and was apparently extruded from a vent on the southern side of the crater. The flow is steep-sided, and has a maximum thickness of over 40 m; it was apparently extremely viscous when extruded, and flowed only a short distance from its source. The flow is a fine-grained rhyolite containing abundant glassy bands. Its surface is fresh and blocky and without appreciable soil cover, and it carries only a sparse cover of plants. This suggests that the flow was erupted within the last 100-200 years.

In summary, explosive eruptions which produced a high proportion of pumice appear to have been the main type of activity from Mount Oiau, but at times viscous silicic lava flows of relatively small volume were also extruded. The most recent activity from Mount Oiau was the eruption of the crater lava flow.

Numanuma Bay

The northern part of Numanuma Bay is bounded by near-vertical arcuate cliffs. Gentle slopes dip inland from the cliffs, and the general physiography of the area strongly suggests the presence of a volcano centred on Numanuma Bay. The area on the northern side of Numanuma Bay is probably the northern half of a volcano which, before it was destroyed, must have been bigger than any of the present-day cones in the area. Numanuma Volcano could have been a source for some of the extensive ash flow deposits between Gomwa and Sebutuia Bays.

Thermal fields on southeastern Fergusson Island

Numerous areas of thermal activity are present between Numanuma Bay and Gomwa Bay on Bwaioa Peninsula, southern Fergusson Island (Fig. 10). The whole thermal field is referred to as the Deidei thermal field, although this name is more commonly used for the two largest areas in the field. These large thermal areas are on the northeastern side of Gomwa Bay and about 1.5 km inland. They are each about 300 m long from east to west, and about 30 m wide; they are about 150 m apart. Both areas contain fumaroles, boiling springs, mud pots, and hot pools, and there are several small geysers which throw boiling water and steam to heights of 3-4 metres (Heming, 1969). Large parts of the areas are made up of bedded sinter.

Davies & Ives (1965) use the names Atunapara, Mararau'eira, and Anadu'u Du'u for thermal areas in the vicinity of Numanuma Bay (Fig. 10). The Atunapara thermal area consists of hot springs and fumaroles around the cliffs on the northern side of Numanuma Bay. The Mararau'eira and Anadu'u Du'u areas north of Numanuma Bay, contain fumaroles and hot springs.

Dobu Island

Dobu is an 8 km^2 volcanic island between Fergusson Island and Normanby Island (Fig. 11). It is a complex of coalesced volcanic centres, and is composed of pumiceous ash and subordinate small flows of rhyolite and obsidian. Three main eruptive centres can be recognized, and they are here termed the main cone, the southeastern crater, and the eastern cone (Fig. 11). Smaller centres are present within the main cone.

Dobu Island is built on a foundation of ash deposits, which are exposed in cliff sections in the northwestern part of the island. The lower beds in these sections usually have a slightly weathered appearance, and are more compacted than the overlying ash; pumice blocks within the lower beds have chilled glassy selvages. These features are interpreted as being due to deposition in water. The lower beds are fine to medium-grained, and in addition to pumice blocks contain angular lava fragments up to 2.5 m in diameter.

The upper parts of the northwestern cliff-sections are less consolidated than the lower parts, and usually show bedding and weakly developed soil horizons. Poorly sorted lenses containing angular rock fragments up to boulder size probably represent stream channels which have been buried by later eruptions.

The older ash beds on Dobu Island are dissected, and form hummocky country with a deeply entrenched drainage system; they are overlapped by pumiceous ash from the main cone.

Viewed from the northwest the main cone has a simple radially incised conical shape which belies its complex structure. The main feature of the cone is a central crater, 900 m in diameter, separated by a low ridge from the southeast coast, and bounded on the northern side by precipitous walls rising to 300 m above sea level on the northwestern side. The northern crater walls are composed of massive lava; elsewhere the crater walls are composed of fragmental materials. The northern part of the crater floor is flat and swampy; the southern part of the crater is undulating, and contains four small hillocks which are small lava cumulodomes. The largest of these is a grassy hillock composed of obsidian rising 30 m above the western part of the crater floor.

An arcuate ridge north of the central crater appears to be the rim of an older crater. The regular, radially incised slopes on the northern, northwestern, and western sides of the crater rim give the main cone its symmetrical appearance when viewed from the northwest. Most of the material forming these slopes of the main cone are well bedded, unconsolidated, medium to fine pumiceous ash.

A poorly defined flow of obsidian on the northeastern side of the main cone apparently originated from the central crater area. This flow is partly overlain by a smaller flow of similar composition which originated in a shallow valley between the central crater and the arcuate rim to the north. The smaller flow is the youngest on the island.

The southeastern crater is a semicircular bay on the southeastern side of the main cone. It is bounded to the north and west by steep-sided arcuate walls composed of agglomerate and fragmental material and is open to the southeast. There are warm springs in the northern part of the bay.

