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GEOLOGY OF THE WHITIANGA GROUP, GREAT MERCURY ISLAND – PART I. COROGLEN SUBGROUP STRATIGRAPHY

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SUMMARY

A 250m thick, lensing sequence of rhyolitic pyroclastites, epiclastites and pyroclastic flow deposits (Coroglen Subgroup) overlies an irregular surface of older andesites on Great Mercury Island. Deposition was mostly subaerial, but occasionally fluviatile or lacustrine; the source being volcanic vents at the southern end of the island. Rhyolite domes intruded the Coroglen rocks and extruded flows both during and after their deposition. Minor basalt was also erupted contemporaneously with the rhyolite.

INTRODUCTION

Great Mercury Island lies off the east coast of Coromandel Peninsula (Fig. 1), 20km east of Kennedys Bay. The geology was first studied by Professor R.N. Brothers in the early 1950's but his results have never been published, although they formed the basis of Schofield's (1967) 1:250,000 map. Recently, Skinner (*in press*) has compiled a 1:63,360 map "from aerial photos using unpublished field data and samples collected by Professor R.N. Brothers."

Field work for the present paper was carried out during the A.U.F.C. scientific trip in May 1975. Using the earlier maps of Brothers and Skinner as a base, the study was directed towards resolving some of the discrepancies between the two and towards accurately mapping the outcrop and studying the stratigraphy of the Whitianga Group pyroclastics (Coroglen Subgroup). Needless to say this study has shown that photogeology is no match for actual field observations.

Geological setting

The oldest rocks of Great Mercury Island are exposed in the north and consist of andesite flows, intrusions and pyroclastics of probable Miocene-Pliocene age (Coromandel Group – Hayward 1974a; Skinner *in press*). Terrestrial erosion that followed produced an irregular, deeply leached topography over which Pliocene–Pleistocene rhyolites (Whitianga Group) were erupted. A similar but diachronous erosion break has been reported throughout the Coromandel Peninsula (Fraser 1910; Hayward and Moore 1973; Hayward 1974a). On Great Mercury Island, a rhyolite dome complex of Minden Rhyolite Subgroup (Zutelija 1976) is preserved in the south and rhyolite pyroclastics (Coroglen Subgroup) mantle the andesite in the north, centre and west. Basalts (Whakau Volcanics – Hayward and Moore 1972; Mercury Basalts – Skinner *in press*) were erupted in the area of the Mercury Islands contemporaneously with the rhyolites. Intrusive andesite (referred to Coromandel Group by Skinner *in*

