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**COASTAL AND NEARSHORE GEOLOGY OF
SAVUSAVU BAY, VANUA LEVU,
FIJI**

by

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TABLE OF CONTENTS

	Page
Abstract	4
Introduction	5
Physical Setting	7
Results and Discussion	11
Savusavu Bay Sediments	11
Coastal Sediments	19
Stratigraphy and Geological History	23
Site Investigations	23
Relict Coral Deposits	24
Geological History	27
Conclusions and Recommendations	28
Acknowledgements	31
References.....	32

Appendix

FIGURES

- Figure 1 Savusavu Bay locality map showing position of echosounding tracklines and sediment sampling points
- 2 Quaternary coastal sediments and offshore bathymetry of Savusavu Bay
- 3 Distribution of nearshore sediment types in Savusavu Bay
- 4 Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples Sections 6-9

- Figure 5 Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples Sections 9A-15
- 6 Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples Sections 16-20
- 7 Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples Sections 21-25
- 8 Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples Sections 26-30
- 9 Relationship between water depth and mud content for sediments in Savusavu Bay
- 10 Wailevu area, northern Savusavu Bay, showing old reef flat beneath coastal plain and its relationship to the present-day reef flat
- 11 Relationship between C14 age and position of samples along a north-south transect across the Wailevu Coastal Plain and reef flat
- 12 Model showing one glacio-eustatic sedimentation cycle in Savusavu Bay

ABSTRACT

Savusavu Bay in southern Vanua Levu, Fiji, is a structural depression formed during the Late Cenozoic and Quaternary, and is probably still active. Holocene valley alluvium and coastal deposits composed of immature sandy sediments occur between rocky headlands around the margins of the bay. Its sides are mantled by fringing and patch reefs, and muddy sands - both terrigenous and calcareous in composition. Muds blanket the flat bed of the bay in water depths generally greater than 10 m. The Holocene deposits reach thicknesses of about 30 m at the coast and thin in an offshore direction. Alongshore sand movements are mainly to the west along the bay's northern shoreline under the influence of the dominant SE trade winds. Its eastern end is exposed to occasional cyclones from the west but most of the bay is a protected.

The Wailevu Coastal Plain, on the northern side of Savusavu Bay, is underlain by a relict coral reef that commenced growing about 4000 years ago. At that time mean sea level in the bay was about 0.9 m higher than present. Growth of the fringing reef, bayward, has averaged 0.25 m/yr.

Of the various developments proposed for the area, the discharge of sewage and wastes into the eastern end of Savusavu Bay has the most serious environmental implications. A study of water movements under a range of natural conditions is an essential prerequisite for devising a safe waste disposal plan for the area.

INTRODUCTION

At the request of the Fiji Mineral Resources Department (MRD), Ministry of Energy, Lands, and Mineral Resources, mapping of the coastal and nearshore sediments of Savusavu Bay was undertaken in February 1986.

The work forms part of a programme of coastal mapping in Fiji (CCOP/SOPAC Project FJ19) to provide geological data for environmental and developmental planning.

Regional geological studies of this type are designed to provide a framework in which the impact of development projects can be evaluated. The results are not intended to address specific engineering problems but rather to reveal broad geological trends and to indicate where other detailed investigations may be desirable. Future development activities in the Savusavu Bay area include proposals to develop Valaga Bay, near Savusavu town, as a commercial port and to discharge sewage into the bay at Savusavu town.

The work was carried out in a 10 day period using the Mineral Resources Department's boat fitted with their DE 719E precision depth sounder and CCOP/SOPAC's small winch for sediment sampling. Position fixing was made by sextant. In general samples are located with an accuracy better than ± 50 m horizontally and \pm m vertically.

A total of 111 sediment samples were collected by dredge along 27 shore-normal lines which were profiled by echosounder (Fig. 1).

The sediments were examined microscopically (after the mud fraction had been measured and removed) to determine texture and composition. Base maps of Savusavu Bay were constructed from

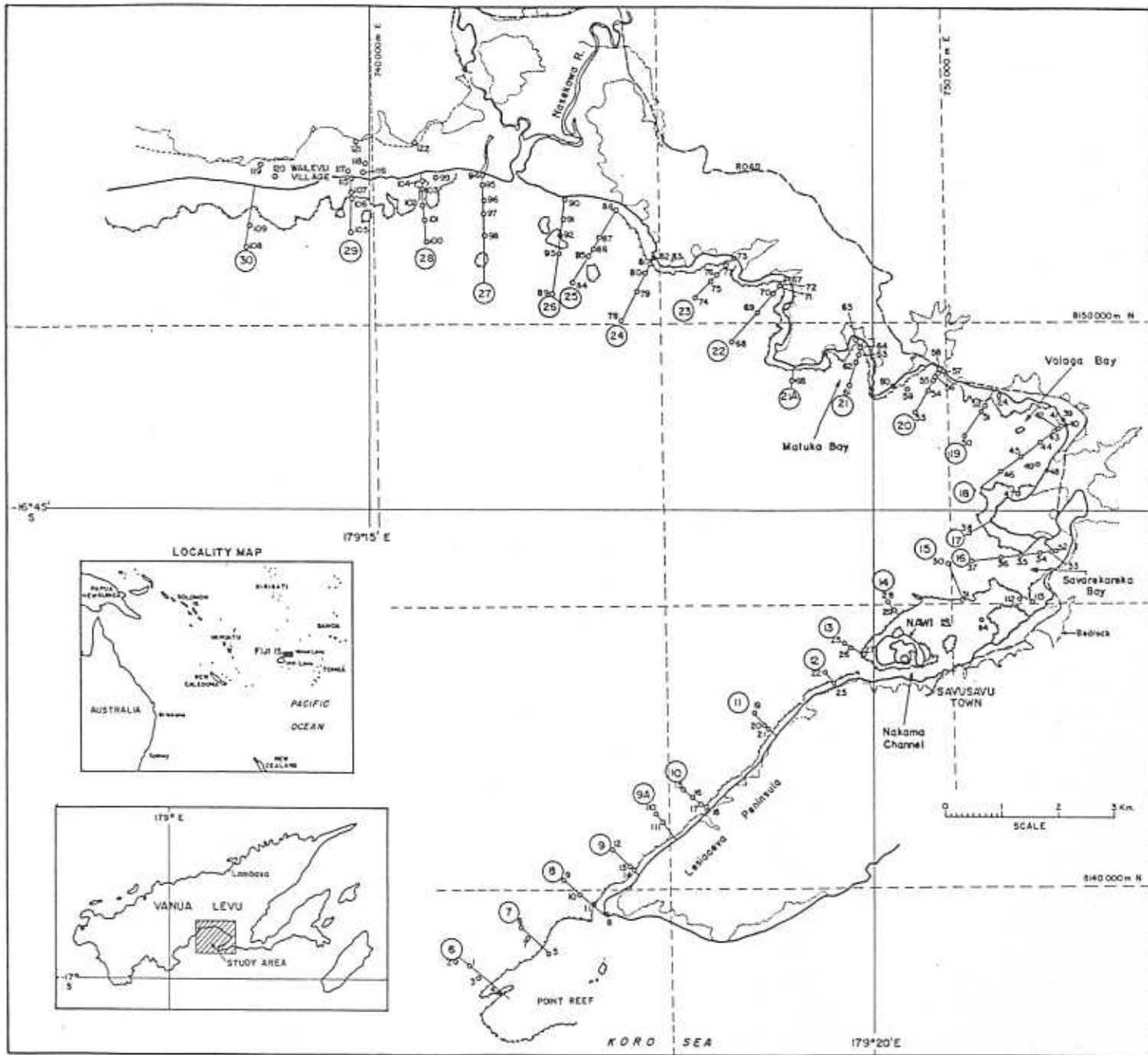


Figure 1. Savusavu Bay showing tracklines and sediment samples (Profiles 6-30 shown on Figures 4 - 8).

TB9=90%

the Fiji Government 1:50,000 map series X755 - DOS 1959 sheet 11 and DOS 1960 sheet 12

Aerial photographs flown in 1978 were used to map the unconsolidated coastal deposits. These were briefly inspected in the field. Buried coral reefs were found along the coast around Wailevu village on the northern side of Savusavu Bay. Samples collected in this area are listed in Appendix 1.

Field work and data analysis were carried out by Peter Roy (Marine Geologist with CCOP/SOPAC Technical Secretariat), Tevita Vuibau (Technical Officer, MRD) and Luna Wong (Technical Assistant, MRD). Radiocarbon dates were obtained by HRD from Beta Analytic Inc.