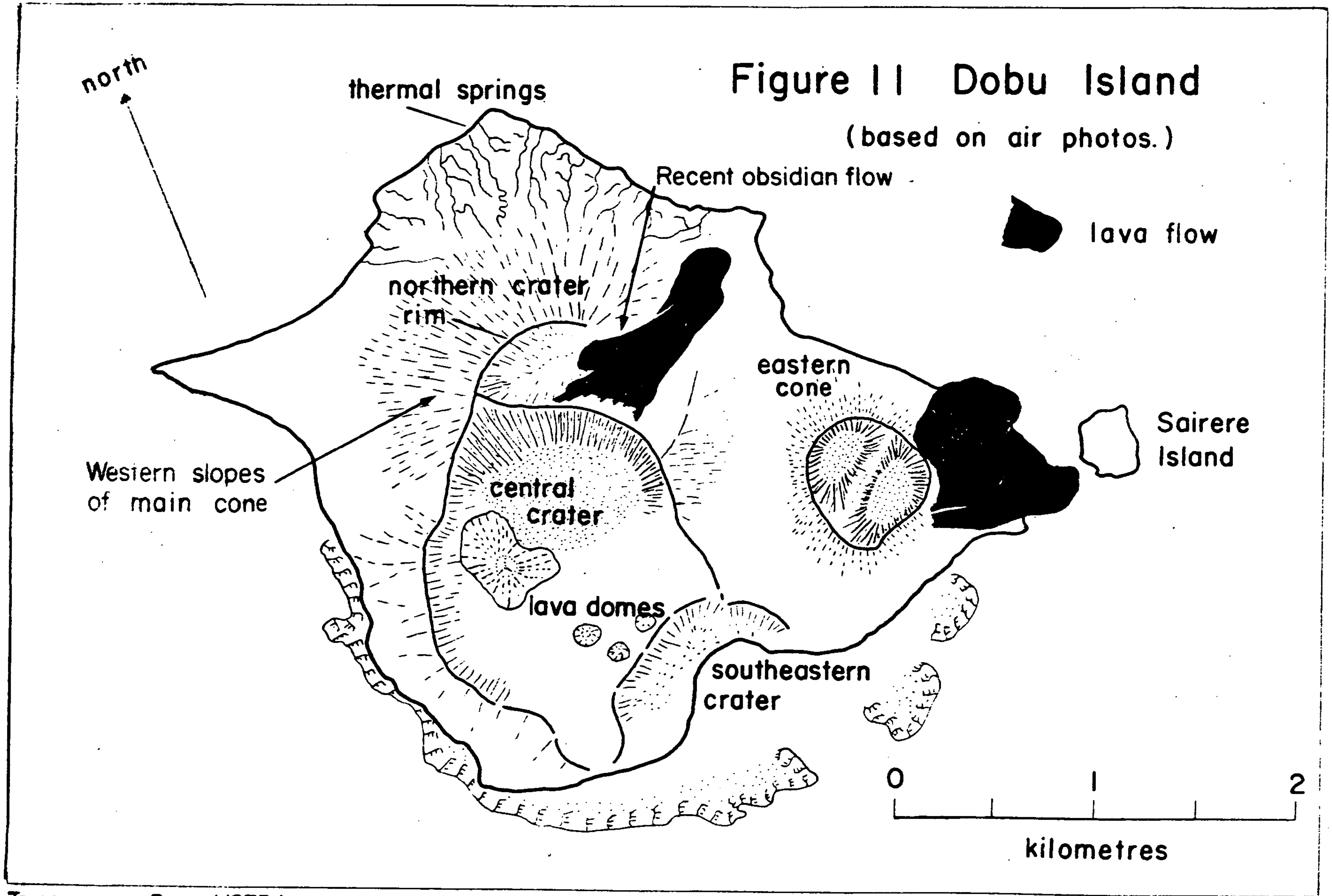

Figure 11 Dobu Island

(based on air photos.)

To accompany Record 1973/67

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The eastern cone is composed mainly of fragmental material, and makes up the eastern part of Dobu Island. The cone contains a steep-sided crater divided into two by a ridge composed of obsidian. There are areas of hot ground and weak solfataric activity in the western part of the crater. Flows of glassy and fine-grained lava which crop out at the eastern tip of Dobu Island apparently originated from the eastern cone. An outcrop of well-jointed, fine-grained lava on the southern side of eastern cone is probably part of the basement on which the cone is built.

Present-day thermal activity on Dobu Island is confined to a few warm springs on the beach and immediately offshore from the northern side of the island, warm springs in the southeast crater, and the small areas of solfataric activity in the crater of the eastern cone. A local report of a hot spring on the northern wall of the main crater has not been confirmed.

Neumara and Oiaobe Islands

Neumara and Oiaobe Islands are small islands lying immediately to the north of Dobu Island (Fig. 8); both are less than 0.5 km^2 in area.

Neumara Island is flat and low-lying and it is probably made up mainly of tuffaceous material, possibly on a coral reef basement. The southern part of Oiaobe Island is also low-lying, and is probably made up of the same type of material as Neumara Island. On the northern end of Oaiobe Island there is a small hillock composed of well jointed fine-grained lava.

Sanaroa Island

The northern part of Sanaroa Island (Fig. 8) is hilly, has a relief of 50-100 m, and is composed mainly of volcanic rocks. The southern part is low-lying, and is made up mainly of coral limestone. The volcanic rocks include welded tuffs, fine-grained rhyolitic lavas, obsidian, and rare vesicular basaltic rocks. No volcanic land forms can be recognized on aerial photographs of Sanaroa Island.

Petrography

The principal volcanic products on southeastern Fergusson Island and on the adjacent islands are rhyolitic tuff and ash, and subordinate small steep-sided flows and cumulodomes of fine-grained and glassy rhyolitic lava. The fine-grained lavas are light grey to green-grey porphyritic rocks, and the glassy lavas are typical porphyritic obsidians. The larger lava flows are predominantly crystalline, but contain abundant glassy bands. Phenocrysts in the rhyolitic lavas are alkali-feldspar (anorthoclase), minor clinopyroxene, iron-titanium oxides and fayalitic olivine, and rare aenigmatite.

