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BMR-APIRA PHANEROZOIC HISTORY OF AUSTRALIA PROJECT

SOUTH WEST PACIFIC DATA PACKAGE

BY

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SUMMARY

As part of the BMR-APIRA Phanerozoic History of Australia Project geological information has been compiled for those parts of the south west Pacific that are part of the Australian Plate or are closely adjacent to it. The area includes the island groups of Tonga, Fiji, New Hebrides (Vanuatu) and the Solomons and the associated ocean basins and plateaux. Papua New Guinea, New Zealand and the Tasman Sea have been dealt with in other project reports.

The information has been compiled in order to produce time slice palaeogeographic maps of the Australian plate. The data are presented in the form of summary stratigraphic columns, time slice data maps and palaeogeographic maps, and this report which includes an appendix of data point descriptions.

The aim of the project has been to provide a new data synthesis relevant to petroleum exploration in the region. The petroleum potential of the south west Pacific itself is limited, but the study of this area has relevance for understanding the development of Australian basins in their regional context. Tectonic events clearly recorded on this eastern plate margin have impact within the continent, such as the wrench reactivation of structures in the Gippsland Basin in the mid-Eocene which has been related to a rearrangement of the Pacific plate (Etheridge & others, 1991).

In considering the petroleum potential of the arc basins of the south west Pacific, the following summary points can be made :-

1) The sedimentary sequence in some of the intra-arc basins is up to 7 km thick. The sediments are dominated by volcaniclastics with subordinate platform and reef facies carbonates and very minor terrestrial deposits.

2) Volumetrically, volcaniclastics probably provide the main reservoir targets, but they have poor porosities and permeabilities due to diagenetic alteration even in originally coarse grained facies. Secondary and primary porosity in carbonate reefs offers better reservoir potential.

3) Backreef, paralic (mangrove swamp) and lacustrine facies are possible source rock facies, as are deep euxinic mudstones developed in isolated basins early in the geological history of the region. Seeps have been reported from Tonga and Fiji indicating the occurrence of some viable source rocks.

4)Potential traps include wrench anticlines, fault blocks and stratigraphic traps such as reefs and fans. Reef traps are probably the best prospects.

5)The major risks for petroleum exploration in the area are the isolated and deep water location of many of the prospects, the lack of known source rocks, poor porosity in volcanic dominated

sediments, the difficulty in identifying reef targets, uncertain and complex maturation histories, and leakage via recently active faults.

INTRODUCTION

The geology of the south west Pacific has been shaped by the interaction of the Australian and Pacific plates and several smaller plates. The area is made up of back-arc and intra-arc basins, island chains and oceanic plateaux. Most geological data are available from the small islands which represent a very small percentage of the area. DSDP and ODP drilling results and regional geophysical studies (seismic and magnetics) provide information from the ocean and arc basin areas.

The stratigraphy of the region is dominated by volcanics and carbonates. An evolutionary progression from basalt to andesite to reef limestones and minor terrestrial deposits occurs in the development of many of the islands.

Oil and gas fields in Niigata Sub-basin of northeast Honshu, Japan, demonstrate that significant amounts of hydrocarbons can accumulate in the volcaniclastics of island arcs. This sequence is Miocene in age and up to 10 km thick; reservoirs include lavas, sedimentary tuffs and turbidite sandstones, and the source rocks are thought to be the associated mudstones (Miyazaki & others, 1979). Carbonate reefs that are age equivalents to those scattered throughout the south west Pacific are major petroleum reservoirs in Indonesia.

The geology and hydrocarbon potential of each of the island groups and associated oceanic areas is discussed in detail in the following sections. Appendix 1 provides data point and data area descriptions by time slice. Also included are summary correlation charts.

ACKNOWLEDGMENTS
Thanks to Jim Cowell and Neville Exon for comments on the manuscript and to Peter Brown for drafting the figures.

TONGA REGION

The Tonga region includes a chain of over 170 islands trending generally north/south, located at the convergent boundary of the Pacific and Australian plates. The island chain continues to the south as the Kermadec Ridge. The Tonga region has a classic arrangement of trench (Tonga Trench), forearc basin (Tonga Ridge), modern island arc (Tofua Ridge), back arc basin (Lau Basin) and back arc or remanent arc (Lau Ridge) (Figure 1). Though politically part of Fiji, the Lau Group islands are described in the Tongan section of this paper. The Tonga island arc is of mid-Eocene to Recent age, and unlike the Solomons and New Hebrides there appears to be no history of arc reversal. Convergence has consistently resulted in subduction of the Pacific plate under the Australian plate.

TECTONIC ELEMENTS:
Tonga Ridge/Tonga Platform: Tonga Ridge is the bathymetric expression of the forearc basin. The ridge is 70 km wide and 1000 km long and water depths range from less than 200 m to over 600 m. Sediment thickness are up to 5 Km (Gatliff, 1990).

Tonga Trench: The Tonga Trench is up to 10 km deep and is the site of a west-dipping subduction zone. The Pacific plate being subducted may be around 100 million years old. Anomaly 34 (84 Ma) is found over 1000 km to the east indicating that the oceanic crust being consummed at the Tonga Trench may have been extruded during the Magnetic Quiet Zone in the early or middle Cretaceous.

Louisville Ridge: The Louisville Ridge intersects the Tonga Trench at the approximate division between the Tonga and Kermadec trench/arc systems. It is being subducted at the Tonga Trench, and the ridge/trench intersection has migrated southward at rates approaching 18 cm/yr since the latest Miocene. This has contributed to a north-south migration of middle Miocene and younger depocentres on the central Tonga Ridge, due to shifting sediment supply associated with the uplift as the ridge is progressively subducted (Ewart & others, 1977; Dupont & Herzer, 1985).

Tofua Ridge: The Tofua Ridge is the modern volcanic arc to the west of the Tonga Ridge. It is composed of a chain of submarine and sub-aerial volcanoes of Pleistocene to Recent age.

Tofua Trough: The Tofua Trough is a partially filled basin separating the central Tonga Ridge from the Tofua Ridge. It may have been the site of latest Eocene or Oligocene extension related to rifting and back arc spreading in the South Fiji Basin.

Lau Ridge: The Lau Ridge is a remanent arc rifted from the Tonga Ridge with the opening of the Lau Basin (Packham, 1978; Herzer & Exon, 1985). The islands on top of the ridge are composed of limestone and volcanics. The earliest known volcanism is Middle Miocene, but the ridge is probably older, perhaps having an Eocene basement similar to the Tonga Ridge. Oligocene sediments of South Fiji Basin onlap the Lau Ridge (Katz, 1986).