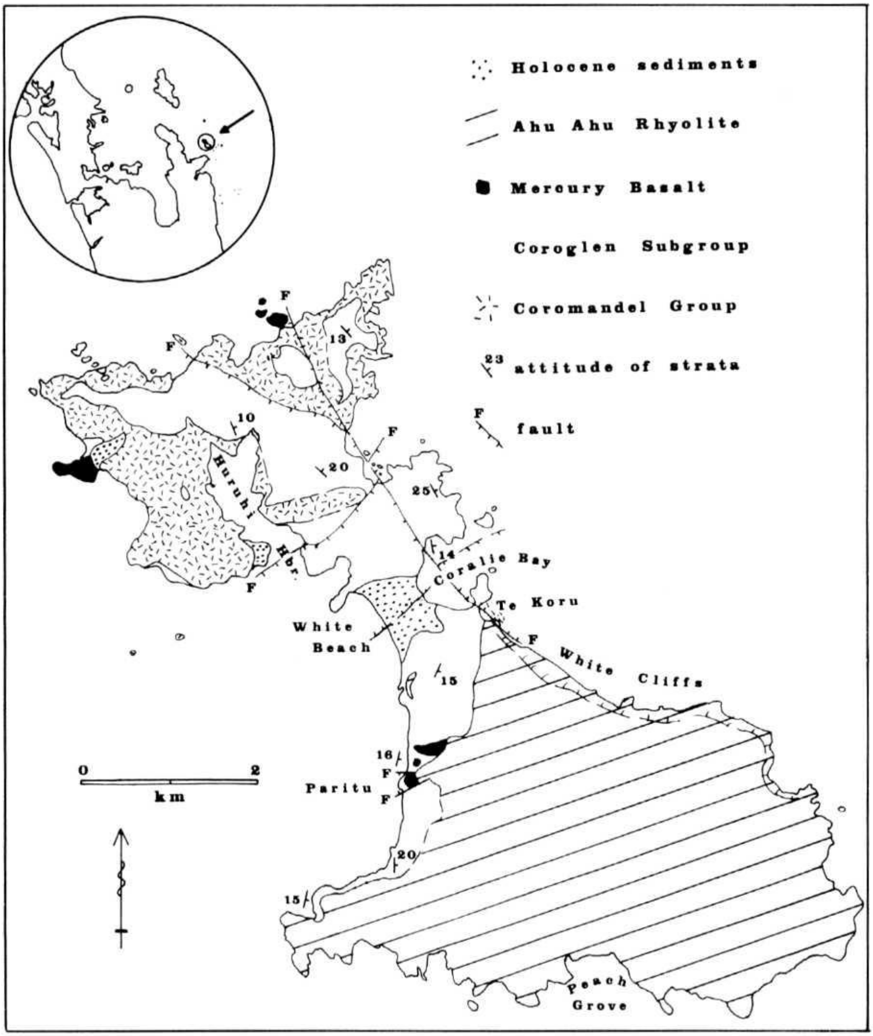

Fig. 1. Geological map of Great Mercury Island.

press) is inferred to have intruded the whole sequence. These supposedly younger andesites could not be distinguished from the older andesites in the field and have not therefore been mapped separately (Fig. 1). No intrusive contacts are exposed and in the author's opinion, only the Mt Cook andesite body gives any suggestion of being younger than the rhyolites.

Coroglen Subgroup bedding indicates that Great Mercury has an easterly tilt in common with much of Coromandel Peninsula (Hayward 1974a), and an arcuate strike from NE in the south through N to NW in the north (Fig. 1). This arcuate trend is considered to be fault induced.

STRATIGRAPHY OF WHITIANGA GROUP: COROGLEN SUBGROUP

Whitianga Group includes all Pliocene-Pleistocene rhyolitic rocks of the Coromandel volcanic sequence and contains two penecontemporaneous and consanguinous subgroups (Thompson 1966; Hayward and Moore 1973; Hayward 1974b): Minden rhyolite = rhyolite domes and lithoidal flows, and Coroglen subgroup = rhyolitic pyroclastites, epiclastites and pyroclastic flows. On Great Mercury Island, Coroglen Subgroup is geographically separated into southern and northern areas by a Holocene sand tombolo between White Beach and Coralie Bay (Fig. 1).

1. Southern Great Mercury

The greater portion of southern Great Mercury consists of Minden Rhyolite (Fig. 1) described by Zutelija (1976), but a lensing sequence of Coroglen Subgroup rocks outcrops in the low western cliffs between Ahikopua and White Beach and extends north-eastwards to Motutaupiri (Figs. 1, 2). Owing to poor inland exposure, the relationship between Coroglen pyroclastites and Minden Rhyolites is often obscure. Intrusive contacts are exposed east of Ahikopua and at Te Koru, whereas rhyolite flows overlie the pyroclastic sequence at Pukoromiko and occur within it at Waitetoke (Fig. 2). No contact on underlying andesites is exposed in this southern area, but it is inferred from comparison with northern Great Mercury to be at a shallow depth. The total exposed thickness is of the order of 150m.

The lowest beds consist of 20-40m of bedded tuffs, lapilli tuff and lapillistone with lenses of andesite- and rhyolite-bearing pumice breccia, and andesite, rhyolite and pumice conglomerate (Columns A to E, Fig. 2). The conglomerate clasts are well-rounded to sub-angular cobbles and pebbles, and sometimes form cross-bedding or scour and fill structures suggesting transport and deposition by fast moving water, probably streams. The bedded pyroclastites are also cross-bedded and scoured in places, but at Pukoromiko mantle-bedded lapillistone and tuff are indicative of subaerial deposition from tephra showers. A 10-20m thick pumice breccia overlies these lower beds; it thins out and becomes less coarse towards the north grading into a massive lapillistone (Columns A, E).