The feldspar phenocrysts are large (0.5 to 2 mm) and abundant compared to the pyroxene phenocrysts which are comparatively rare and small (less than 0.3 mm). The pyroxenes are pale to dark green, and probably range in composition from hedenbergitic augite to aegirine-augite. Small grains of iron-titanium oxides commonly form clusters with pyroxene phenocrysts. Phenocrysts of olivine are less common than pyroxene phenocrysts, and they are not present in all specimens. Aenigmatite is present as small phenocrysts, and only in a few specimens. In the crystalline lavas the groundmass is fine-grained, and is composed of feldspar, irregular patches of quartz, and minor clinopyroxene, brown-green to blue amphibole (arfvedsonite), and aenigmatite. The glassy lavas have a groundmass of colourless, or less commonly brown, isotropic glass containing microlites of feldspar, pyroxene, iron-titanium oxides, and aenigmatite. In some specimens the glass contains abundant flow-oriented ovoid bubbles.

Two specimens of porphyritic tuff have been collected from rounded boulders adjacent to the lower reaches of the Salomo River in southeastern Fergusson Island. The specimens contain large (up to 2 mm) angular crystals of plagioclase (oligoclase) and less common alkali-feldspar (anorthoclase) and small crystals of pale green clinopyroxene, iron-titanium oxides and possible aenigmatite, and rounded fragments of rhyolitic lava up to 3 mm across. These are set in a fine-grained turbid brown matrix of welded devitrified glass shards and zeolite.

Sparsely porphyritic lava blocks collected from the older ash deposits on the northern side of Dobu Island contain phenocrysts of plagioclase (calcic andesine), clinopyroxene, and rare olivine, in a fine-grained groundmass of plagioclase, clinopyroxene, iron-titanium oxides, fine green-brown mesostasis, and minor secondary calcite. Plagioclase and clinopyroxene, with or without olivine, form subophitic clusters of possible accumulative origin in some specimens. A similar rock-type forms boulders on the shores of the possible volcanic centre to the southeast of Mount Lamonai.

A porphyritic inclusion collected from large blocks of rhyolitic lava at the base of the cliffs on the northern side of Numanuma Bay contains phenocrysts of plagioclase, iron-titanium oxides, and clinopyroxene in a fine groundmass of plagioclase, clinopyroxene, and opaque oxides. Some of the opaque oxide phenocrysts in this specimen contain relic cores of hornblende.

Davies & Ives (1965) described a vesicular basaltic rock consisting of labradorite, clinopyroxene, and iron-stained devitrified glass which crops out in the lower reaches of the Salamo River in southeastern Fergusson Island. Apart from this occurrence, basic and intermediate volcanic rocks have been found only as inclusions in rhyolitic lava flows and as blocks in pyroclastic deposits.

The rhyolitic lava flows at the eastern end of Dobu Island contain abundant rounded inclusions of dark grey porphyritic vesicular rock ranging from a few millimetres to tens of centimetres in diameter. The inclusions contain phenocrysts of labradorite, clinopyroxene, and olivine in a fine-grained groundmass of plagioclase, clinopyroxene, and abundant iron-titanium oxides. A similar rock was collected from a rounded boulder on the east coast of Sanaroa Island. It is sparsely porphyritic, and contains small phenocrysts of labradorite in a groundmass of plagioclase, clinopyroxene, iddingsitized olivine, and abundant grains of iron-titanium oxides.

NORMANBY ISLAND

Volcanic products cover a large part of the northwestern part of Normanby Island, and they form isolated areas south of Sewa and Awaiara Bays (Fig. 12). Duchess Island, off the west coast of Normanby Island, is also made up of volcanic rocks. The maximum thickness of volcanic rocks on