PHYSICAL SETTING

The south-central part of Vanua Levu, including Savusavu Bay, is composed of late Cenozoic lavas, breccias and volcanic sediments of the Natewa Volcanic Group (Woodrow, 1976). Most of the volcanic rocks were extruded subaqueously and have been uplifted. They now form a rugged terrain with elevations of up to 500 m in the study area. The gross morphology of the area is primarily block faulting and folding, modified by fluvial erosion. The bay area probably represents a subsided block bounded by faults along its northern and eastern sides. The eastern fault forms the deeply sloping bay-side of Lesiaceva Peninsula. This feature has elevations of 200+ m and owes its relief to a series of volcanic cones located along an east-west anticlinal axis (Cox, 1980). Geothermal and aerial magnetic studies reported by Cox (1981) suggest that the peninsula is bounded by faults and is underlain by a young intrusive body at depths as little as 200 m. The intrusion may be related to a plug of olivine basalt, the Savusavu intrusion to the east of

Savusavu town. Whelan et al. (1985) report a radiometric date of 295 ± 02 Ma for this basalt, which is compositionally similar to basalts on the nearby island of Taveuni which were extruded in Pleistocene times (Cox, 1981).

The Nasekawa is the main river in the area and flows into the northern side of Savusavu Bay. The largest areas of Quaternary sediments onshore are associated with the delta of the river and an adjacent coastal plain (Fig. 2)

Coral reefs fringe the shoreline of Savusavu Bay. At the end of Lesiaceva Peninsula, Point Reef reaches a maximum width of 2 kms (Fig. 3). A zone of reefs extends across the mouth of the bay from its western side leaving a relatively narrow and deep passage adjacent to Point Reef (Fig. 2). Elevated reef limestones of Pleistocene age occur along the south-central coast of Vanua Levu, and there is probably an emerged reef at Savarekareka Point (R. Smith, MRD. pers. comm.), to the north of Savarekareka Bay (Fig. 1).

Savusavu Bay is less than 100 m deep and presumably was exposed during the last glacial maximum 17,000 years ago when sea level was about 100 m below its present position (Fig. 2). Its bed is now blanketed with fine marine sediments. The bay is protected from most open-ocean storm waves. The dominant southeasterly winds generate local waves that mainly affect the northern shore of the bay. Here net littoral transport is towards the west along the shoreline but most of the bay bed is below wave base. Only during cyclones when strong westerly winds are generated is the head of the bay subjected to wave attack. Occurrences of reef blocks (1+ m in diameter) deposited on the reef flat during cyclones are shown in Figure 2

Prevailing winds can also be expected to induce currents within the bay and these are particularly important for

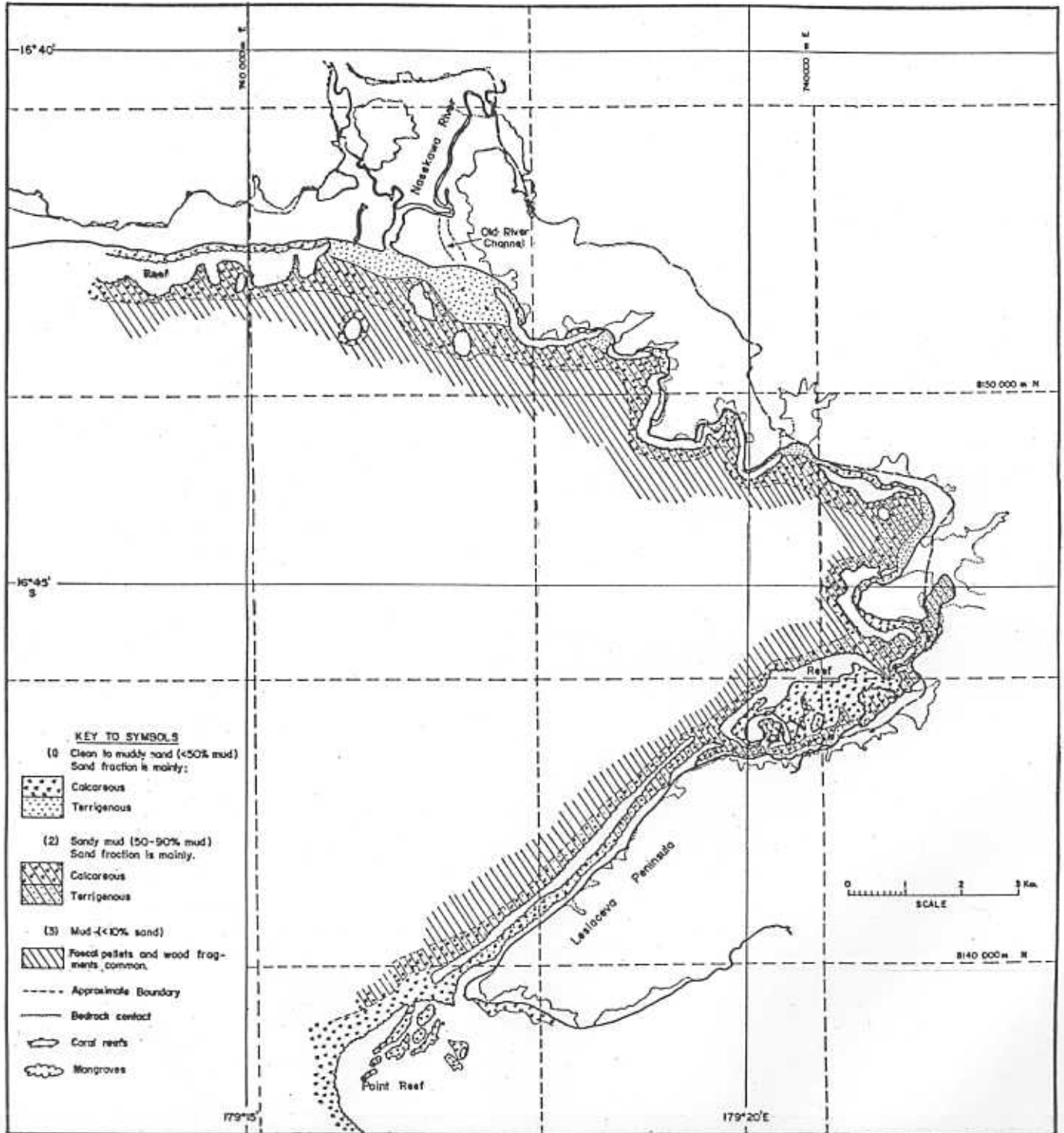


Figure 3. Savusavu Bay showing distribution of nearshore sediment types.

189-90%

dispersing pollutants. The area is micro-tidal with a spring range in the order of 1 m. Tidal currents are locally important, especially in Nakama Channel, on the adjacent sand flats in front of Savusavu town, and also in the mouth of the bay near Point Reef. The surface of Point Reef itself is subject to strong wave-induced water movements towards the northwest due to the breaking of ocean waves on the southern reef front.

RESULTS AND DISCUSSION

Savusavu Bay Sediments

The sides of Savusavu Bay are relatively steep and are composed of sands and muds mantling coral reefs (Figs 4 to 8). The bed of the bay is almost flat and is composed of mud rich in faecal pellets and organic material (mainly shells, foraminifera, and wood fragments). There are two populations of sand-sized sediment: one is made up of calcareous material: the other of terrigenous fragments eroded from the hinterland. The calcareous sand is mainly reef detritus (coral, algae, bryozoa, and mollusca) and generally occurs in close proximity to the reefs. Very muddy sediments occur further offshore on the bay bed and contain a very fine sand fraction composed mainly of foraminifera, bryozoa, and thin-walled shell fragments.

Terrigenous sands occur at river and creek mouths. They reflect the nature of the source rocks onshore and are compositionally and texturally immature. The main components are dark lithic and mineral grains, red-brown oxidised fragments, and rare quartz particles. Olivine is very common (5-20 %) in the sand in Valaga Bay and occurs as a minor component (5 %) off the Nasekawa River mouth. In the former case it is probable that an outcrop of olivine basalt, similar to that forming Savusavu Hill nearby (see Vanua Levu Geological Map sheet 12), also occurs in the Valaga Bay drainage