These units are overlain by lensing flows. A 30m+ thick rhyolite flow (Columns A, B), probably extruded from a centre in the south-west of the island, wedges out northwards towards Paritu. A 5m thick rhyolite flow lens at Waitetoke (Column F) occurs at approximately the same stratigraphic level. Almost contemporaneous with the eruption of these rhyolite flows, basalt was extruded over the pyroclastites at Paritu (Column E). A plug-like body of basalt exposed in the stream north of Paritu (Fig. 2) was presumably the intrusive feeder to this flow.

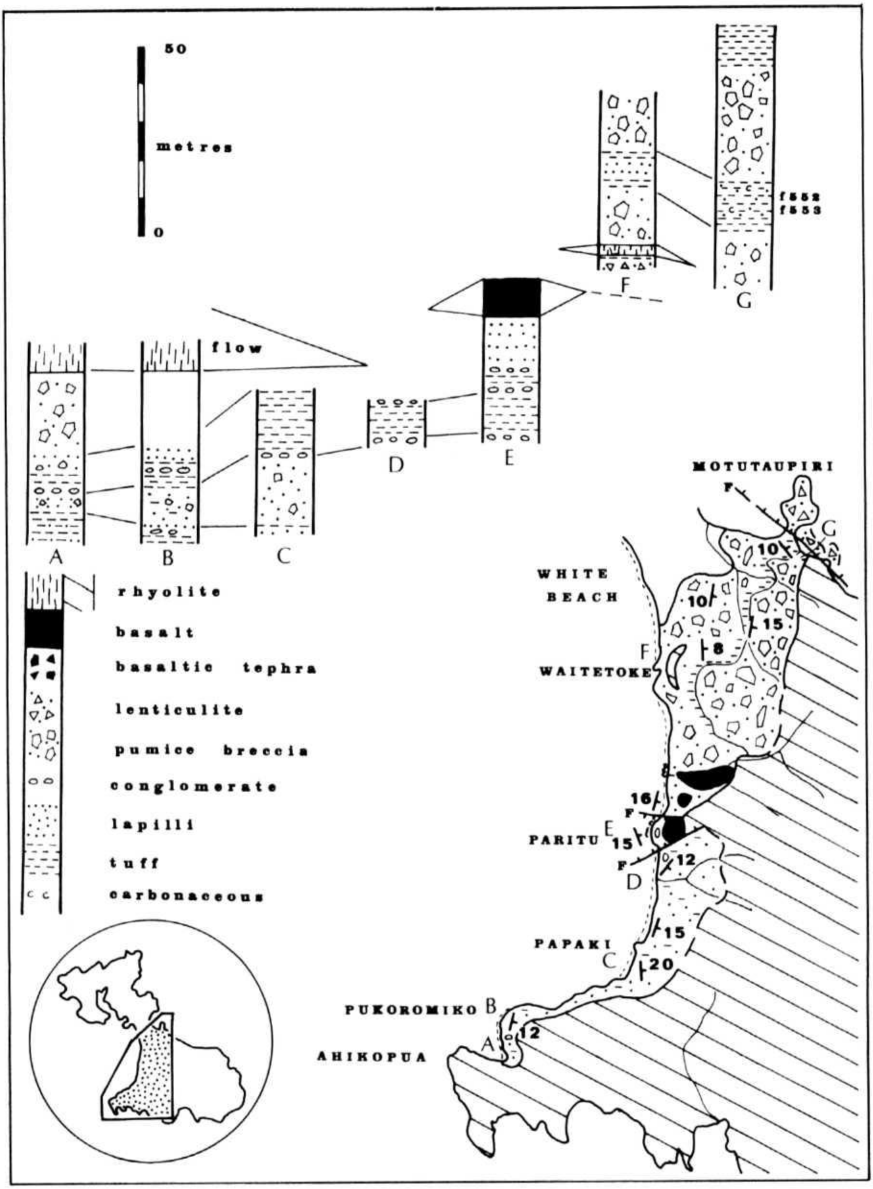

Fig. 2. Coroglen Subgroup geology and stratigraphic columns of southern Great Mercury Island.