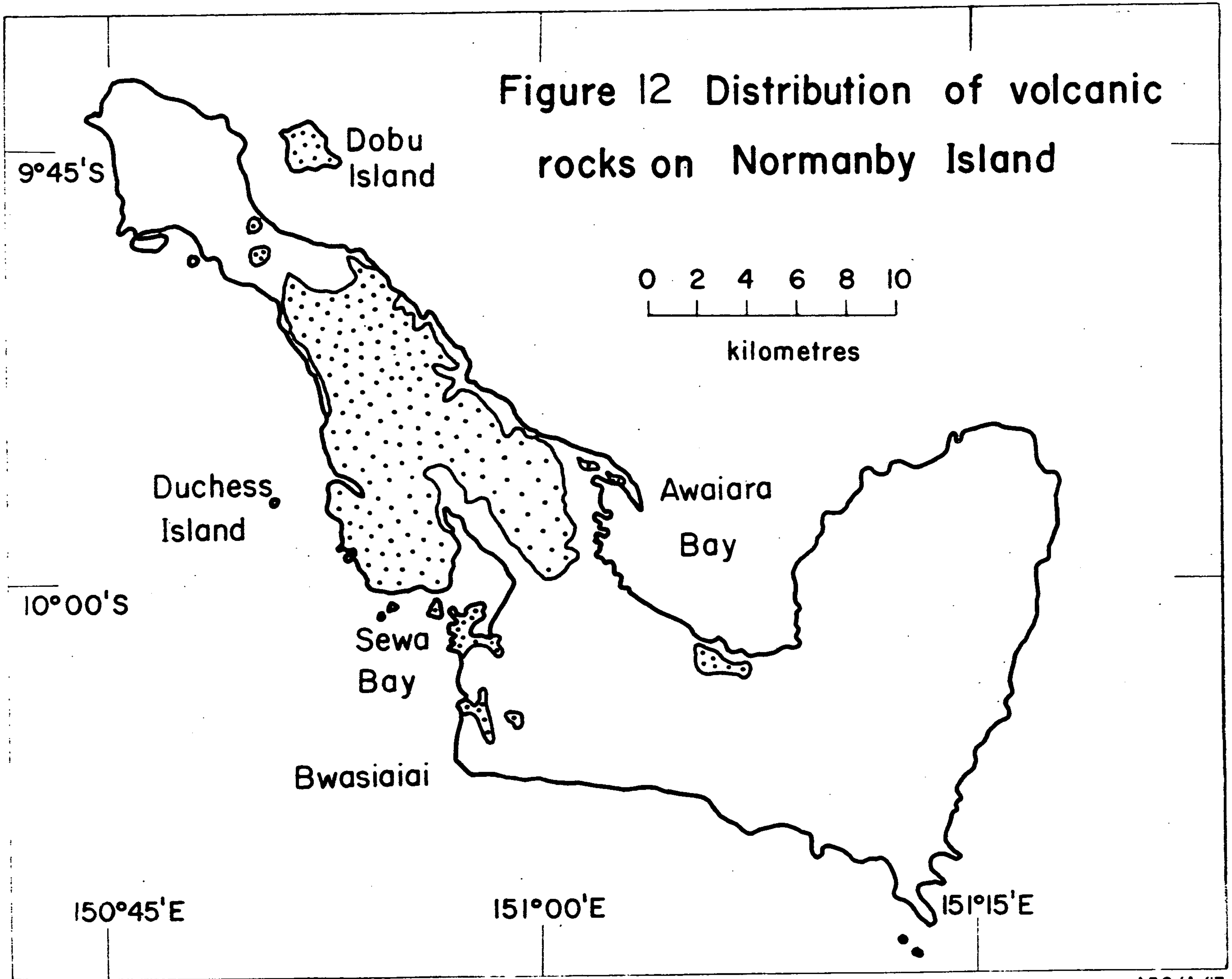

Figure 12 Distribution of volcanic rocks on Normanby Island

To accompany Record 1973/67

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Normanby Island - of the order of several hundred metres - is reached in the hills to the north of Sewa Bay. In this area the rocks are more deeply dissected, and are typically slightly altered. Dip slopes of agglomerate were noted by Davies (1967) in the hills west of Awaira Bay, but no volcanic land forms have been recognized by the present writer.

No isotopic age determinations have been carried out on the volcanic rocks collected from Normanby Island. Some of the Normanby Island lavas show petrographic similarities with the Recent lavas on Dobu Island and southeastern Fergusson Island; this suggests that they may be comparable in age. However, the lack of volcanic land forms and the comparatively high degree of secondary alteration found in many of the Normanby Island lavas suggests that most of the volcanic rocks on the island are at least as old as Pleistocene.

Thermal activity is found at Bwasiaiai on the southwestern tip of the island. The thermal area lies on the line of a major fault, and Davies (1967) considered that the thermal activity is related to the faulting and not to any recent volcanic activity.

Petrography

Basaltic and intermediate lavas are common in southwestern Normanby Island. They are for the most part medium to dark grey sparsely to strongly porphyritic rocks containing phenocrysts of olivine and clinopyroxene or of labradorite (An_{50-65}), clinopyroxene, and olivine, with or without small grains of iron-titanium oxides. Weakly pleochroic orthopyroxene forms phenocrysts in some specimens. The groundmass of these rocks is fine-grained, and consists mainly of plagioclase, subordinate clinopyroxene and iron-titanium oxides, and less commonly olivine; interstitial brown glass is abundant in some specimens. Vesicles are present in some specimens, and these are commonly lined with fine-grained zeolites.

Hornblende-bearing lavas are less common. They are typically porphyritic, containing phenocrysts of plagioclase, clinopyroxene, and hornblende, and less commonly biotite and iron-titanium oxides, and rarely olivine. The fine-grained groundmass consists of plagioclase, clinopyroxene, and opaque oxides.

Porphyritic leucocratic volcanic rocks are common in the northern part of Normanby Island. Many specimens contain phenocrysts of andesine (An_{30}, less commonly An_{40-45}), subordinate biotite or clinopyroxene, chlorite pseudomorphs (possibly after mafic phenocrysts), and rare hornblende. The groundmass is fine-grained, and consists of feldspar (plagioclase and alkali feldspar), quartz, and minor iron-titanium oxides and chlorite. Epidote, calcite, and chlorite are common secondary minerals.

Porphyritic rhyolitic lavas containing phenocrysts of alkali feldspar, subordinate quartz, and rare pyroxene (aegirine-augite) in a fine feldspathic groundmass crop out in northeastern Normanby Island. These rocks probably form only a small part of the volcanic rocks on the island, but they are interesting in view of their petrographic similarity to the lavas on Dobu Island and southeastern Fergusson Island.

THE AMPHLETT GROUP, AND UAMA AND TEWARA ISLANDS

These islands lie to the north and northeast of Fergusson Island (Fig. 13), and are composed entirely of lava and agglomerate. There are twenty islands in the Amphlett Group, ranging in size from less than 10 m^2 to 4 km^2. The largest islands in the group are Watota, Belobeloia, Yabwaia, Urasi, and Wamea Islands. Uama and Tewara Islands lie 25 km to the southeast, between the Amphlett Group and Sanaroa Island.

The Amphlett Islands and Uama and Tewara Islands are steep and rocky. They are surrounded by relatively deep water, and the highest, Yabwaia Island, rises to 586 m above sea level. The roughly circular outline of the Amphlett Group suggests that the islands may represent the outer remnant of a large volcano, or group of volcanoes centred in the middle of the group, but the altitudes of lava flows and bedded agglomerate in the islands show no systematic pattern to support this. Cliffs rise vertically to over 200 m on the southwestern side of Urasi and Wamea Islands and could possibly represent remnant caldera walls.