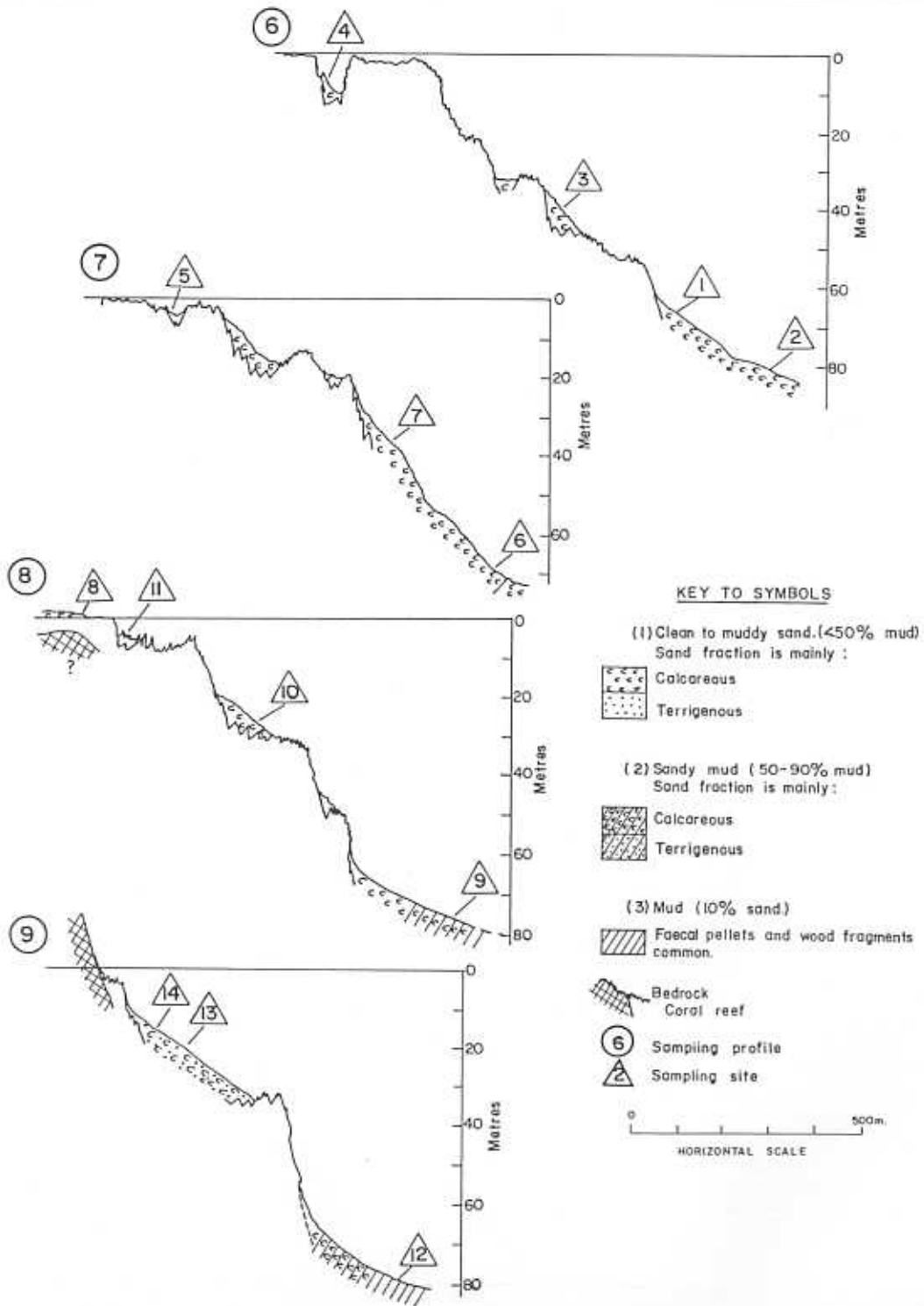


Figure 4. Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples, Sections 6-9.

7B9 = 80%

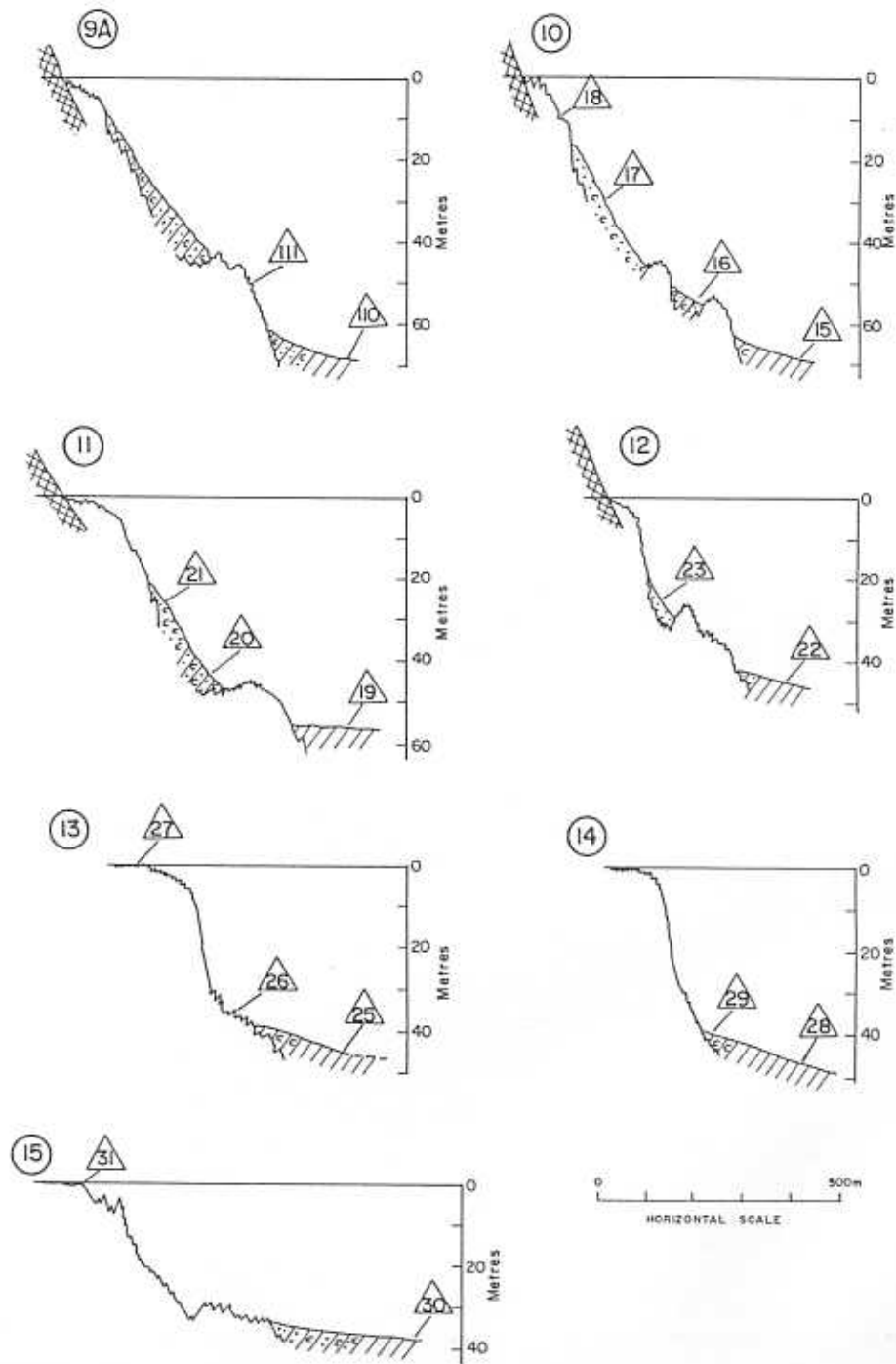


Figure 5. Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples, Sections 9A-15. (For Key to Symbols see Figure 4)