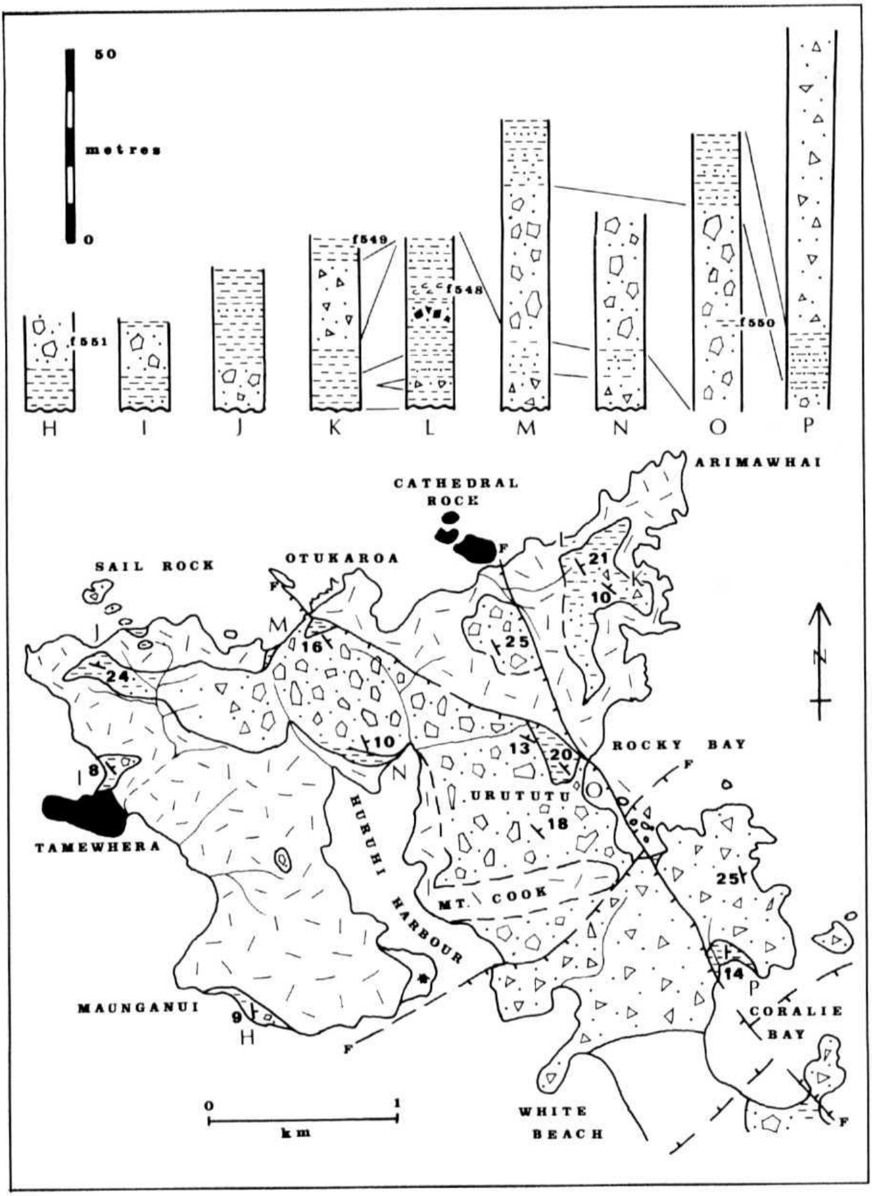

Fig. 3. Coroglen Subgroup geology and stratigraphic columns of northern Great Mercury Island. See Fig. 2 for legend.