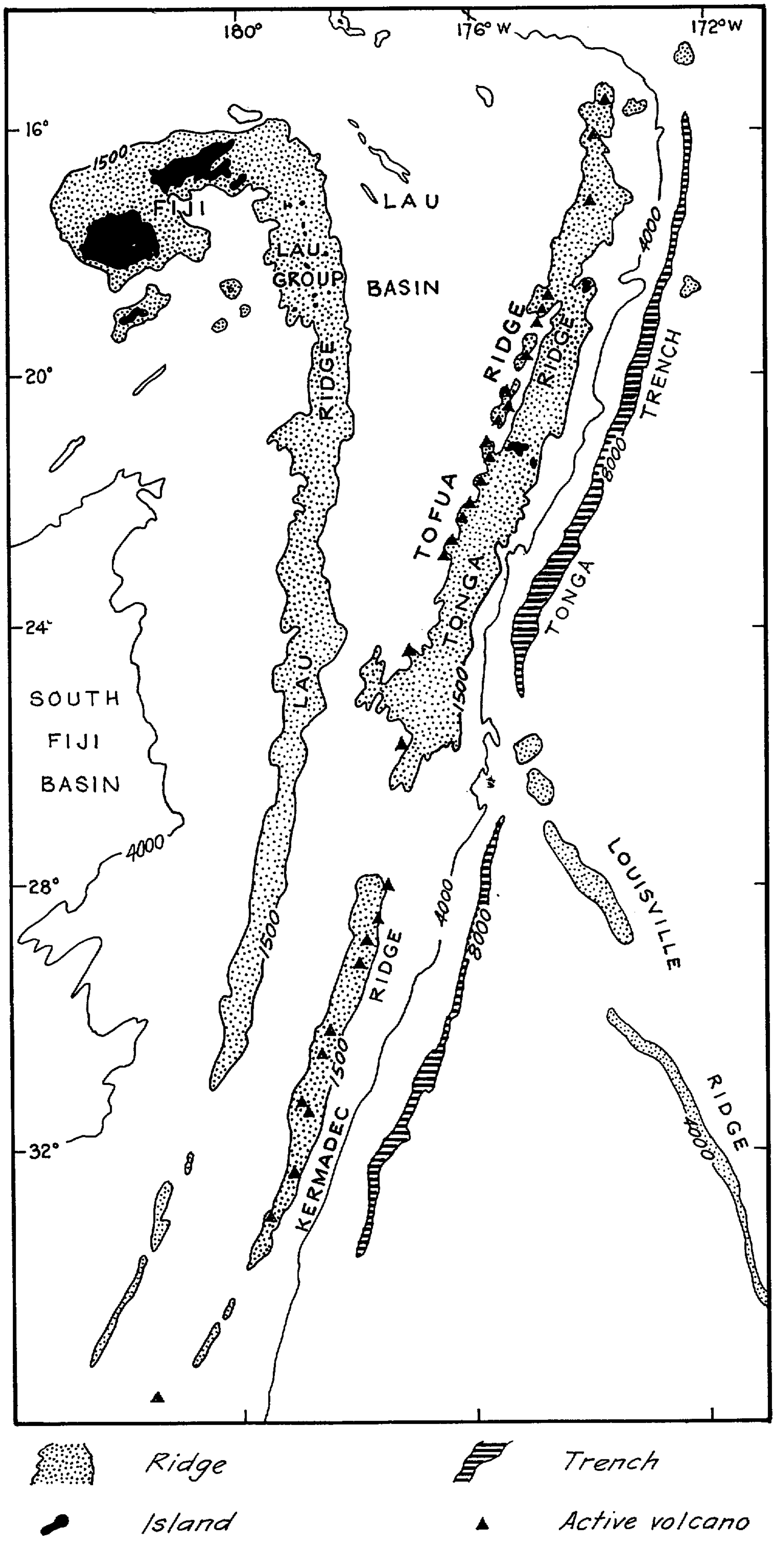

FIGURE 1. Tonga region tectonic elements (from Herzer & Exon, 1985).

Lau Basin: The Lau Basin is a back-arc basin between Lau and Tonga Ridges. Magnetic anomalies 1 to 3 have been identified (Cherkis, 1980) indicating that the Lau Basin opened in the very Late Miocene to Early Pliocene. It is floored by oceanic tholeiite with a thin and sporadic sediment cover, mainly volcanics derived from the Lau and Tonga ridges. Katz (1986) estimates that there is over 1000 m of sediment in the southwest part of the basin. DSDP 203 located in the Lau Basin intersected Pleistocene and Late Pliocene nanno ooze, volcanic sand and cobbles, and did not reach oceanic basement.

STRATIGRAPHY:

The oldest known rocks in the Tonga region are the Eocene Eua Volcanics composed of basalt flows, tuffs and agglomerates, andesite, and gabbro. These middle to upper Eocene volcaniclastics on Eua, are coeval with the oldest rocks on Fiji. Gatliff (1990) suggests that it is possible that the Tonga Ridge may have an older, pre-Eocene basement related to its former position close to New Caledonia.

The volcanic basement is overlain by Upper Eocene foram platform limestone, which is then unconformably overlain by Miocene to Lower Pliocene reefal limestones. Equivalent marine volcaniclastics were deposited in outer shelf to bathyal depths. An unconformity occupying most of the Oligocene is indicated from well control on the Tonga Ridge (see Appendix 1). However, Honza (1991) reports deep water Oligocene carbonates overlying the Eocene sediments.

Middle to Upper Miocene volcaniclastics derived from the Lau Ridge form a westward thickening wedge. The youngest units are Upper Pliocene to Pleistocene reefal limestones and the deposits of modern fringing reefs and the Pliocene to Recent volcanoes of the Tofua Ridge.

GEOLOGICAL HISTORY:

In middle to late **Eocene** time, an ancestral central Tonga Ridge was probably located on a convergent margin at the Australia-India/Pacific plate boundary. The Eua Volcanics are the products of very early stage island arc evolution, less fractionated than recent Tongan volcanics. They may have formed as part of the ocean floor extruded from a fissure type rift zone (Honza, 1991). Prior to the Oligocene opening of the South Fiji Basin, Tonga was close to the continental fragment of New Caledonia (Karig, 1970, Packham, 1978). Eocene sedimentation was probably affected by the larger landmass to the west (Gatliff, 1990). Normal faulting created deep half grabens and uplifted ridges at this time (Herzer & Exon, 1985).

In the **Oligocene** the arc rifted and the South Fiji Basin began to form by back-arc spreading. The united Tonga/Lau Ridge migrated eastward, as the back-arc basin opened and Pacific lithosphere was consumed. This produced faulting and tilting, and the deposition of upper Oligocene volcaniclastic turbidites, plus pelagic sediments. The Oligocene eustatic drop in sea level eroded and reworked the volcaniclastic sediments. Towards the end of the Oligocene reefs began to develop on the crests of basement tilt blocks.

After 26Ma **(Miocene)**, sea floor spreading ceased in the South Fiji Basin, and the east-facing New Hebrides-Fiji-Lau-Tonga arc again became the Australia-India/Pacific plate boundary. By the early Miocene reefs were well established on parts of the central Tonga Ridge. Volcanic conglomerates on Mango Island in the Nomuka Group (Data point 2005, see Figure 8) suggest that volcanoes occurred on the Lau Ridge by middle Miocene times.

In the **Late Miocene**, (~8Ma), the northern part of the pre-existing arc reversed, and the Pacific plate continued to be subducted only beneath the Fiji-Lau-Tonga portion of the arc. There was uplift, doming, westward tilting and intrusion in the southern part of the Tonga Ridge. Miocene to early Pliocene volcanism was centred along a line extending from Tongatapu (Data point 2004) north-northeast to Vava'u (Data point 2007). Pliocene to Recent volcanic activity shifted westward approximately 50 km to the Tofua Ridge (Honza, 1991).

During the **Early Pliocene to Quaternary** there was back-arc spreading, uplift of the Tonga Ridge, and initial sea floor spreading in the Lau Basin. Limestones were deposited on and around the main islands and volcanism occurred along the Tofua Ridge.

HYDROCARBON POTENTIAL:

Exploration history:- Oil seeps on Tongatapu encouraged the first phase of exploration in the early seventies lead by Shell. This entailed onshore mapping, offshore seismic and the drilling of two onshore wells without success. A second round of drilling by Webb Resources occurred in 1976. Following a Vibroseis survey on Tongatapu three wells were drilled again without success. Offshore seismic was shot in the Eua Channel. Cruises and studies in the Australia-New Zealand-USA Tripartite Cruise Programme (1982, 1984) and by the Japan Marine Science and Technology Centre *M.S. Natsushima* in 1984 have provided a regional coverage of multichannel seismic, sea bed sampling and analysis of the oil seeps. The most prospective area on the known evidence is the 'Eua Channel, which is being actively explored at present.

Drilling results: Kumifonua 1 & 2, Tonga Shell 1971, TD 1684 m & 1685 m in Lower Miocene volcaniclastics, did not reach Upper Eocene limestone targets due to limited rig capacity. They were sited on gravity and magnetic survey data and reprocessing of seismic data shows the wells were drilled off structure. They intersected 120 m of Plio-Pleistocene reef limestones overlying 1500 m of fine to coarse volcaniclastic sediments interbedded with a few thin limestones.

Kumimonu 1, Webb Tonga, 1978, TD 2555 m in presumed volcanic basement. However, despite being overlain by Upper Eocene marine volcaniclastics, the bottom hole sample dated at 13.9 + 1Ma, and was interpreted as a dolerite sill. The well was believed to have been drilled off structure.

Kumimonu 2, Webb Tonga, 1978, TD 2295 m in presumed volcanic basement, again found to be a dolerite sill within Upper Eocene marine volcaniclastics that dated at 21.3 +.04Ma. The well was drilled on a feature interpreted as a submarine channelised fan deposit with an erosive base and convex upper depositional surface (Gatliff, 1990) thought to be related to the Oligocene low stand of sea level.

Kumimonu 3, Webb Tonga, 1978, TD 2635 m. Some reefal Miocene limestone were intersected (intervals 15 m & 46 m thick). There were no hydrocarbon shows and the well was drilled off structure. (Maung & others, 1982; Gatliff, 1990).