Petrography

The Amphlett, Uama, and Tewara Islands are made up of volcanic rocks which crop out as massive jointed flows and agglomerate beds which are intruded by dykes on several of the Amphlett Islands. The rocks are medium to dark grey or less commonly red-brown, and characteristically porphyritic, and are vesicular in some outcrops. Typical phenocrysts assemblages are olivine, clinopyroxene, and orthopyroxene, with or without plagioclase; labradorite and pyroxene with or without olivine or iron-titanium oxides replacing hornblende and biotite; and plagioclase (An_{45-55}), hornblende, biotite, and rare pyroxenes. Quartz xenocrysts surrounded by narrow reaction rims are present in some specimens. The groundmass of these rocks is fine-grained, and consists mainly of plagioclase with subordinate pyroxene, iron-titanium oxides, minor interstitial glass or mesostasis, and, in more basic specimens, some olivine.

EGUM ATOLL

Egum Atoll lies midway between Fergusson Island and Woodlark Island (Fig. 1) on the southern side of a submarine topographic high known as the Woodlark Rise (Krause, 1967). It is a typical atoll, being composed of reefs and low-lying coral islands which rise from relatively deep sea, and enclose a large lagoon containing small volcanic islets (Fig. 14). The coral islands lie mainly on the northern and northeastern sides of the lagoon. The largest island, Yanaba Island, is composed of reef limestone which is raised about 5 m above sea level at its western end. Reefs extend southeast and southwest of Yanaba Island, and enclose the northern part of the lagoon, but the reefs around the southern half of the lagoon are entirely below sea level.

In the centre of the lagoon there are two groups of small rocky volcanic islets which rise about 15 m above sea level. The southwestern group - an islet of about 0.2 km^2 and two large offshore rocks - is called Nasakori or Panemote Island. The other group consists of six small islets, 0.5 km^2 or less in area, and is known as the Egum Islands. The islands are composed of jointed porphyritic volcanic rock containing abundant rounded inclusions.

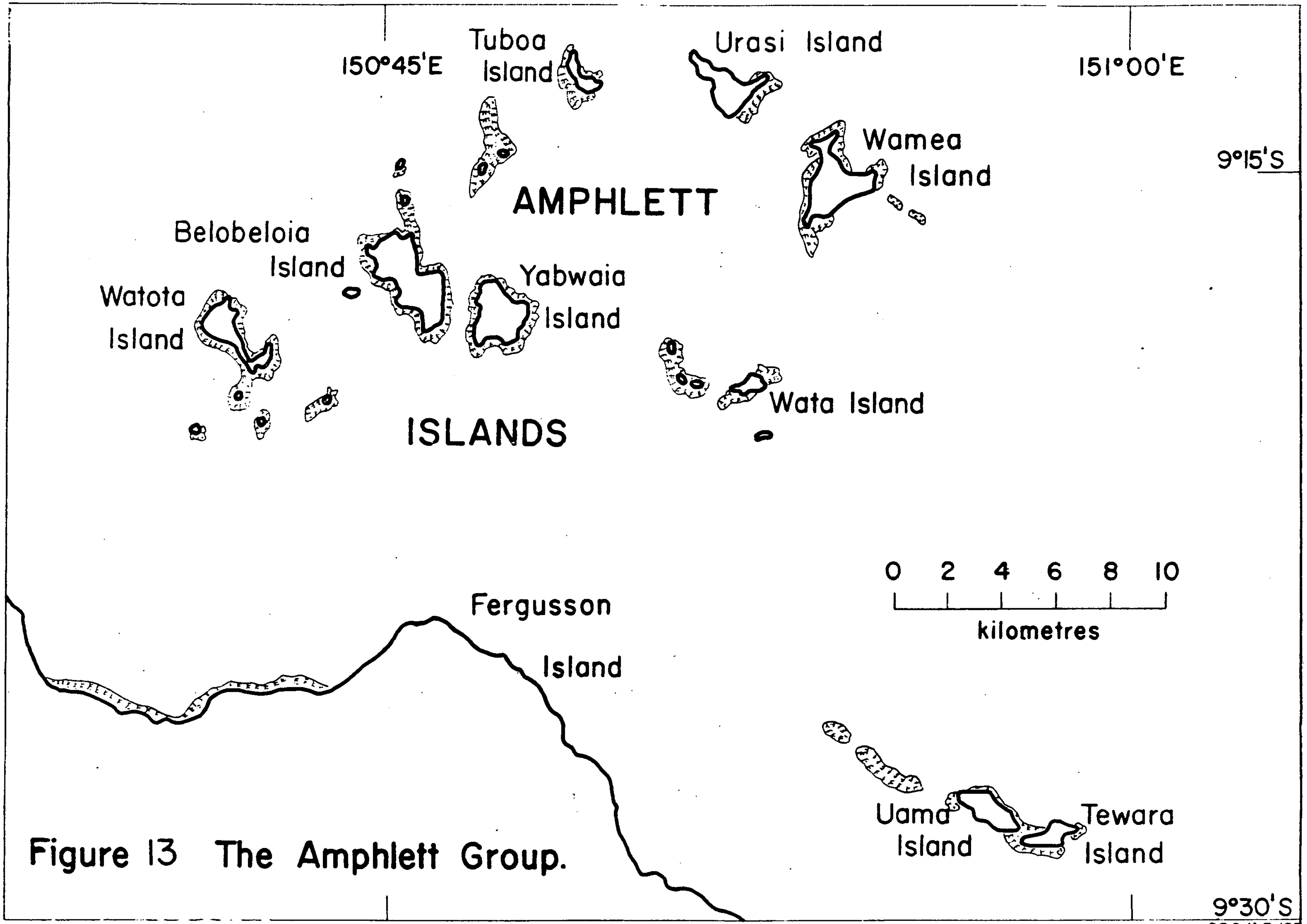

Figure 13 The Amphlett Group.