The 70m sequence overlying these flows is only preserved in the north (Columns F, G) and consist of two andesite- and rhyolite-bearing pumice breccias separated and overlain by bedded tuffs, lapilli tuff and lapillistone. Carbonised and silicified logs (N40/f552, f553) occur within these bedded pyroclastites at Te Koru (Coal Bay).

2. Northern Great Mercury

Coroglen Subgroup occurs in several fault blocks on northern Great Mercury (Fig. 3) and rests on an irregular surface of Coromandel Group andesites. Pockets of bedded rhyolitic pyroclastites fill steep-sided depressions (gullies) in the underlying andesite in several places (Columns H, I, J). A larger depression near Arimawhai (Columns K, L) is filled by a sequence of lensing pyroclastites. A 5m thick bed of scoriaceous and angular basalt lapilli occurs conformably within that part of the sequence nearest the basalt piug of Cathedral Rock (Fig. 3). This bed is overlain by 10m of well-bedded carbonaceous tuff and lapillituff that contains numerous carbonised logs and leaf impressions (N40/f548). These sediments accumulated in a small lake possibly ponded by the preceding basalt eruptions. The flora is dominated by leaves of manuka (*Leptospermum scoparium*) with less common leaves of shrubs and a few forest trees (Appendix 1). Manuka heath is an early phase in vegetation succession and its development here probably followed the burial of earlier vegetation beneath tephra.

The remnants of an extensive sheet of rhyolitic pyroclastites overlie the depression-filling Coroglen rocks and are exposed over much of northern Great Mercury. A basal lens of pumice lenticulite and bedded tuff in the north (Columns M, N) is overlain by a 40-60m thick unwelded rhyolite-, andesite- and perlite-bearing pumice breccia which outcrops over an area from Otukaroa to Mt Cook (Fig. 3). A 2m thick unit of bedded, log-bearing tuff (N40/f550) occurs within the pumice breccia on the south side of Urututu (Column C) and indicates at least two eruptive episodes. Subaerial deposits of bedded tuff, pumice lapilli tuff and lapillistone overlie the pumice breccia (Columns M, O, P). The uppermost exposed unit is an 80-100m+ thick, partly welded, laminated lenticulite (ignimbrite) which outcrops between Rocky Bay and the White Beach tombolo (Column P) and also east of the fault that cuts across Motutaupiri Peninsula and Te Koru (Figs. 1, 2, 3).

Overall correlation (Fig. 4)

The Coroglen Subgroup sequence on Great Mercury has a maximum exposed thickness of 250m. Suggested correlation of the southern and northern successions is shown in Fig. 4. The conglomerate-bearing, bedded tephra sequence in the south is tentatively correlated with the lower, mostly depression-filling, bedded tephras in the north. The thick pumice breccia deposits of the southern sequence (Columns F, G) are lithologically identical to those in the north (Columns M, N, O). The thick lenticulite of the northern sequence is deduced to be stratigraphically above anything exposed in the south.

DISCUSSION

The absence of any marine deposits in Coroglen Subgroup that now lies in part below sea level indicates that either eruptions occurred during a time of lower sea level (a Pleistocene glacial epoch), or that there has been post-eruption tectonic depression.

The domes of southern Great Mercury are the only known rhyolites within a radius of 10km so that it seems most likely that the pyroclastites were also erupted from this area. Early eruptive events produced mainly tephra showers (tuff, lapilli tuff and lapillistone) with small pyroclastic flows (pumice breccia). Minor lithoidal flows that lie conformably within the southern sequence indicate