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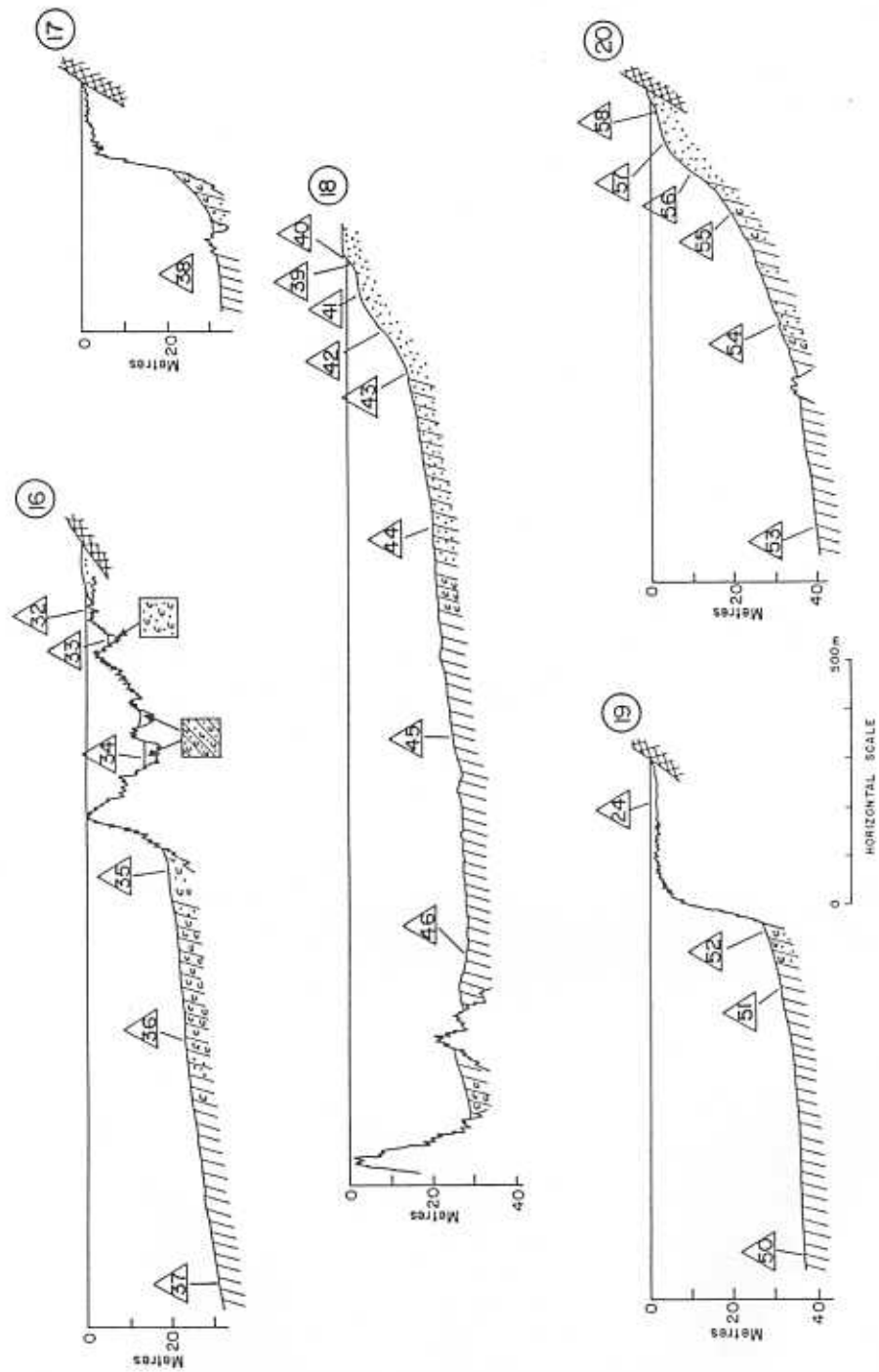


Figure 6. Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples, Sections 16-20. (For Key to Symbols see Figure 4)

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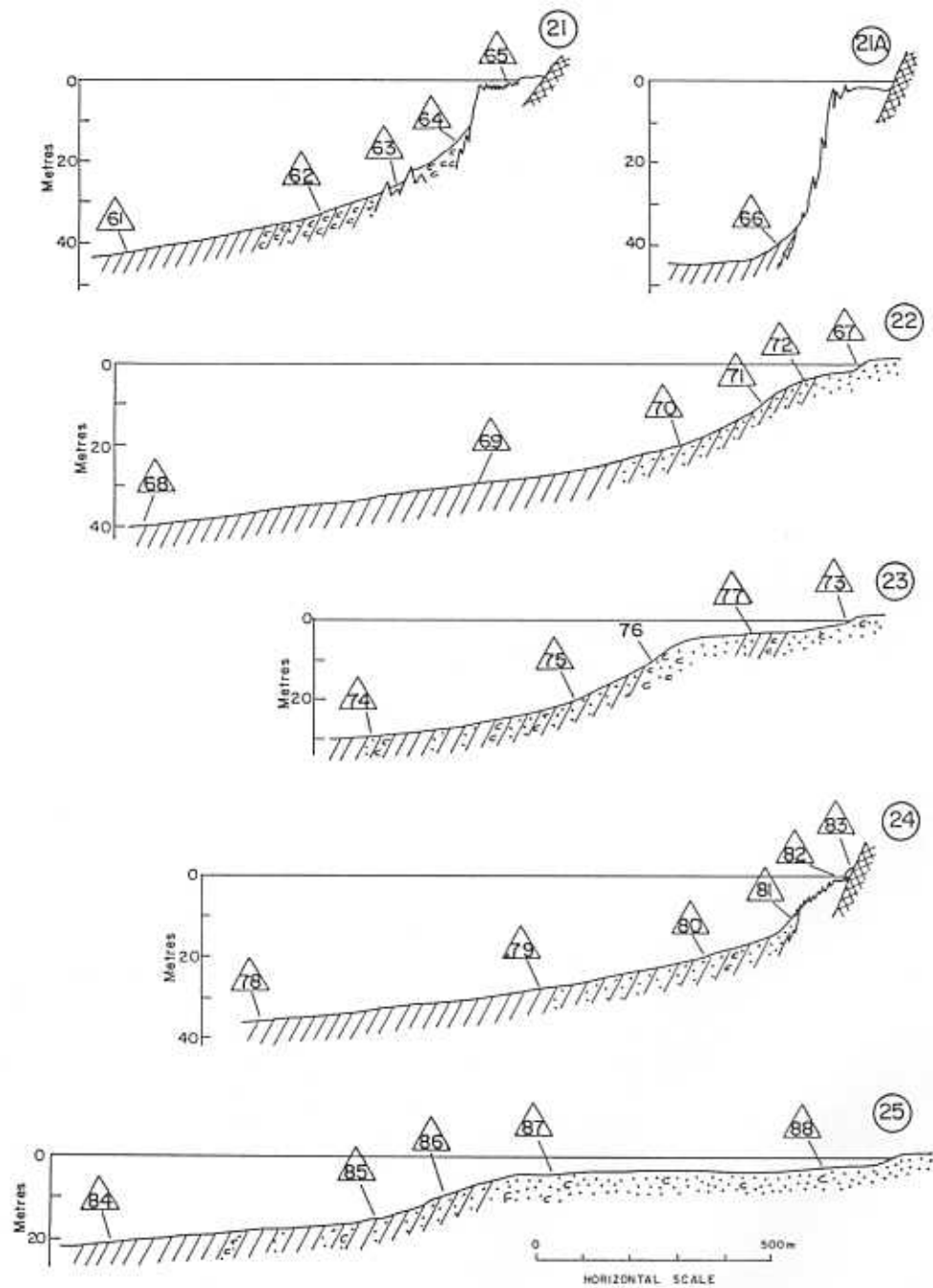


Figure 7. Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples, Sections 21-25. (For Key to Symbols see Figure 4)