Reservoirs: The sedimentary sequence is dominated by deepwater volcaniclastics with low reservoir potential due to secondary alteration and cementation (Gatliff, 1990). Shallow marine Eocene and Oligocene carbonate targets offer better reservoir potential, with the chance of both primary and secondary porosity. Speleological studies of Eocene limestones on 'Eua suggest that there was a pre-Miocene karstic event (Gatliff, 1990) which may relate to the Oligocene regression. ?Miocene coral reef buildups, observed on seismic in the southern part of the Tonga Ridge are buried a 1000 m within the sediment section and are in water depths of around 1000 m (Maung & others, 1982).

Seal: The volcaniclastics, mudstone and lithic sandstone that dominate the sedimentary sequence are non-porous and impermeable, and would act as a seal facies. There are a great number of normal faults, many of which penetrate the surface, and the presence of seeps indicates that there has been some leakage.

Source: Outcrop and well samples analysed have low organic matter contents (Buchbinder & Halley, 1985), but oil seeps demonstrate that source rocks do exist. Whether there is sufficient source to generate a commercial accumulation is unknown. Analysis indicates a biodegraded oil from a carbonate source that is thermally mature (Sandstrom, 1985). Back reef lagoon and inter-reef basinal facies in the Miocene/Pliocene section and Eocene foram limestone are possible candidates. Live oil seeps are reported to have been generated from the sediments of the Eua Channel, a restricted basin containing deeply buried Late Eocene to early Oligocene sediments. During the Eocene Tonga may have been close to New Caledonia where oil seeps have also been reported there, and an Eocene flysch sequence is postulated as the source (Paris, 1981).
The present geothermal gradient is estimated at 30 degrees C/km from well data and an oil window located at 3000-4000 m is indicated (Gatliff, 1990). Heating related to the Pliocene opening of the Lau Basin would have had an impact on the thermal maturation of suitably located source rocks.

Traps: Reefs are the preferred trap type. Fault block traps in volcaniclastics have less chance of reservoir facies and faults commonly come to the surface. In the southern Tonga Platform 1.2 seconds (~1620 m) of sediment is highly faulted with NNE/SSW trending faults affecting the seabed topography (Maung & others, 1982).

Risks: The identification of reefs from seismic is ambiguous, in many cases in the region reef targets prove to be volcanic features. This may be a risk that technology can lessen. Other major risks are source quality and quantity. The palaeogeographic setting suggests a few sweet spots rather than widespread source rock facies.

FIJI REGION

Fiji is an oceanic island group dominated by the two major islands of Viti Levu and Vanua Levu. It is located between the New Hebrides arc in the west and the Tonga arc to the east. The marginal ocean basins of the North Fiji Basin and the South Fiji Basin lie to the north and south (Figure 2).

TECTONIC ELEMENTS:
Fiji Islands: The Fiji Islands are a group of oceanic islands that formed as part of the New Hebrides - Tonga arc and were later removed from the active plate boundary by opening of the North Fiji Basin.

Hunter Fracture Zone: The Hunter Fracture Zone is a major transform boundary separating the still active spreading system of the North Fiji Basin from the older crust of the South Fiji Basin. It is a plate boundary that in part coincides with a belt of shallow earthquakes (Hawkins, 1976). It may have developed as an oblique wrench fault system in the collision zone between Fiji and the Lau Ridge (Wood, 1979). Transform motion along the fracture zone takes place at about 4-5 cm/year (Falvey & Greene, 1988).

South Fiji Basin: The South Fiji Basin is an ocean basin located between Fiji and New Zealand. It is 4000 to 4700 m deep with a central ridge. The basin is Oligocene in age and anomalies 12 to 7 have been identified giving an age of 33 to 26Ma (Weissel & Watts, 1979). Malahoff and others (1982) suggests a slightly older age of 36 to 26Ma. The oldest crust in the basin may be Eocene as the basin was once continuous with the ?Cretaceous to Eocene New Hebrides Basin, which youngs southwards towards the South Fiji Basin.

DSDP Sites 285 & 205 In the South Fiji Basin recovered Oligocene nannofossil ooze and volcanic ash over oceanic basalt; thick middle Miocene volcaniclastics (derived from the Lau-Colville Ridge and New Zealand and transported by turbidity currents) and biogeneic ooze; Late Miocene nanno ooze and fewer volcanics; and Pliocene to Recent abyssal red clays (Weissel & others, 1982; Katz, 1986; Greene & Wong, 1988).

North Fiji Basin: The North Fiji Basin is a marginal sea no older than the Middle to Late Miocene, that is 0-7Ma. The anomalies identified are 4 through 2 and currently there is an active spreading centre. The marginal basin displays ridge-ridge-ridge triple junction development with active spreading occurring between the New Hebrides and Tonga subduction zones. The North Fiji Basin has an irregular rough basement surface with thin pelagic sedimentation (0.15 - 0.3 sec). The western margin has accumulated some volcanic ash and turbidites derived from the New Hebrides arc (Falvey, 1978; Greene & Wong, 1988; Jolivet & others, 1989).

STRATIGRAPHY:
Onshore: The stratigraphy of the Fiji Islands includes Eocene andesite, basalt, dacite and limestones; early Oligocene tonalite; late Oligocene to early Miocene volcaniclastics, lavas, tuffs, limestones, sandstones and mudstones; mid to late Miocene

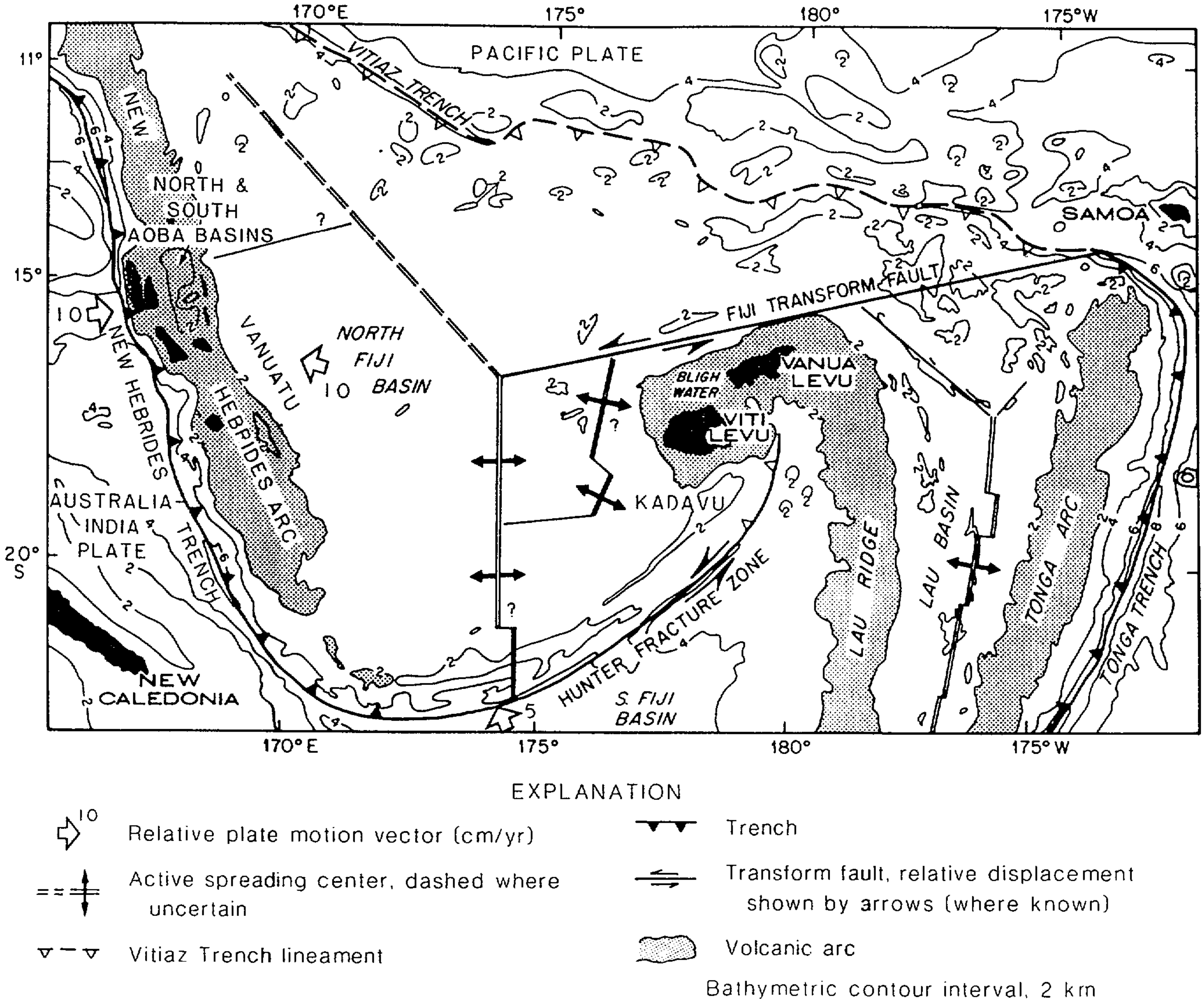

FIGURE 2. Fiji region tectonic elements (from Falvey & Greene, 1988).