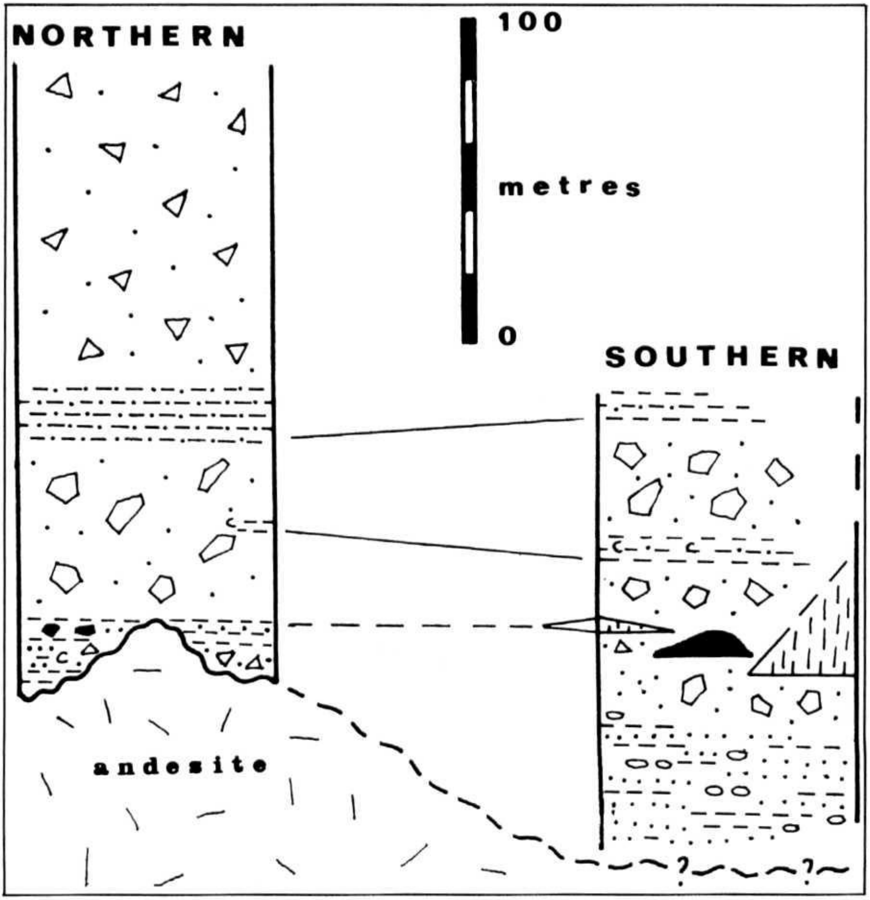

Fig. 4. Combined Coroglen Subgroup stratigraphic columns of northern and southern Great Mercury and their inferred correlation.

that magma reached the surface soon after rhyolitic volcanism commenced, possibly via a small centre near Ahikopua (Zutelija 1976). Further pyroclastic flow and tephra eruptions were followed by the intrusion and extrusion of the large south Great Mercury rhyolite dome and eruption of a lenticulite