80%

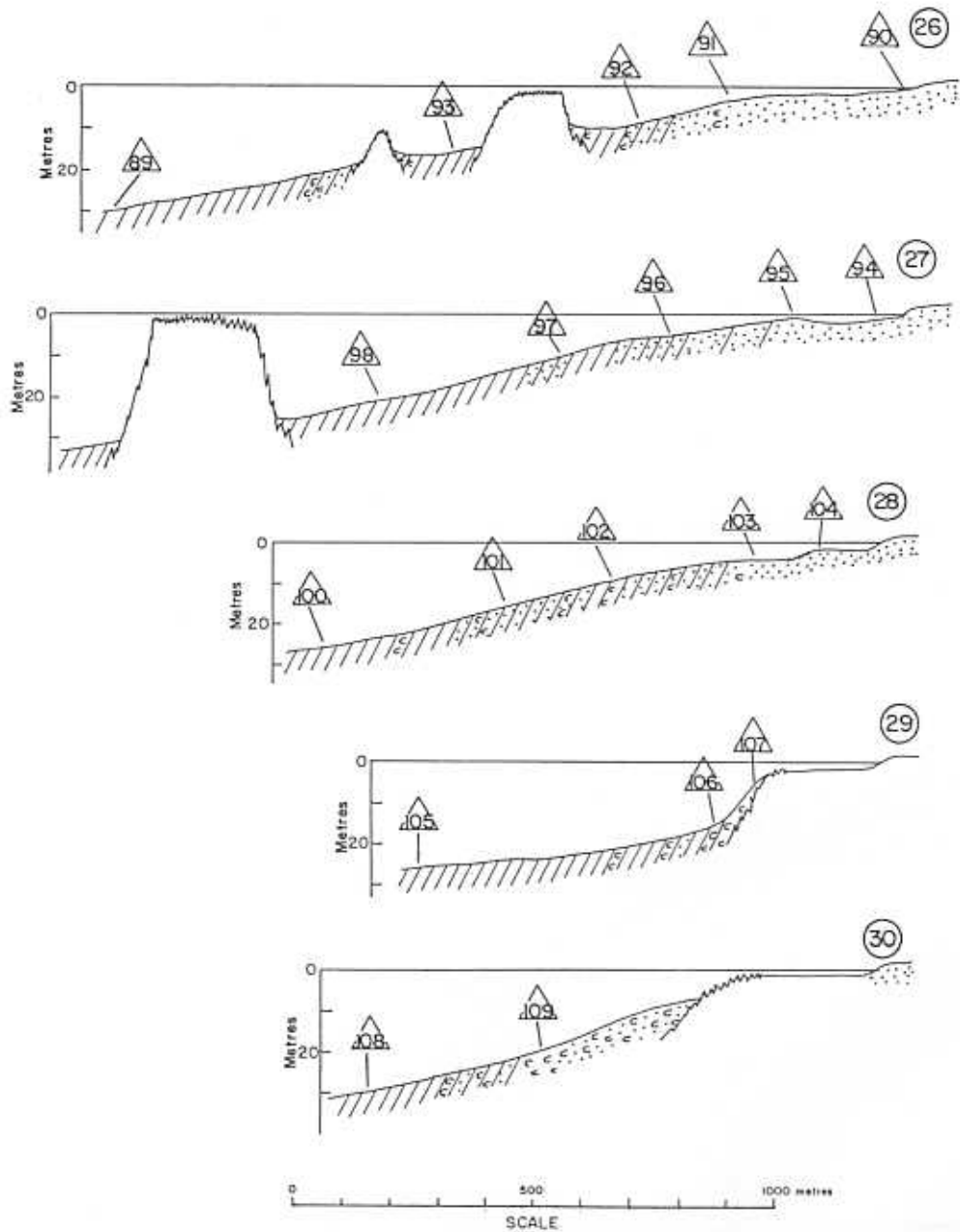


Figure 8. Cross sections showing the relationship between seafloor morphology and the texture and composition of sediment samples, Sections 26-30. (For Key to Symbols, see Figure 4)

00%

catchment. The sands typically are composed of angular grains. They are relatively coarse and moderately poorly sorted inshore of water depths less than 5 m but are very fine and well sorted in deeper water.

Coral reefs fringe about 85 % of the bay. From diving observations and echosounding records, it seems that living coral grows in depths less than 10 m and mostly less than 8 m. Areas of rough bottom in greater depths, such as occur below depths of 30 m along Lesiaceva Peninsula (cross sections 6-12 in Figs 4 and 5), are probably relict reefs that grew at sea levels considerably lower than present. Reef flat surfaces are mainly composed of coral rubble and algae, and near river mouths they contain admixtures of fluvial sand. Breaks in the reefs occur in embayments and are related to outflows of muddy fresh water at river mouths, especially off the Nasekawa Delta and in Valaga Bay (Fig. 3) where the sediments are predominantly terrigenous. Isolated patch reefs occur further offshore in water depths of 15-25 m (Fig. 9 and cross sections 26 and 27 in Fig. 8).

Sand-sized material is rarely dispersed more than 1 km offshore (Fig. 3). Sand-dominant sediments (sand and muddy sand) usually extend only a few hundred metres from the shore and occur in water depths of less than 5 m. The relationship between water depth and mud content of the calcareous and lithic-rich sediments is shown in Figure 9. However, there are three areas where sandy sediments are widespread: (1) on the western side of Point Reef clean calcareous sands extend to depths of 80+ m; (2) opposite Savusavu town calcareous sands form a broad intertidal bank; and (3) off the Nasekawa Delta there is a lobe of clean, coarse grained river sand.

(1) On the western side of Point Reef the presence of clean

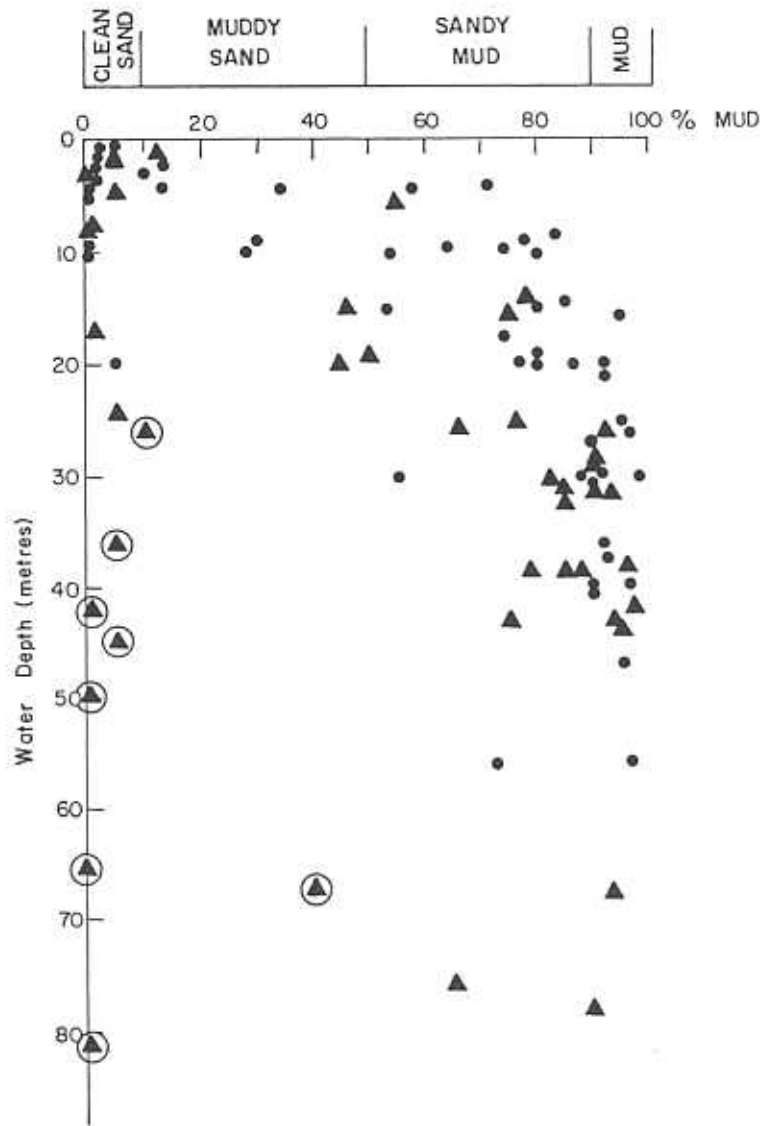


Figure 9. Relationship between water depth and mud content for sediments in Savusavu Bay. Sediments with a mainly terrigenous sand fraction are shown \blacktriangle ; those with a mainly calcareous sand fraction are shown \bullet . Clean sands mostly occur above 10 m; \circ indicates samples off Point Reef that occur in deep water and contain relatively little mud. Elsewhere mud content tends to increase with water depth.

7/10

calcareous sand in deep water suggests that bottom currents in the passage are sufficiently strong to prevent mud from settling. The currents may be tidal or wind-induced. The sand is derived from the reef crest and is carried into the bay by wave-induced currents.

(2) Opposite Savusavu town calcareous sands on the flats are derived from reefs that presumably sit on a shallow bedrock substrate of which Nawi Island is a part. The area lies at the apex of two acutely intersecting fault systems (Woodrow, 1976) which suggests an underlying tectonic control on bedrock morphology. The sands have prograded southward away from the reef crest into the Nakama Channel bordering the mainland. This is up to 15 m deep and the adjacent calcareous sand deposits may reach similar thicknesses beneath the present sand flats.

(3) Off the Nasekawa Delta the sand lobe is offset about 1 km to the east of the present river mouth and indicates the position of a former mouth (Fig. 3). Remnants of the old channel associated with this former river mouth (Fig. 3) occur as swamps onshore (Fig. 2). The absence of a similar lobe off the present river mouth suggests that it has been active for a shorter length of time than was the old outlet.

Coastal Sediments

The main coastal deposits in the Savusavu Bay area - those associated with the Nasekawa River and bordering Valaga Bay - show the interaction of both fluvial and marine processes. In these areas flood plain deposits in the river valleys lie next to coastal plain deposits extending along the adjacent coast. It is inferred from this arrangement that, once the river valleys were infilled, fluvial sediment deposited at the river mouth was reworked by waves and transported down coast to accumulate in prograded shoreline deposits. It is argued later

in this paper that coastal progradation commenced about 4,000 years ago. Along the northern bay shoreline net littoral transport is to the west and in Valaga Bay it is to the north and west.

The Wailevu Coastal Plain is 600 m to 800 m wide and ranges in elevation from 1.0 m to about 1.4 m above mean sea level. It is backed by steep bedrock slopes that are cliffed in places, probably by marine abrasion (Fig. 10). Low-relief beach ridges (100+ m wide, <0.3 m high) form a narrow zone along the front of the coastal plain. The ridges are composed of a mixture of river sand and calcareous reef-derived fragments. The river sand is lithic-rich and very immature; it is supplied by the Nasekawa River that enters the bay 2 km to the east of Wailevu village. Inland from the beach ridges, the coastal plain is composed of brown silty clays. Aerial photographs of the far western end of the coastal plain show features that are interpreted as recurved spits.