(11-8Ma) gabbro (Colo intrusions); and Late Miocene to Pliocene sandstones, mudstones, basal conglomerate, limestones and andesite.

Offshore basins: Offshore sedimentary accumulations include the Bligh Water, Bau Waters, Suva and Baravi basins (Figure 3). These sedimentary basins are marginal to the updoming of the main island and may date back to the Eocene (Katz, 1986).
Bligh Water Basin: The Bligh Water Basin located to the north of Viti Levu ranges in depth from under 100 m to 1000 m. Over 2 km of Recent to Oligocene sediments were intersected in the two wells drilled in the basin (Bligh Water 1 & Great Sea Reefs 1, see Appendix 1, data points 2010 & 2011). Most of the sequence penetrated was fine grained deep water facies. The basin has up to 4 km of upper Miocene and younger sediments.
Bau Waters Basin: This basin is located east of Viti Levu and ranges in depth from less than 100 m to around 500 m. Two deep wells were drilled (Maumi 1 & Cakau Saqata 1) and over 2000 m of volcaniclastic sediment from Pleistocene to Middle Miocene in age was penetrated in the offshore (Johnson, 1991).
Suva Basin: The Suva Basin is generally over 2000 m deep and is located off southeast Viti Levu. From seismic information it has a sedimentary sequence of 4 km thick, most of which is expected to be Neogene volcaniclastics (Johnson, 1991).
Baravi Basin: The Baravi Basin is located offshore southwest Viti Levu and contains in excess of 2.5 km of sediment of ?late Miocene to Pliocene age (Katz, 1986). In the Miocene, the Baravi Basin would have been the continuation of the North and South Aoba Basins of the New Hebrides (Katz, 1986), prior to the opening of the North Fiji Basin.
Koro Sea Basin: Between the volcanic islands of the Koro Sea, east of Viti Levu, are up to one second of Plio-Pleistocene, volcanic derived turbidites, in waters of 2 to 3 km (Katz, 1986).

GEOLOGICAL HISTORY

From the Late Eocene to mid Miocene, Fiji and the New Hebrides were part of one island arc related to the Vitiaz Trench, where the Pacific Plate was subducted under the Australian Plate. In the Oligocene the South Fiji Basin opened due to back arc spreading. During the Middle to late Miocene this arc broke up causing the large scale rotation of arc fragments that separated the Fiji Platform from the New Hebrides at 8-7Ma (Falvey & Greene, 1988). Fiji was rotated anticlockwise nearly 30 degrees (James & Falvey, 1978). There was initiation of a new subduction system and back arc opening of the North Fiji and Lau basins. By the Miocene/Pliocene boundary Fiji had changed from an island arc to an oceanic island group. This removal of the plate boundary is reflected in a change from andesitic to shoshonitic and basaltic magmas around 5Ma (Gill, 1976).

RESOURCE POTENTIAL:
HYDROCARBONS:

Exploration history: Active oil and gas seepages reported on the sea floor have simulated exploration activity in Fiji since 1968. Most activity has been concentrated on the shallow water shelf areas around Viti Levu. Five deep wells have been drilled and a large amount of multi-channel seismic has been collected. Johnson (1991) presents interpretations of recently released propriety

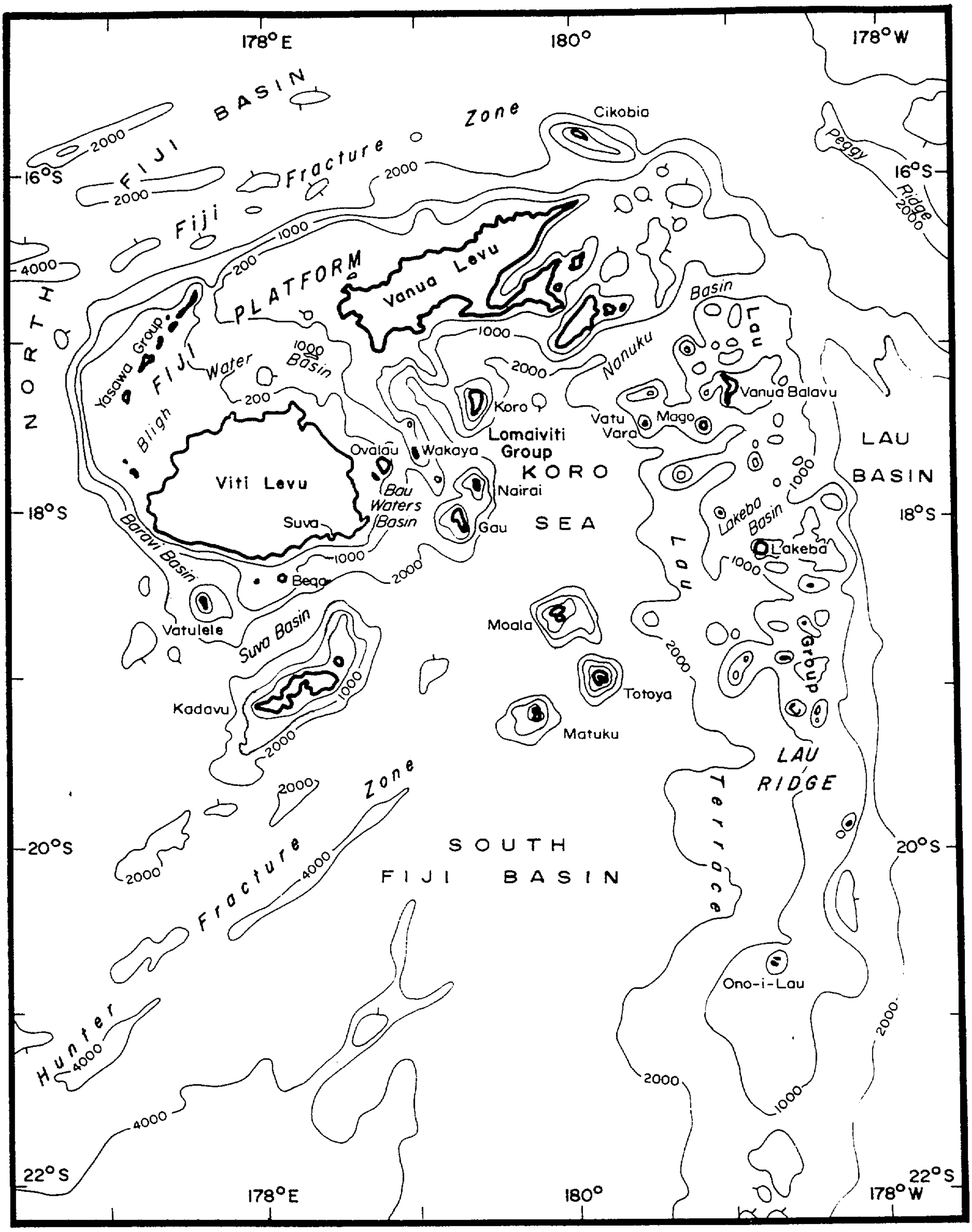

FIGURE 3. Fiji basins (from Johnson, 1991).

seismic data.

Drilling results: Chevron drilled Bligh Water 1 and Great Sea Reef 1 in 1980, offshore in the Bligh Water Basin on major structural highs (Johnson, 1991). Total depths were in excess of 2700 m and the wells bottomed in Oligocene volcanic sediments. No source rocks were intersected (Gill & McDougall, 1973; Rodda, 1982) and the Miocene reef targets were not found due to facies change to deep water sediments and/or removal by unconformity (Johnson, 1991).

Buabua 1 & 2 were drilled onshore in west of Viti Levu by Bennett Petroleum in 1981. Total depth was 300 m located in the Plio-Pleistocene Meigunyah Beds. Gas blow and oil scum was reported but Miocene reef targets were not reached. Johnson (1991) suggested that the oil show was contamination from a refined product.

The Yakuilau Island well, located in Nadi Bay, was drilled in 1982 to 1526 m. It penetrated Pleistocene to late Miocene clastics including volcaniclastic mudstones, conglomerates and sandstones, and had minor gas shows (Johnson, 1991).