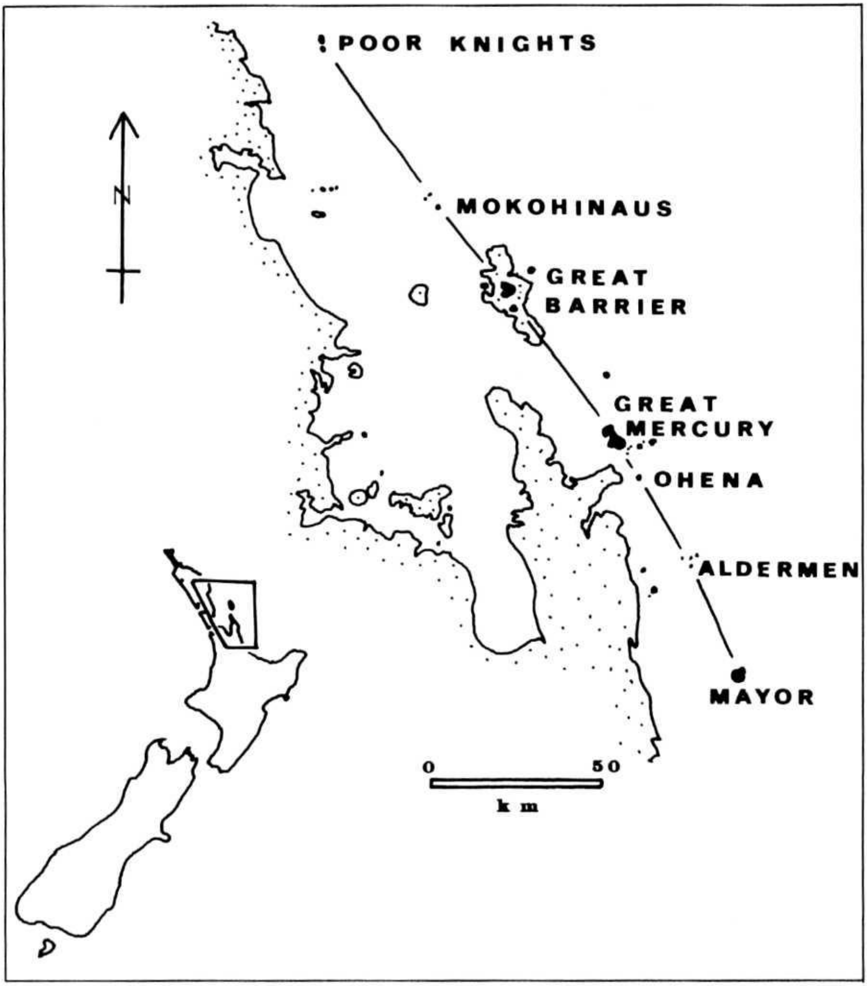

Fig. 5. Line of rhyolites forming offshore islands along the eastern margin of the Coromandel volcanic zone, north-east New Zealand.

pyroclastic flow (ignimbrite). The relative chronology of these last two events is unknown.

The rhyolites of Great Mercury are part of a gently arcuate line of Cenozoic rhyolite centres (Fig. 5) that form a string of offshore islands along the eastern side of the Coromandel volcanic zone (Kear 1964). This line extends south from the tuff, breccia and ignimbrite of the Poor Knights Islands, through rhyolitic domes and breccias of the Mokohinau Islands (Fleming 1950) and the Hobson Rhyolite of Great Barrier Island (Thompson 1960), through Great Mercury and the rhyolite domes of Ohena Island (Skinner *in press*), to the domes and pyroclastites of the Aldermen Islands (Hayward and Moore 1973) and Mayor Island (Brothers 1957).

The basalt flow at Paritu and basaltic pyroclastites near Arimawhai, being conformable within the Coroglen Subgroup, indicate penecontemporaneous eruption of Mercury Basalt and Whitianga Group rhyolites on Great Mercury. This has already been noted on Red Mercury Island where rhyolitic tuff occurs within the basalt flow sequence (Hayward and Moore 1972), and elsewhere in the Mercury and Ohena Island Groups (Skinner *in press*).

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APPENDIX 1 – GREAT MERCURY FOSSIL RECORD SITES

Fossil record numbers are those of the New Zealand Fossil Record File and collections are held by the Geology Department, University of Auckland. No ages are determinable.

N40/f548 (N40/275932) – 30mm thick pumiceous silt containing leaves of *Leptospermum scoparium*, *Cyathodes fasciculata*, *Phyllocladus trichomanoides*, *Persoonia toru*, *Geniostoma ligustrifolium*, *Beilschmiedia tarairi*, *Neopanax* sp., *?Brachyglottis repanda* and *?Muehlenbeckia complexa*. Carbonised logs occur in 1.5m thick pumiceous silt above these.

N40/f549 (N40/276929) – coarse tuff containing silicified wood.

N40/f550 (N40/274916) – 0.5m thick coarse tuff bed containing silicified wood.

N40/f551 (N40/258906) – pumice breccia containing a carbonised log.

N40/f552 (N40/292902) – buff, angular fine pebble and granule-bearing fine tuff containing carbonised and silicified logs.

N40/f553 (N40/290902) – buff, pebbly silt containing carbonised logs.