The present coast comprises a narrow beach and reef flat. The beach face is moderately steep and rises from the inner edge of the reef flat to the limit of storm swash zone which is marked by pumice at +1.12 m msl. The reef flat is 300 m to 600 m wide and ranges in elevation from -0.3 m to about -1.0 m msl (Fig. 10). Its surface is composed of coral rubble with a patchy veneer of sand. Living corals occur along its outer edge at water depths below -0.8 m msl. The above elevations are from a surveyed north-south transect on the eastern side of Wailevu village (Fig. 10). Heights above mean sea level have been obtained by relating water levels at the times of survey to published tide data for Suva (corrected to Vanua Levu).

Both the Wailevu and Valaga coastal plains are shown to be composed of alluvium bordered along the coast by a narrow zone

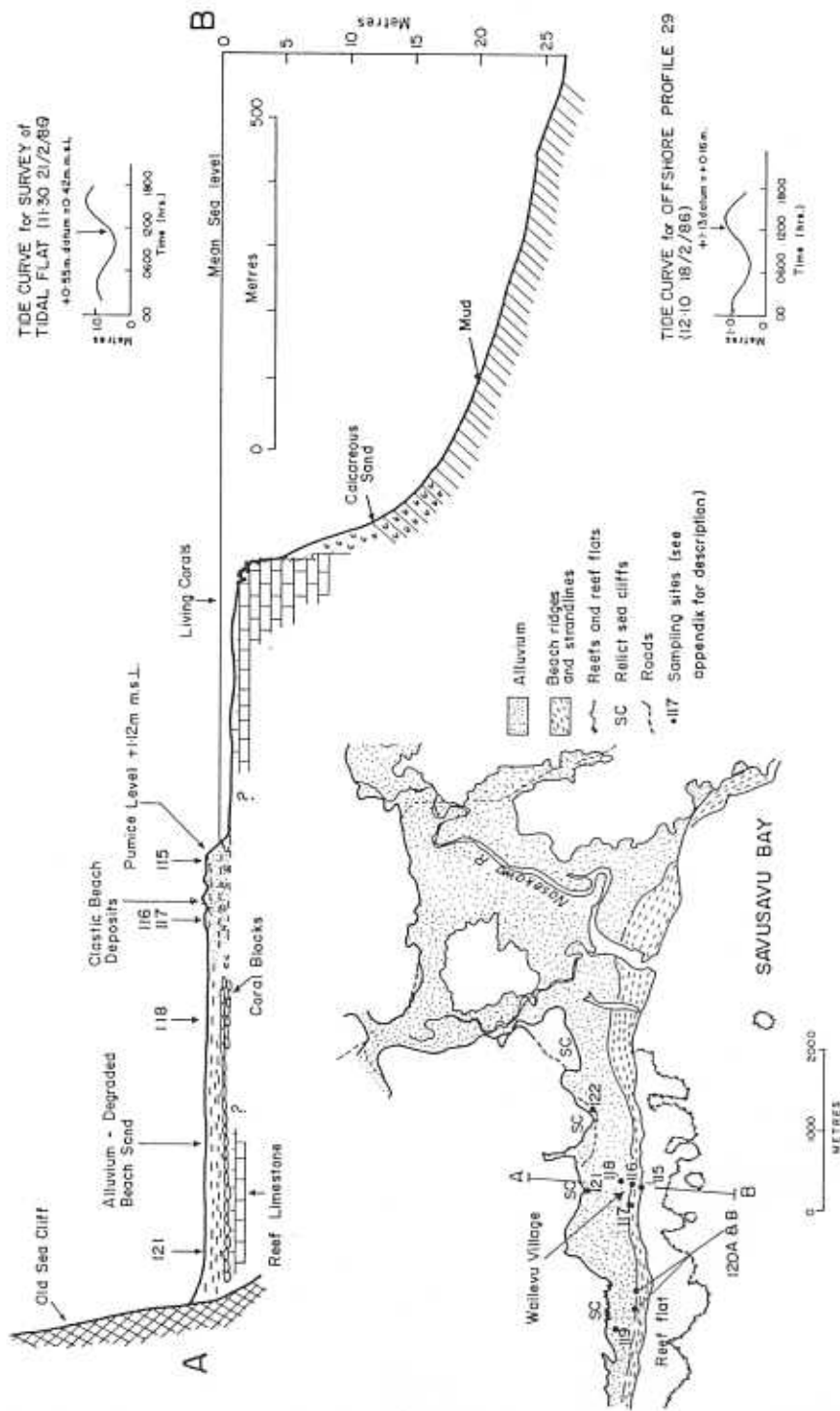


Figure 10. Wailevu area, northern Savusavu Bay, showing old reef flat beneath coastal plain and its relationship to the present-day reef flat.

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of beach sand. This conforms with the present day sediment types. However it is likely the alluvium represents old beach deposits that, because of their unstable mineral composition, have degraded in situ to form a clayey sediment, otherwise indistinguishable from flood plain alluvium.

The present-day beach fronting the Nasekawa Delta and Wailevu Coastal Plain has an irregular, cusped plan-form and shows alternating sections of erosion and accretion over distances of 1.0 km to 0.5 km. Alongshore sand transport here appears to be non-uniform and involves the slow growth and decay of alternating beach segments. Rates of change are unknown but are presumably slow. Active sand transport only occurs during high tide and the full impact of storm waves is reduced by the wide reef flat. At Wailevu village coastal protection measures include an offshore boulder mound built about 60 years ago to reduce wave action on the beach and a more recently constructed sea wall. Fallen coconut palms attest to continued erosion to the east of the village, a trend that will eventually reverse as the adjacent zone of accretion migrates alongshore. However, the practice of taking truckloads of sand off the beach immediately updrift of the village is undoubtedly retarding any natural recovery.

Coastal deposits elsewhere around the bay are few (Fig. 2). In small coastal valleys they are composed of very poorly sorted mixtures of oxidised mud, sand, and gravel. On the shoreface these are reworked by waves to form a narrow zone of gravelly sand, commonly mixed with coral fragments. In some of the northern bays, such as Matuka, wave-cut scarps in the alluvium and colluvium suggest that the shoreline is undergoing active erosion between episodes of flood accretion. Nearby on the rocky promontories, small accumulations of coral rubble and

sand do not show the same evidence of erosion and possibly have more stable shorelines.

Calcareous beach deposits occur on the southern coast of Lesiacava Peninsula. Here the wide reef flat and high energy wave current regime generate and disperse abundant reef-derived sediment. Some sediment has accumulated on the coast but probably most of it is washed westward across the reef flat into Savusavu Bay.

STRATIGRAPHY GEOLOGICAL HISTORY

Subsurface information on the Quaternary sediments in the Savusavu Bay area is confined to results of previous site investigations in Valaga Bay and the Nasekawa Delta, and field observations of relict coral reefs beneath the Wailevu Coastal Plain.

Site Investigations

Drilling in Valaga Bay - part of investigations for the port development - encountered about 20 m of soft, dark grey, shelly mud overlying an oxidised Pleistocene substrate at -30 m (Anonymous, 1980). The marine sediments extend landward beneath the coastal plain and are overlain by sandy and gravelly clays, probably former beach and nearshore deposits now degraded in situ. A recently completed marine seismic survey in the eastern part of Savusavu Bay found a 30+ m thick sequence of unconsolidated sediments with numerous erosional and structural discontinuities (T.Vuibau and R.Smith,MRD, pers.comm.) Drilling shows that the uppermost unit is shelly and is of Holocene age. Those underlying it represent cycles of deposition and erosion, probably associated with glacio-eustatic sea level fluctuations, extending back into the Pleistocene Epoch.

In the Nasekawa Delta, marine sediments (shelly muds

and sands) were found up to 5 km inland from the coast at bridge drilling sites (Ibbotsen, 1958). Although the original drilling logs lack sufficient detail to construct precise stratigraphic sections, some general trends are apparent. The marine sediments occur beneath 3 m of modern river sand and gravel and extend to 26-31 m (deepening in a seaward direction) below the ground surface. They grade down into non-shelly gravels of probably fluvial origin. These marine sediments represent an early phase of estuarine sedimentation following the submergence of the Nasekawa River valley at the end of the post-glacial marine transgression.

Relict Coral Deposits

Relict coral, as in situ pavements and re-worked blocks, shallowly underlie the Wailevu Coastal Plain. They are exposed in natural springs and in water wells. The coral occurs at about mean sea level and forms a very gently sloping surface that is presumably continuous with the adjacent reef flat.