Maumi 1 and Cakau Saqata 1 were drilled by Bennett Petroleum in 1982 in the Bau Water Basin. Maumi 1 was located near the southeast coast of Viti Levu and penetrated to 1591 m. It intersected some fossiliferous beds of Late to ?Middle Miocene age and had gas shows. Cakau Saqata 1 was drilled in the offshore on a reef to 2272 m. It intersected 150 m of late Pleistocene reef, 1500 m of Plio-Pleistocene volcaniclastic mudstones and sandstones, basalt; and under the basalt - tuff, tuffaceous sandstones and mudstones of Late to Middle Miocene age. The well bottomed in andesite dated at 8.8Ma, close in age to the Colo plutonic intrusion. Minor oil fluorescence was recorded between 380 m and 472 m (Johnson, 1991).

Reservoirs: Carbonate reservoirs are the favoured reservoir targets, though they are less common than in the Tongan sequences. There are Miocene and Pliocene limestones, some with reefal facies and thicknesses over 100 m. Apart from any preserved primary porosity, fractures and karstic solution can produce secondary porosity. Johnson (1991) reports lower to middle Miocene limestones with 5% porosity and permeabilities of 0.1 to 0.4 mD, and upper Miocene to lower Pliocene limestones with 37% porosity and permeability of 1899 mD.

The great bulk of the Fijian sedimentary sequence is volcanic dominated clastics which can be expected to have poor porosity and permeability at depth, as shown from the well results. Johnson (1991) tables some good porosity values (25 - 50%) but poor to fair permeabilities (0.7 - 672 mD) for lower Pliocene and upper Miocene sandstones from outcrop samples.

Seal: Volcaniclastic mudstones are a potential seal facies that is common within the sequence.

Source: No proven source rocks have been found in Fiji and most of the section penetrated by wells is dominated by volcaniclastics. Buchbinder and Halley (1985) reported on 27 outcrop samples, only four, from Late Miocene to Pliocene sandstones, had TOCs in the range of 0.49 - 1.16%. The kerogen type was found to be gas prone. Similarly, studies of over a hundred core samples from stratigraphic drilling on Viti Levu by Boreham (1989) found only type III kerogen. TOC values up to 2.07% were reported and there is some potential for gas generation.

Maturation profiles are highly variable due to the complex thermal history of the Fiji Islands. The top of the oil window in Bligh Water 1 is 2400 m, but onshore, in Maumi 1, is at 1060 m (Johnson, 1991).

Oil and gas shows have been reported from a number of wells despite the poor source rock characteristics of most of the section. Hydrocarbon anomalies have been recorded from shallow core samples from the Bligh Water (methane, ethane and pentane) and Bau Waters (methane, ethane and oil fluorescence) basins (Johnson, 1991).

Traps: The best potential traps are buried reefs. Some mound structures in the Pliocene section have been interpreted on seismic from the Bligh Water Basin (Johnson, 1991). In general, only the upper Miocene and younger section can be resolved on seismic making identification of older Miocene reef targets difficult (Johnson, 1991).Other trap types include anticlines, fault blocks, flower structures and unconformity traps.

Risks: Reservoir and source quality are major risks. Other risks are target identification and leakage from faults that cut the sea bottom.

MINERALS:

Gold and sulphide mineralisation is associated with Colo Orogeny intrusions and also with Pliocene volcanic centres, such as the Au-Ag-Te mineralisation related to the Tavua Volcano.

NEW HEBRIDES REGION

The New Hebrides is a Late Oligocene and younger volcanic arc, formed by collision of the Australia-India Plate and the Pacific Plate. The arc trends near north/south between the Solomons and the Hunter Fracture Zone (Figure 4). It includes the islands of the Republic of Vanuatu (formerly known as the New Hebrides) and the southernmost island group of the Solomons, the Santa Cruz Group (Nendo). The New Hebrides Trench separates the arc from a complex oceanic area to the west that includes the New Hebrides, West Santo and the D'Entrecasteaux basins, the D'Entrecasteaux Zone and the Torres Plateau (Figure 4). The Vitiaz Arc and Trench lie to the north of the New Hebrides Arc now separated by the North Fiji Basin (Figure 4).

TECTONIC ELEMENTS:

New Hebrides Arc: The New Hebrides Arc is shown on Figure 5 and can be divided as follows:-

i) a western belt of Late Oligocene to Middle Miocene age (Espiritu Santo, Malekula, Torres Islands, eastern part of Nendo),

ii) a central volcanic chain of Late Miocene to Holocene age (Nendo to Anatom),

iii) an eastern belt of late Miocene to Early Pliocene age (Pentecost and Maewo),

iv) intra-arc basins (Vanikolo Basin and the basins of central Vanuatu) between the western and eastern belt islands, and

v) incipient back arc rifts, north (Vot Tande Trough) and south (Coriolis Trough) of the central basin (Dubois & others, 1978).

New Hebrides Trench: The trench is an eastward-dipping subduction zone, that marks the convergent plate boundary between the Australia-India Plate and the Pacific Plate. It has a depth ranging from 5 km to over 7 km (Greene & Wong, 1988).

New Hebrides (North Loyalty) Basin: The New Hebrides Basin is a Late Cretaceous to Mid Eocene ocean basin (80 - 42Ma). The identified magnetic anomalies are ?18 to 23 (Weissel & others, 1982) and represent the period 55 - 42Ma, early to mid Eocene.The ocean floor youngs to the south where it was once continuous with the Oligocene South Fiji Basin.

DSDP 286, located in the New Hebrides Basin (Data Point 1139, part of the New Zealand - New Caledonia compilation), intersected middle to late Eocene volcaniclastics overlain by late Eocene to Oligocene nanno ooze, latest Oligocene to Miocene red clay and Plio-Pleistocene ash, ooze and clay. The Eocene sediments show there was an active volcanic arc and subduction zone along the D'Entrecasteaux Zone and into the Loyalty Ridge/New Caledonia (Maillet & others, 1982). By the latest Oligocene and through the Miocene the New Hebrides Basin was at abyssal depths; and from the Plio-Pleistocene there was an active source in New Hebrides Arc to the east.

D'Entrecasteaux Zone: The D'Entrecasteaux Zone is an irregular sea floor ridge, ranging in depth from 4500 m to 2500 m, that trends east/west to se/nw from the New Hebrides to New Caledonia. It is a twin ridge system with the southern ridge being a chain of seamounts. The D'Entrecasteaux Zone is interpreted as a Late