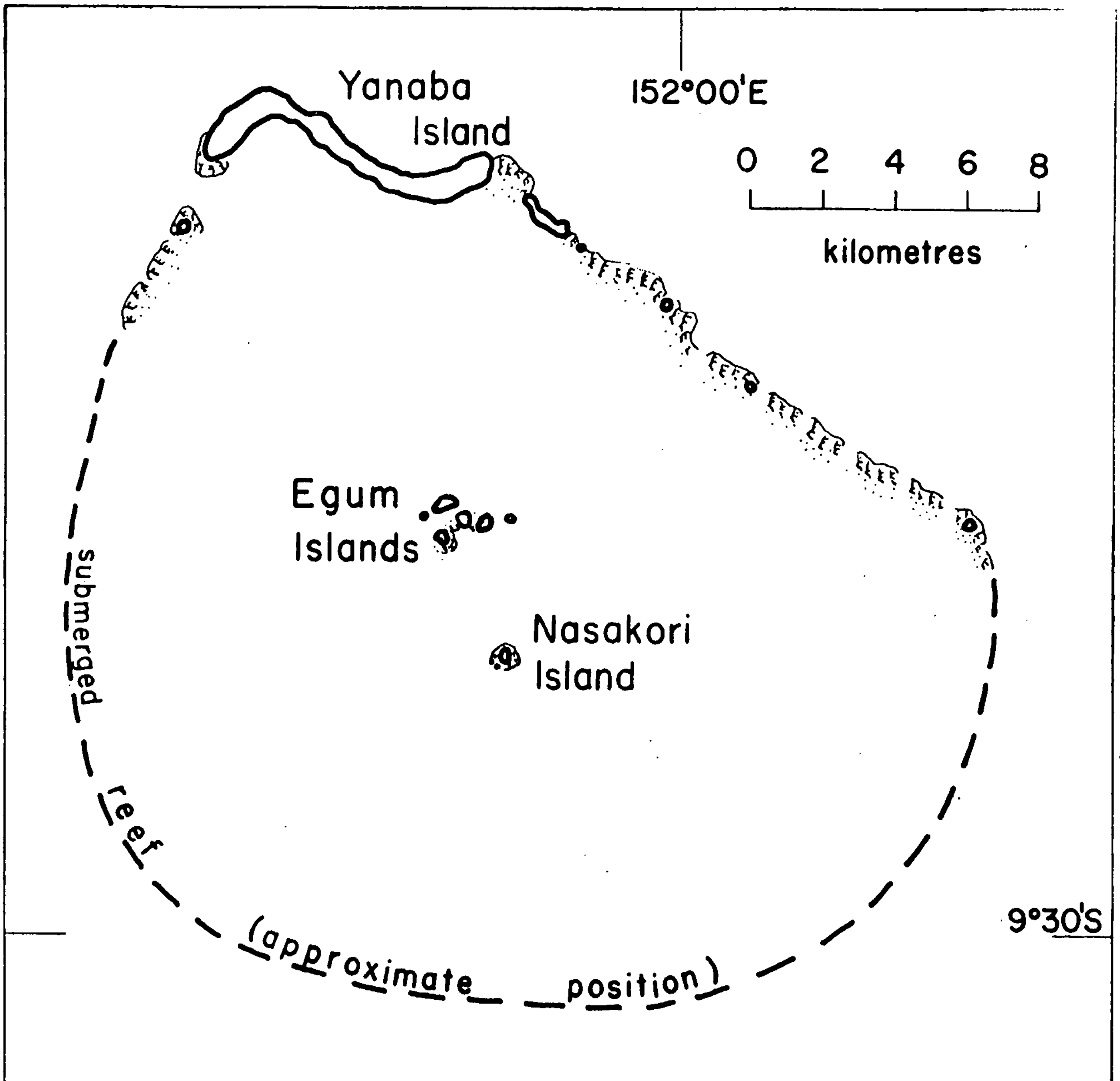

Figure 14 Egum Atoll.

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Petrography

The Egum Atoll volcanic rocks contain phenocrysts of calcic andesine, iron-titanium oxides, clinopyroxene, and less commonly orthopyroxene, biotite, and hornblende in a fine groundmass of plagioclase, pyroxene, and opaque oxides. Aggregates of iron-titanium oxide grains displaying biotite and hornblende morphology are common in some specimens.

Inclusions in the lavas are fine to medium-grained, and consist of plagioclase, iron-titanium oxides, and minor clinopyroxene.

LUSANCAY ISLANDS

The Lusancay Islands (Fig. 15) are part of a reef complex bordering the Solomon Sea basin. To the south, an area of mainly shallow sea separates the islands from the D'Entrecasteaux Group.

The Lusancay Islands are for the most part low-lying coral and sand cays, but Matagu, Nauria, Kawa, Simsim, and Wagalasa Islands on the southern side of the group are relatively high (up to 70 m), steep, and rocky. Matagu Island is composed of cream to pink coral limestone. Kawa Island consists mainly of coral limestone, but large boulders of light grey biotite-bearing volcanic rock on the beach on the western side of the island suggest that this island may have a basement of volcanic rocks. Nauria Island is composed entirely of fine-grained well jointed volcanic rocks, and Simsim and Wagalasa Islands each have a prominent volcanic hill rising 60-70 m above sea level at their southern ends.