A survey transect across the coastal plain, reef flat and nearshore zone shows that the relict coral pavements at the rear of the coastal plain (Samples 121 and 122) are elevated 0.925 m above living corals on the reef flat (Fig. 10). Samples of corals and coral blocks from a number of sites across the coastal plain have been dated by the radiocarbon method to: (1) establish a chronology of coastal accretion; and (2) provide information on relative sea-level change in the Savusavu area. The results are listed in Appendix 1 and confirm the coastal plain is Holocene in age and represents shoreline progradation since postglacial sea level attained its present position. Studies in other parts of the Southwest Pacific indicate that this occurred about 6,000 yrs BP (before present) (Thom and Roy, 1985; Hopley, 1983; Taylor, 1978).

Figure 11 shows the history of progradation of the Wailevu

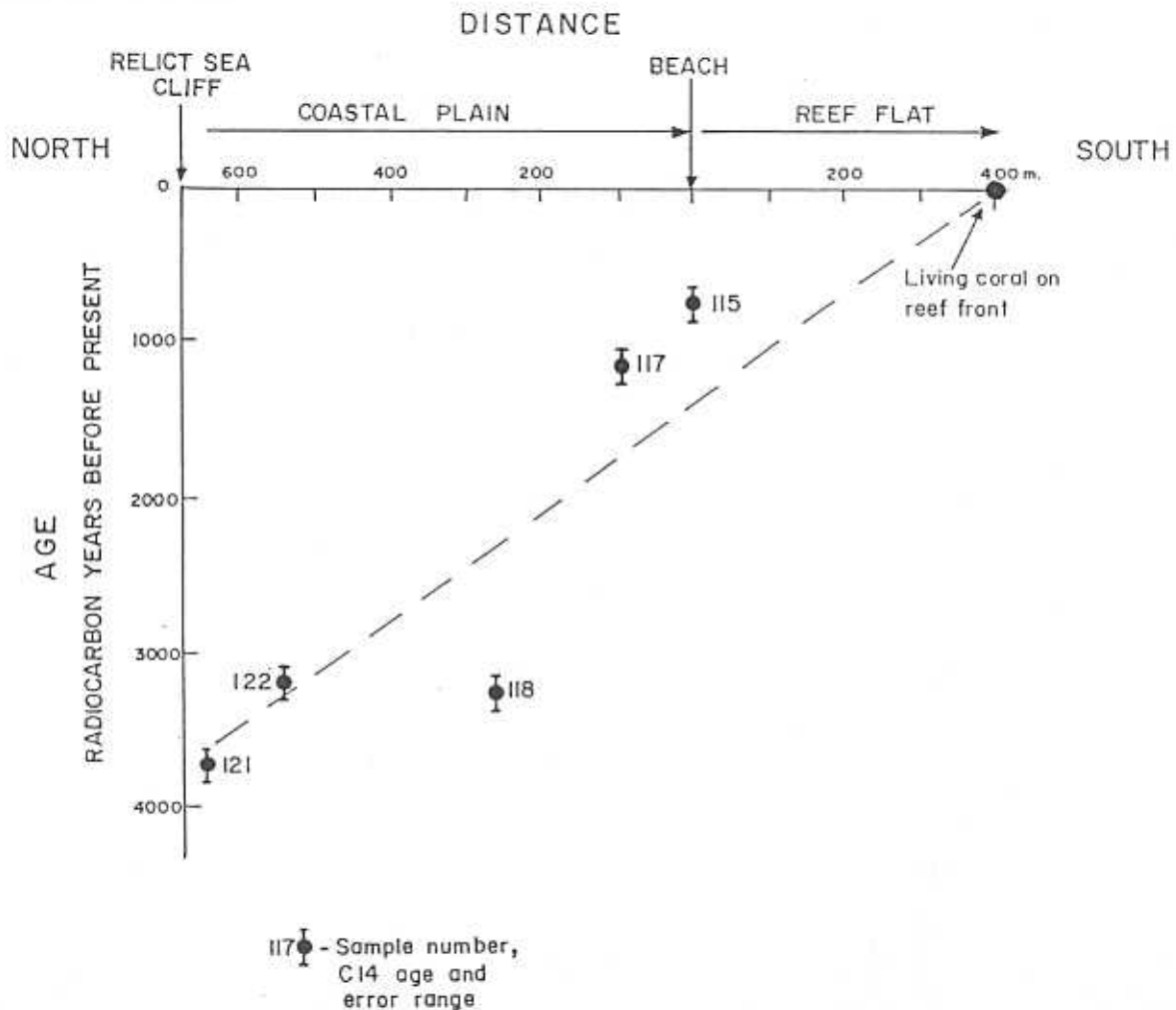


Figure 11. Relationship between C14 age and position of samples along a north-south transect across the Wailevu coastal plain and reef flat. The dashed line suggests an average trend for reef growth in this part of Savusavu Bay and represents an average growth rate of 0.25 m/yr. Samples 121 and 122 are in situ coral; sample 118 (coral rubble) appears to have been reworked seawards and incorporated into younger reef deposits; and samples 115 and 117 are reworked fragments from the lower part of the beach ridges that overlie the relict reef flat.

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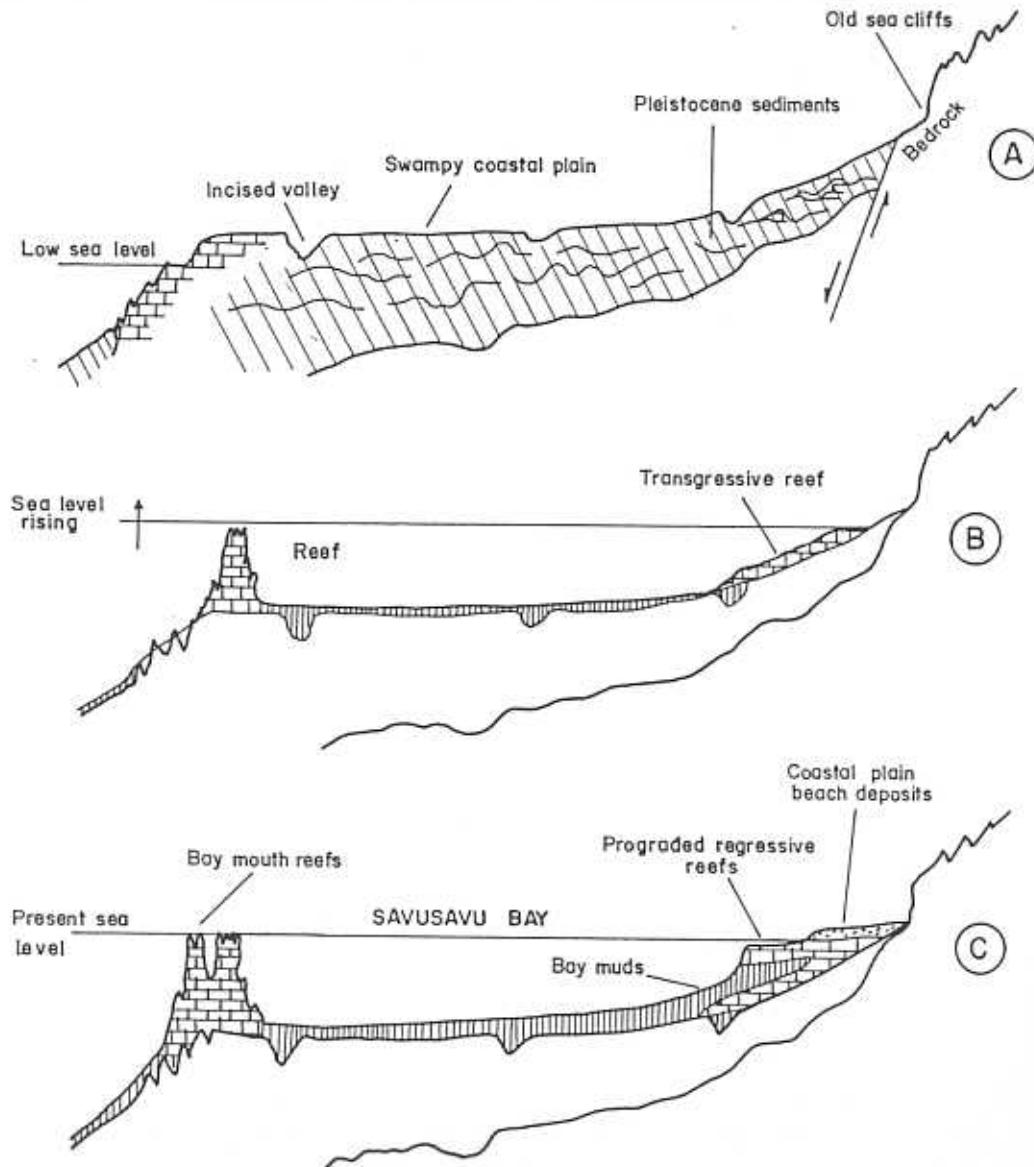


Figure 12. Model showing one glacio-eustatic sedimentation cycle in Savusavu Bay. North-south cross section extends from the Wailevu Coastal Plain to the bay mouth.