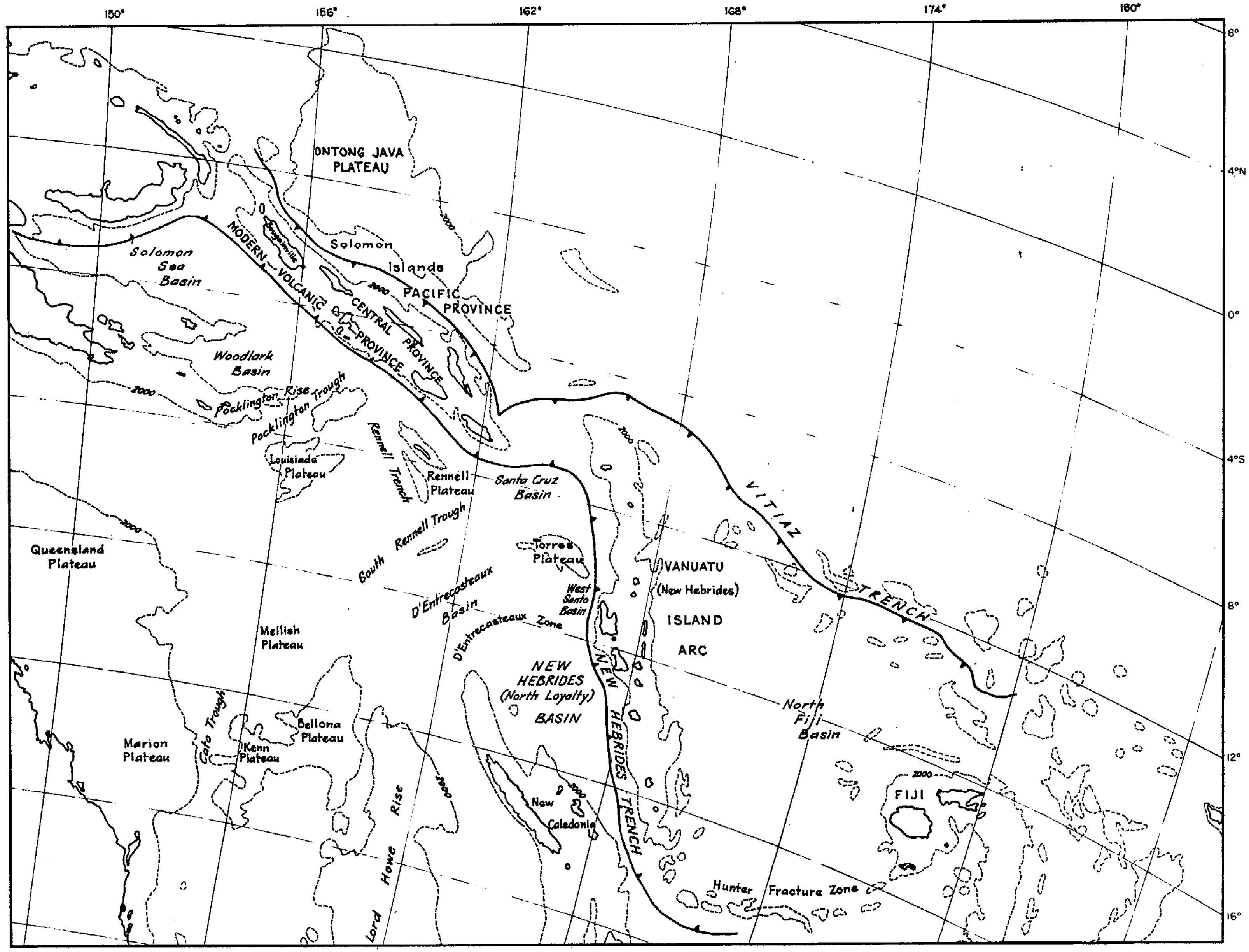

FIGURE 4. New Hebrides and Solomons tectonic elements.

Eocene northeast-dipping subduction and obduction system that is exposed on New Caledonia (Greene, Collot & others, 1991). It is currently under thrusting the New Hebrides and ridge subduction has caused hundreds of metres of vertical deformation in a few 100,000 years, with effects reaching parts of the arc not actually underthrust by the ridge (Fisher, 1986). Santo and Malekula are being uplifted at rates up to 4.3 mm/yr (Jouannic & others, 1979), an effect that will ameliorate the proposed greenhouse-induced sea level rise. The collision has caused significant transcurrent faulting and volcanism such as at Aoba (Falvey & Greene, 1988).

The D'Entrecasteaux Zone first collided with the New Hebrides Arc around 8-7Ma at a position south of Malekula, where an indentation on the frontal arc is attributed to the subduction of a seamount (Greene & others, 1988). Collision with the north and south ridges of the D'Entrecasteaux Zone began about 4-3Ma (Greene & others, 1988).

D'Entrecasteaux Basin: This basin is old, deep (4000-4500+ m) oceanic crust to north of, and separated from, the New Hebrides Basin by the D'Entrecasteaux Zone. It may be of similar Eocene age to the New Hebrides Basin.

West Santo Basin: The West Santo Basin is a small area deeper than 5 km to west of the island of Espiritu Santo and to the west of the New Hebrides trench. It trends east/west and is interpreted as an older trench feature related to D'Entrecasteaux Zone immediately to the south (Greene & Wong, 1988).

Torres Plateau: The Torres Plateau ranges in depth from 2500 m to less than 1000 m and is located to the immediate west of the New Hebrides Arc. It is domed and elongate in the east/west direction. The plateau has 0.4 sec sediment cover, with an unconformity between an interpreted Plio-Pleistocene sequence and a slightly deformed sequence beneath. The faulted and deformed sediments abut a possible volcanic high in the south of the plateau (Burne & others, 1988). The Torres Plateau may be a continental fragment or an oceanic plateau (Dupont & Recy, 1980). It may have been rifted off the Bellona Plateau prior to opening of the D'Entrecasteaux Basin.

Vitiaz Arc & Trench: This inactive arc trench system is located to the northeast of the New Hebrides Arc. It was the site of Late Eocene west-dipping subduction, the Pacific Plate under Australia-India Plate. The Vitiaz Frontal Arc was then continuous with the Tonga and Solomons Arcs (Outer Melanesian Arc) in a west-dipping system (Greene & Wong, 1988).

Arc volcanism occurred at 22-25Ma and again possibly at 15Ma (Kroenke, 1984). The ?Late Oligocene to Early Miocene volcanism was largely basaltic and was the source of coarse clastic material deposited as deep submarine fans in the present eastern belt of the New Hebrides (see columns). Between 11 and 8Ma the arc was inactive and subsiding and subduction reversal had started (Greene & others, 1988). Around 8Ma there was arc fragmentation (Malahoff & others, 1982), the plate boundary shifted westwards to the New Hebrides and the North Fiji Basin opened.

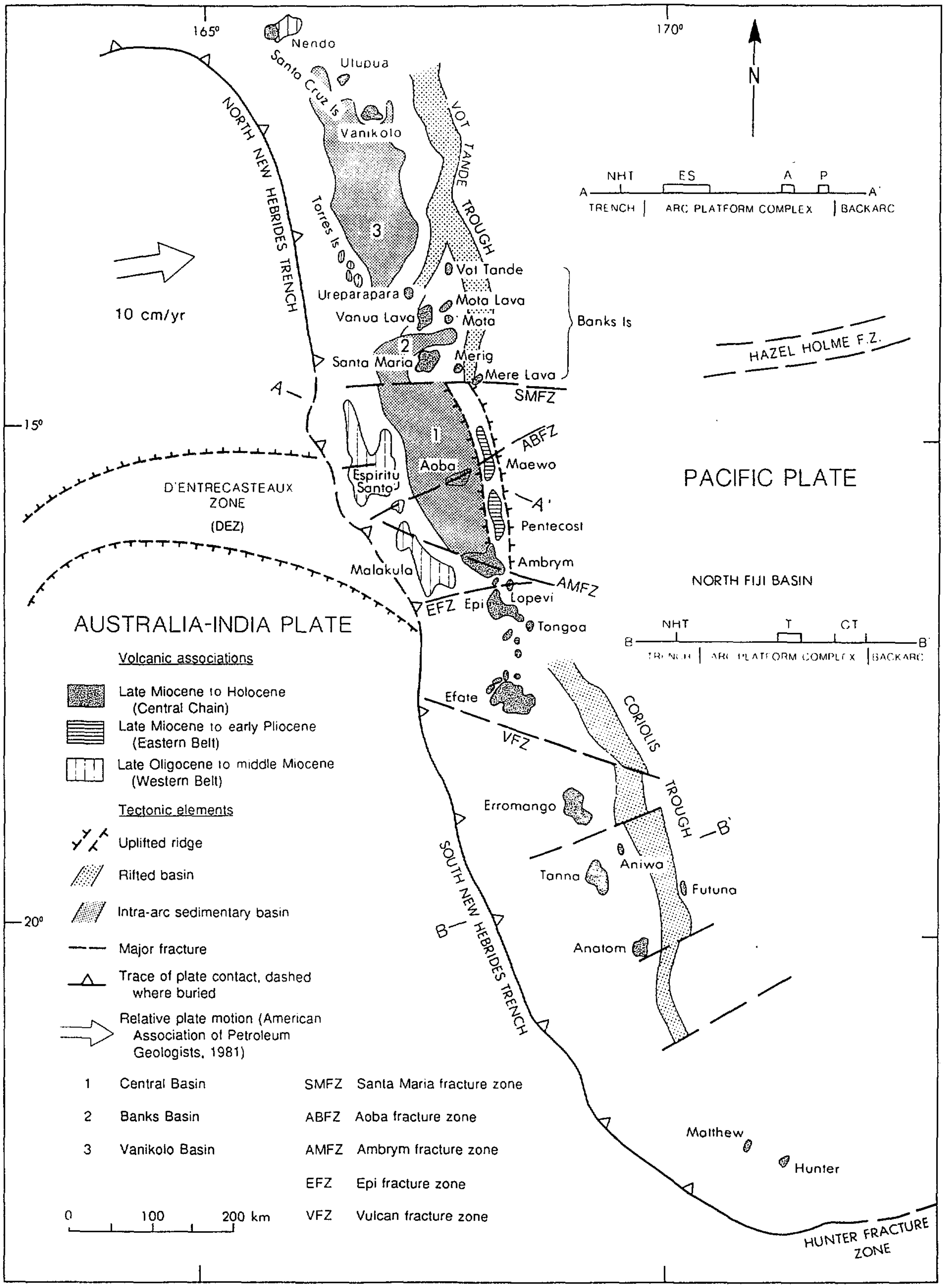

FIGURE 5. New Hebrides location map (from Falvey & Greene, 1988).