The volcanic rocks which crop out on some of the Lusancay Islands may be representative of a volcanic basement which aeromagnetic work (CGG, 1971) suggests underlies the Trobriand and Marshall Bennett island groups. Some confirmation of this comes from the report of Mr Glen E. Steen (pers. comm., 1972) that volcanic rocks similar to those in the Lusancay Group crop out on Boinagi and Ioana Islands on the western side of the Trobriand Group.

K-Ar dating of specimens from Simsim and Wagalasa Islands (Appendix I) yielded ages of 1.10 and 1.08 m.y., respectively, indicating a Pleistocene age for the volcanic rocks in the Lusancay Islands. A further K-Ar determination of 2.3 m.y. on a specimen from Simsim Island was kindly supplied by Mr Steen (Amoco, Australia). This older age suggests that Pleistocene is a minimum age for the volcanic rocks in the Lusancay Islands.

Petrography

The volcanic rocks in the Lusancay Islands are fine-grained and medium to dark grey or less commonly red. In thin section they are porphyritic, and contain well formed, sparse to abundant phenocrysts of clinopyroxene up to 0.5 mm in diameter set in a very fine-grained groundmass. Elongate biotite crystals are also present as phenocrysts in some specimens. Many of the clinopyroxene phenocrysts are zoned and show pale green or brown rims and a colourless core. The groundmass in these rocks consists of plagioclase and probably alkali-feldspar with minor iron-titanium oxides and pyroxene. Biotite and small low-birefringence six-sided crystals tentatively identified as leucite are present in the groundmass of many of the specimens collected in the Lusancay Group.

Gabbroic inclusions are common in the volcanic rocks which crop out in the Lusancay Islands. They are medium to fine-grained (0.5-1.5 mm), and typically consist of plagioclase (An_{65-70}) and clinopyroxene accompanied by minor iron-titanium oxides.

DISCUSSION

The potassium-argon dates which are presented in Appendix I cover most of the areas of Late Cainozoic volcanics in the islands east and northeast of Papua and provide a framework for a discussion of the age of volcanic activity in the islands.

The oldest data available is 11.4 m.y. from Panarora Island (Fig. 2) and it provides evidence of a localized episode of volcanic activity in the Louisiade Archipelago during upper Miocene time. Elsewhere in the islands the volcanic rocks are Pliocene or younger.

The dates from Wawina Island (3.9-3.5 m.y.) in the Amphlett Group (Fig. 13), from Egum Atoll (2.9-2.8 m.y.) and the Lusancay Islands (2.3-1.1 m.y.) show that volcanic activity was widespread in the islands during upper Pliocene to Pleistocene times. Davies & Ives (1965) have suggested that because some of the volcanic rocks on Kukuia Peninsula, southwestern Fergusson Island, are folded they may be Pliocene in age. However, the potassium-argon dates from Kukuia Peninsula (1.33-0.42 m.y.) suggest that a substantial proportion of the volcanic activity on the peninsula took place during Pleistocene times.

Youthful volcanic landforms indicate that volcanic activity continued into the Recent on Goodenough Island, on the western and southeastern parts of Fergusson Island, and on Dobu Island between Fergusson and Normanby Islands. On Fergusson Island, present-day thermal activity in the Iamalele-Fagululu area in the west and in the Deidei and adjacent areas in the southeast, suggests that renewed volcanic activity in these areas is a strong possibility.

ACKNOWLEDGEMENTS

The author acknowledges the valuable assistance and companionship in the field of Mr B.J. Humphreys and the hospitality of many people in the islands, especially that of Mr R. Hallahan, ADC, Esa-ala. R.W. Johnson and W.B. Dallwitz gave useful criticisms of the original draft report, and this assistance is gratefully acknowledged.