- A. Low sea level stand, bay bed exposed to subaerial weathering and erosion.
 - B. Rising sea level drowns the bay, fringing coral reefs begin to grow.
 - C. High sea level still-stand, coastal progradation.
- NOTE - At river mouths, reef lithofacies are replaced by fluvial deltaic sequences.

7/10

Coastal Plain. Two groups of dates are evident. Three dates lie within the 3,000-4,000 yrs age range. These are from coral from the relict reef surface. Samples 121 and 122 are in situ but 118 is coral rubble which appears to have been reworked seawards and incorporated in younger reef deposits. Two younger dates (780 yrs BP and 1140 yrs BP) are on beach material that overlies and post-dates by about 700 years, the reef flat on which they were deposited. Assuming continuous coral growth throughout the late Holocene, it appears the fringing reef has grown into the bay at an average rate of 0.25 m/yr (Fig. 11).

Geological History

Savusavu Bay is a geologically young, structural basin that is only partially infilled with fluvio-deltaic and marine sediments. Limited subsurface data indicate that deltaic deposits at the present coast mainly accumulated since the valleys were inundated by the post-glacial marine transgression. Older valley-fill deposits were mostly removed by river erosion during the preceding period of glacially lowered sea level. In contrast, sediments that occur beneath the bay bed are believed to record a succession of depositional and erosional events related to post-glacial/interglacial cycles. Their superposition suggests gradual subsidence of the floor of the bay.

Figure 12 shows a possible sequence of events and the development of litho facies associated with those events. At sea levels lower than 60 m the exposed floor of Savusavu Bay formed a wide swampy coastal plain (A in Fig. 12). Across this, rivers meandered to a coastline located seawards of the present bay mouth. During interglacials, rising sea level drowned the bay floor and, once full marine conditions were established, corals began growing around its margins (B in Fig. 12). The reefs grew

upwards and landwards while sea level continued to rise. But once it stabilised they, together with fluvial-deltaic deposits at the river mouths, began to prograde into the bay (C in Fig. 12).

The limited subsurface and age data from the Wailevu Coastal Plain and the Nasekawa River valley suggest that here coastal plain progradation lagged behind the growth of fringing reefs. These, in turn, were not initiated until about 4,000 yrs BP, or more than 2,000 years after sea level is thought to have risen to its present position. In the preceding period (c. 10,000-4,000 yrs BP) the excavated valley of the Nasekawa River was drowned by the post-glacial marine transgression and infilled with estuarine sediments. Reasons for the delay in the initiation of fringing reef growth are unclear. Elsewhere in the bay, where side slopes are steep, reefs are very narrow and have grown bayward very slowly. Possibly, along the Wailevu coast, a prerequisite for rapid reef growth was the accumulation of a shallow (<10 m deep) ramp of fluvial sediment (bay mud in Fig. 12) on which the reefs could build into the bay.

CONCLUSIONS AND RECOMMENDATIONS

Savusavu Bay, a structural basin in which subsidence and erosion have exceeded net accretion, preserves a partial record of Late Cenozoic sedimentation cycles. Deposition has been associated with glacio-eustatic periods of high sea level. The sediments representing these depositional periods are separated by erosional discontinuities formed during low stands of sea level. Coastal valleys on the northern side of the bay contain mainly Holocene deposits, fluvial deltaic and estuarine sandy sediments that grade bayward into marine muds and laterally into coral reefs.

The southeastern side of the bay is steep-sided and erosional. It is bordered by the Lesiaceva Peninsula, a tectonically active block with uplifted reef limestones on its southern side.

Under non-cyclonic conditions the eastern part of the bay is protected from the dominant southeasterly winds. Along the bay's northern shoreline, the net littoral movement of sediment is to the west and has resulted in coastal plains prograding immediately down drift from river mouths. The sand forming these was derived from the adjacent rivers and deposited in beaches but because of its immature composition the older beach sands at the rear of the coastal plain have broken down into clays. The resulting alluvium (see Fig. 2) is indistinguishable in the field from flood plain deposits.

The Wailevu Coastal Plain on the northern side of Savusavu Bay is underlain by a relict coral reef Holocene in age. Its maximum elevation indicates that post-glacial sea level was about 0.9 m above its present level 3,000 - 4,000 years ago. Taylor (1978) arrives at a similar conclusion from the elevation of solution notches cut in Pleistocene limestones on the central-south coast of the island. In Tonga (Tongatapu and 'Eua) relict microatolls about 2 m above present low tide level have been dated at between 6,100 and 6,500 yrs BP (Taylor, 1978). To resolve these relative sea level changes into eustatic and other components is virtually impossible especially in places such as Vanua Levu where there is clear evidence of recent tectonic activity. Nevertheless, the configuration of the shallow Savusavu embayment (c. 240 km² in area) raises the possibility that hydro-isostatic loading and rebound during and after the postglacial marine transgression could conceivably produce the relative sea level changes observed at Wailevu.

Although the supply of fluvial sand to the coast by the Nasekawa River should ensure long-term accretion of the Wailevu Coastal Plain, its alongshore transfer is non-uniform and local sectors of erosion occur. To reduce erosion around Wailevu village, the practice of taking loads of beach sand from its eastern (updrift) side should be discouraged or, at least transferred further to the west.

The relatively deep water and the protected setting of Valaga Bay makes it an ideal location for a new port under most conditions. However the presence of large storm blocks on the reef surface nearby (see Fig. 2) attest to the exposure of the area to cyclone-derived wave action. Perhaps the offshore patch reef in Valaga Bay could be used as an emergency mooring during cyclones. It is also important to design wharves and foreshore structures to withstand the effects of cyclones. Soft, muddy estuarine sediments in the subsurface could also create foundation problems for those structures.

The question of pollution arising from sewage discharged from Savusavu town and from the new port development at Valaga has not been investigated directly. However, from general observations made of water movements in the bay, it is clear that pollutants could be trapped at its eastern end. This is especially likely when winds blow from the western quadrant. Nakama Channel in front of Savusavu town relies on tidal flushing to remove town wastes and suffers low level pollution when winds are westerly. Areas that are particularly prone to pollution are the sand flats and mangrove areas around Savusavu town. Shellfish eaten by the local community are taken from these areas and an experimental mussel fishery is being developed in Savarekareka Bay, nearby. Though mangroves can act to purify treated sewage effluent (Watling, 1985), care needs to be taken to avoid the type of health problems that

arose in Tarawa, Kiribati. due to faecal pollution of food gathering areas.

It is recommended that a comprehensive study be implemented to measure water movements in eastern Savusavu Bay under the full range of weather and tidal conditions. These data should be used to prepare an environmentally safe plan for waste disposal in the whole Savusavu Bay area.

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APPENDIX 1

Wailevu Coastal Plain sample data list

(See Figure 10 for sample locations and Figure 11 for accretion trends)

Sample 115. About 7 m inland from beach. Coral and shell fragments in medium to coarse sand from -0.075 m msl. Ground surface (wave 03 m deep) is at +1.025 m msl. C14 age = 780+ 70 yrs BP (Beta 16710).

Sample 117. About 100 m Inland from beach. Coral fragments in brown sandy clay from 13 to 15 m below ground surface. C14 age = 1140 +_ 60 yrs BP (Beta 16709).

Sample 118. Coral rubble exposed in a well 125 m below ground surface (i.e. within 01 m of msl), 265 m inland from coast. C14 age = 3290 +_ 80 yrs BP (Beta 16711).

Sample 119. Coral rubble exposed in natural spring about 1 m below ground surface (i.e. about +0.4 m msl), 360 m inland from coast.

Sample 120. Coral blocks (some showing signs of subaerial weathering) and rubble in natural spring 13 m below ground level (i.e. about msl), 170 m inland from coast.

Sample 121. In situ coral pavement in natural spring 07 m below ground surface 640 m inland from coast. Surveyed elevation of coral surface is +0.12 m msl. C14 age = 3760 +_80 yrs BP (Beta 16712).

Sample 122. In situ coral pavement in natural spring 10 to 07 m below ground surface, 570 m inland from coast. C14 age = 3210 +_80 yrs BP (Beta 16713).

- Note: 1 Samples submitted for radiocarbon dating were not assessed for recrystallisation. Since all samples were collected from below the water table, diagenetic effects are assumed to be minimal.
- 2 It is probable that some sample numbers have been confused: Laboratory number Beta 16709 is assumed to refer to field sample 117 (not to 116 which was not submitted for dating) and Beta 16710 refers to sample 115 which was collected on the present coast (not to 117 which was from a site located 100 m inland). The above table shows the 'corrected' ages and sample numbers.