STRATIGRAPHY:

Onshore: Apart from clasts of Upper Eocene material possibly derived from Fiji, the oldest rocks known in the New Hebrides Arc are serpentinised peridotites with an Oligocene metamorphic age outcropping on Maewo in the eastern belt; and abyssal red mudstones from Malekula in the western belt of probable Late Oligocene age (see Correlation Chart and Appendix 1, Data points 2021 & 2022).

An Upper Oligocene through to Middle Miocene sequence of lavas, volcaniclastics and carbonates accumulated in the western belt, terminating with Middle Miocene intrusives. Following a mid to late Miocene hiatus, volcaniclastics and carbonates were deposited. In the eastern belt, Middle Miocene turbidites are overlain by upper Miocene to lower Pliocene volcanics, that are capped with carbonates. The Central Chain volcanics are Late Miocene to Holocene in age and have some associated volcaniclastics and reef deposits.

Offshore basins: The intra-arc basins have sediments up to 6 km thick that may be as old as Oligocene. Figure 6 shows the intra-arc basins, with the Vanikolo Basin in the north, between the Santa Cruz Islands and the Banks Group, and the basins of central Vanuatu to the south, between the Banks Group and Ambrym.

Seismic data and onshore correlations indicate that the central basinal area has a sequence of faulted and folded island arc volcanics and sediments of upper Oligocene to middle Miocene age, overlain by 2000 m of upper Miocene to Plio-Pleistocene pelagic sediments, foram mudstones and turbidites. The intra-arc region between the main islands is asymmetrical with a steep eastern margin and a more gradual, step-faulted western margin, where a number of small shelf basins are located.

Vanikolo Basin: The Vanikolo Basin is in water depths between 1000 m and 2000 m. It contains over 6 km of sediment, probably as old as Late Oligocene (Holmes, 1988; Falvey & others, 1991) with equivalents outcropping on Torres Islands and Espiritu Santo (Data points 2024 & 2023, Appendix 1).

Banks Basin: The Banks Basin is suggested by Falvey & others (1991) to be a northern extension of the North Aoba Basin. It lies at depths of around 1000 m.

North Aoba Basin: The North Aoba Basin is a deep water basin mostly lying below 2000 m. It has 5 km of sediment interpreted as late Oligocene or early Miocene volcaniclastics and carbonate, overlain by Miocene/Pliocene calcarentites and calcilutites, and Holocene ash and pelagic sediments (Fisher, 1988). This stratigraphy was partially confirmed by recent drilling on ODP Leg 134. Over 1000 m of basin sediments were penetrated at Site 832 in the North Aoba Basin. Pleistocene volcanic siltstones, Pleistocene to Late Pliocene chalk and basal volcanic breccia unconformably overlay Pliocene and Late Miocene carbonates. The hole bottomed in undated volcanic breccia (Greene, Collot & others, 1991). In the east the basin thins towards the margin, while the western boundary is interpreted to be a reef complex and fan deposit (Falvey & others, 1991).

South Aoba Basin: The South Aoba Basin is a deep water basin mostly lying below 2000 m. It has 4 km of sediment, is fault bounded and has a large anticline on its western edge (Falvey & others, 1991).

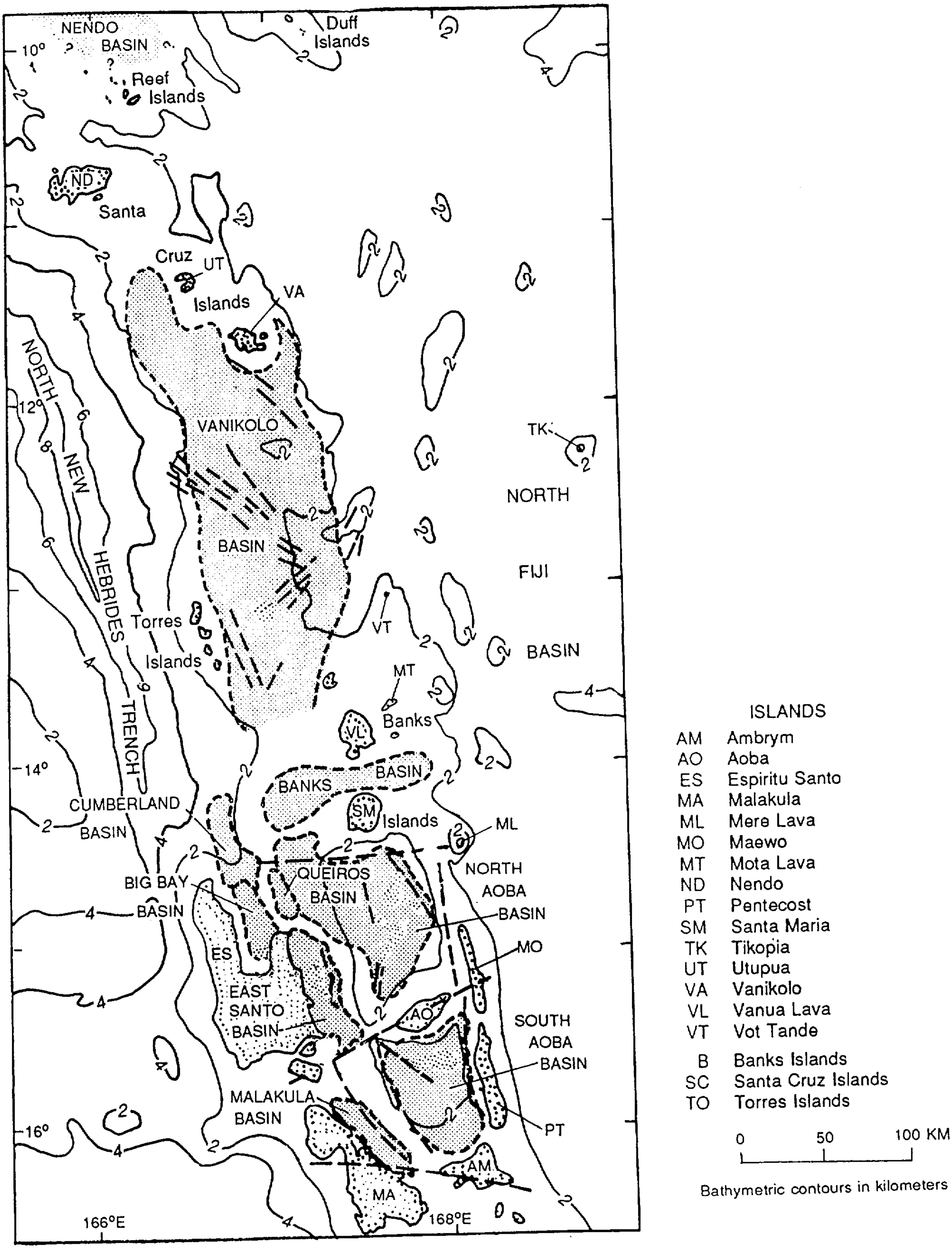

FIGURE 6. New Hebrides intra-arc basin map (from Falvey & others, 1991).

East Santo Basin: The East Santo Basin is a small, shelf basin largely lying above 1000 m. It has 2 km of sediment correlated with the Miocene to early Pliocene sequence outcropping on Espiritu Santo (Falvey & others, 1991).
Malekula Basin: The Malekula Basin is a shelf basin mostly lying above 1000 m. It has 2 km of sediment and appears to be continuous with the South Aoba Basin (Falvey & others, 1991).
Cumberland, Queiros and Big Bay basins: These are small shelf basins located to the north and east of Espiritu Santo in water depths ranging between 1000 m and 2000 m. Sediment thickness are up to 3 km (Falvey & others, 1991).

GEOLOGICAL HISTORY:

The New Hebrides Arc may date back to the Late Eocene, with initial development behind the Vitiaz frontal arc, part of a west-dipping subduction zone, Pacific Plate under Australian Plate, that also included the Solomons and Tonga arcs (Carney & MacFarlane, 1979; MacFarlane & others, 1988). Arc reversal from west to east facing occurred in post-middle Miocene times, 8 to 6Ma (Greene & Wong, 1988). The accompanying tectonism produced narrow shelfal areas and deep water basins; and was related to the opening of the North Fiji Basin. Falvey (1978) reported a 30 degree clockwise rotation of the New Hebrides Arc commencing about 6Ma in response to the opening of the North Fiji Basin.

An alternative model (Louat & others, 1988) proposes that the New Hebrides Arc has been formed by continuous eastward convergence with the changes in the location of the volcanic activity being related to variation in the steepness of the Benioff Zone, rather than the reversal of subduction direction. In this model the central basin is interpreted as a late stage extensional feature in the island arc.