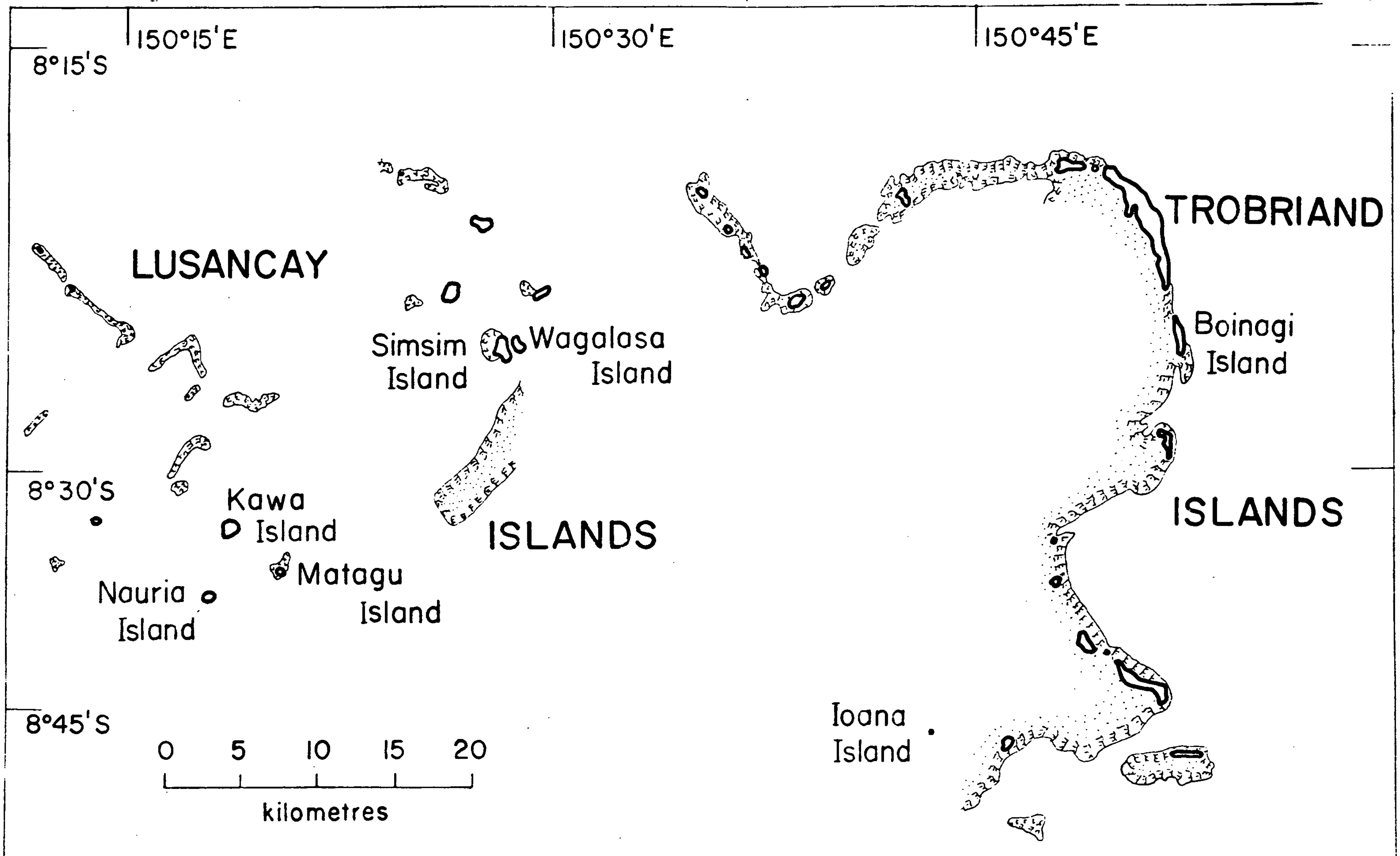

Figure 15 Lusancay and Trobriand Islands

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36

APPENDIX I

POTASSIUM-ARGON DATES ON SAMPLES OF LATE CAINOZOIC VOLCANICS FROM THE OFFSHORE ISLANDS OF EASTERN PAPUA

Specimen No.	Locality	Material Used	Atmospheric Ar^{40}	Wt % K_2O	Ragiogenic Ar^{40}/K^{40}	Age	
3689E [1]	Panarora Island	total rock	34.4 40.3	1.639 1.641	6.693×10^{-4} 6.439×10^{-4}	11.4±0.3 11.4±0.3	Upper Miocene
0096	Wawina Island	horn-blende separate	67.2 68.8	0.699 0.704	2.329×10^{-4} 2.099×10^{-4}	3.98±0.5 3.59±0.5	Pliocene
0217	Egum Islands	total rock	55.1 55.2	1.944 1.928	1.702×10^{-4} 1.660×10^{-4}	2.91±0.15 2.84±0.15	
2243 [2]	Simsim Island	total rock		5.067 5.065	1.36×10^{-4}	2.3 ± 0.1	Pliocene
0140	Simsim Island	total rock	47.9	4.399 4.426	0.6404×10^{-4}	1.10±0.10	to
0148	Wagalasa Island	total rock	94.4	5.757 5.755	0.6294×10^{-4}	1.08±0.15	Pleistocene
0154	Kukuia Peninsula	total rock	97.6 98.1	0.329 0.326	0.7750×10^{-4} 0.5993×10^{-4}	1.33±0.25 1.03±0.25	Pleistocene
0172	Kukuia Peninsula	total rock	89.2 91.3	1.339 1.353	0.2424×10^{-4} 0.2793×10^{-4}	0.415±0.15 0.478±0.15	

1 Data from Smith (in press)

2 Data kindly provided by Mr Glen E. Steen of Amoco Exploration Company and presented here by permission of the company; analysts - Geochron Laboratories, U.S.A.

Remaining samples were analysed at AMDL by Dr A.W. Webb; sample details are given below.

Field and petrographic notes on samples used for potassium-argon dating are given below. All sample numbers carry the BMR prefix 7089.

No.

0096 Wawiwa Island, Amphlett Group (09°17'S, 150°45'E; phenocrysts of plagioclase, hornblende, minor hypersthene; fine feldspathic groundmass; outcrop.

0140 Simsim Island, Lusancay Group (08°23'S, 150°27'E); sparse phenocrysts of clinopyroxene in fine feldspathic groundmass; outcrop.

APPENDIX I (Cont.)

No.

0148 Wagalasa Island, Lusancay Group (08°23'S, 150°27'E); sparse phenocrysts of clinopyroxene and biotite in fine feldspathic groundmass; large blocks on beach on southeastern side of island.

0154 Kukuia Peninsula, Fergusson Island (09°37'S, 150°28'E); phenocrysts of plagioclase and olivine in a fine feldspathic groundmass; angular boulder, Badavidavi Creek.

0172 Kukuia Peninsula, Fergusson Island (09°37'S, 150°30'E); phenocrysts of plagioclase, olivine, clinopyroxene and orthopyroxene in a groundmass of plagioclase, pyroxene, and opaque minerals with minor olivine and interstitial glass; outcrop in the centre of the peninsula.

0217 Egum Island, Egum Atoll (09°25'S, 151°57'E); phenocrysts of plagioclase and iron-titanium oxides in a feldspathic groundmass; outcrop.

40x