HYDROCARBON POTENTIAL:

Exploration history: Since 1969, over a dozen geophysical surveys have been carried out (Greene & others, 1988), but as yet no petroleum exploration wells have been drilled in Vanuatu. A recent review of the petroleum prospectivity of Vanuatu and the Solomons (Falvey & others, 1991) highlights the margins of offshore basins as having some potential.

Reservoirs: Most sands are volcaniclastic greywackes with low porosity, there is little quartz in the sequences and the lower Miocene of the western belt has suffered low-grade metamorphism and zeolitization. Consequently carbonates provide the best chance of reservoir facies. There are coherent masses of reef limestones in the lower to middle Miocene of Malekula and Espiritu Santo (Ora Limestone, units of the Matanui Group and Peteao Formation). Limestones are commonly recrystallised but there is the potential for fracture and vuggy porosity (Katz, 1988).

Seal: Volcaniclastic mudstones and pelagic sediments are potential seal facies. The volcaniclastics tend to be self sealing if faulted (Falvey & others, 1991).

Source: There is generally low organic matter content in the volcaniclastic dominated sequences. Pyritiferous carbonaceous sandstones were described from Malekula by Mitchell (1966), but analysis of outcrop samples has been discouraging.

Only 4 of 42 samples studied by Buchbinder & Halley (1988) had total organic matter contents (TOC) greater than 0.5% (0.52% - 1.44%TOC from Peteao Formation and 0.54%TOC from Pelapa Formation, early Middle Miocene of Espiritu Santo). The samples were thermally immature, had type III kerogen and suggest limited gas potential (Buchbinder & Halley, 1988). Values of 1.38% and 1.80% TOC and H/C ratios for kerogen between type II and III were obtained from algal reef sediments of the Pelapa Formation (Glikson, 1988). Mallick & Greenbaum (1977) reported that 4 of 30 samples from the middle Miocene and Plio-Pleistocene of Espiritu Santo had gas prone kerogens and displayed 'early - early peak or early peak maturation'.

However, unsampled facies in the offshore may have higher organic matter contents, such as the Miocene to Pliocene deep water sequences of the eastern belt (Katz, 1988). In northern Maewo, Mio-Pliocene tuff/mudstone occurs with local pyritiferous marls (Carney & MacFarlane, 1979). Marginal marine environments (mangrove swamps, lagoons and reefs) bordering offshore basins may have the potential to produce adequate amounts of organic matter. If this material is then transported into deeper water by turbidity currents it can be preserved and buried to sufficient depths for maturation (Falvey & others, 1991).

Eastern belt sediments have experienced high heat flow for the past 7 million years, favouring maturation (Katz, 1988). The central basins have been subjected to two phases of heating related to arc volcanism, one during the Mio-Pliocene (eastern belt) and one during the Pleistocene (central chain). Maturation modelling for the South Aoba Basin (Falvey & Greene, 1988) predicts the peak oil generation window to cover the lower and middle Miocene section.

Traps: Middle Miocene sediments of the central basins are structured - block faulted, and there is a large anticline on the western flank of the South Aoba Basin (Fisher, 1988). Lower to Middle Miocene reefs and Upper Miocene clastic wedges and fans enclosed by pelagic sediments could provide stratigraphic traps. Unconformity traps related to the Late Miocene hiatus in the western belt are also a possibility.

Risks: Adequate source and reservoir facies are major risks. There is also the risk of preservation of any hydrocarbon accumulations that may have developed. Middle Miocene tectonism and uplift in the western belt produced tight folding, shearing and some low grade metamorphism, factors mitigating against preservation of hydrocarbon accumulations.

SOLOMON REGION

The Solomon region includes the double island arc of the Solomon Islands, and to the east the oceanic Ontong Java Plateau. Also included are descriptions of various oceanic plateaux, rises, troughs and basins located to the west of the Solomon Islands that are related to the opening of the Tasman and Coral seas (Figure 4). Bougainville, which is politically part of Papua New Guinea is not included in this report.

TECTONIC ELEMENTS:

Solomon Islands: The Solomon Islands are a double island arc with an inter-arc basin. They are the product of interaction between the Australia-India and Pacific plates since the Eocene. The arc has Cretaceous to early Tertiary oceanic basement rocks. Late Eocene to early Miocene volcanism was related to southwest-dipping subduction, and Late Miocene to present day volcanism is related to northeast-dipping subduction. Arc reversal was caused by the arrival of the Ontong Java Plateau at the subduction zone.

Ontong Java Plateau: The Ontong Java Plateau is an oceanic plateau of the Pacific Plate located along the northern margin of the Solomons. A significant part of the plateau is shallower than 2000 m. It is composed of thickened oceanic crust of Lower Cretaceous to Jurassic age. It formed along the Phoenix-Pacific ridge at a location far to the east of its present position, perhaps near the hot spot cluster close by Tahiti (Wells, 1989). Hot spot activity and/or exceptionally slow spreading along the ridge produced the massive outpouring of basalt that forms the plateau. Oceanic plateau formation may mark an early stage of continent generation such as in Iceland.

In its journey eastwards the Ontong Java Plateau has passed over other hotspots which have helped maintain its high elevation, and caused unconformity and igneous activity as seen on Malaita and Santa Isabel (Wells, 1989).

DSDP Sites 289 and 288 on the plateau penetrated Aptian or older, oceanic crust. The overlying pelagic sequence is 1500 to 1000 m thick, of Cretaceous to Eocene age, and composed of radiolarian and nanno chalk, chert and tuff. The same sequence is exposed in Malaita Fold Belt (Kroenke,1972).

Louisiade Plateau: The Louisiade Plateau is a dome-shaped structural feature with faulted flanks and a ridge crest at 1829 m. It may be a continental fragment or underlain by oceanic crust. Wells (1989) suggests that it is an oceanic plateau or continental margin flood basalt province related to the rifting of Lord Howe Rise and the slow motion of the Australian Plate over hot spots. From seismic correlation with DSDP 287, it has an ?Eocene-Oligocene pelagic biogenic sequence, which has been eroded from the ridge crest. References to the Louisiade Plateau are found in Larue and others (1977) and Recy and others (1977).

Pocklington Rise: The Pocklington Rise is an area of complex bathymetry. It may represent a faulted basement surface overlain by thinner sediments, or be a volcanic feature.

Pocklington Trough: The Pocklington Trough separates the Pockington Rise from the Louisiade Plateau. It may a relict subduction zone that was northward directed (Karig, 1972; Recy & others, 1977).

South Rennell Trough: The South Rennell Trough is a southwest/northeast trending ridge with a central trough located to the north of the D'Entrecasteaux Basin. It may be an Oligocene spreading ridge formed at the same time as the South Fiji Basin. Thin sediment fill occurs in deepest parts but generally basement is exposed (Larue & others, 1977).

Rennell Plateau: The Rennell Plateau is an area of less than 2500 m water depth around Rennell and Bellona islands and Indispensable Reef. The islands are uplifted Pleistocene reefs on a possible Eocene island arc. Seismic records show flat-lying, fault displaced sediments 1.1 second thick. The atolls have up to 500 m of reefal build-up indicating slow subsidence of the pre-Miocene basement platform (Larue & others, 1977).

Rennell Trench: The Rennell Trench is generally less than 4500 m deep and is located along the southwestern boundary of the Rennell Plateau. It is interpreted as a relict of northeast directed Eocene subduction and was once continuous with New Caledonia (Kroenke, 1984).

Solomon Sea Basin: The Solomon Sea Basin has a sediment thickness of 400-900 m. High sharp basement ridges separate small basins. It is currently being consumed to north and northeast by New Britain and Bougainville Trenches, and to the south by the Trobrian Trough. It is considered to be at least as old as early Neogene (Katz, 1986) and may have formed in the Late Eocene (45Ma) at the same time as the New Hebrides and D'Entrecasteaux basins (Falvey & Greene, 1988).

Woodlark Basin: The Woodlark Basin has a rough sea bottom morphology as the basin opened only 3.5 million years ago (Katz, 1986). The sedimentary cover is thin and lacking near the central spreading ridge. Sediments thickens away from the ridge and are up to 200 m thick in the west, towards Papua New Guinea, the source of most of the sediments.

Bellona, Kenn and Mellish Plateaux: The Bellona Plateau is an area less than 2000 m deep, located in the North Tasman Sea, between the Marion Plateau and Lord Howe Rise. Its western spur is termed the Kenn Plateau and the Mellish Plateau is a similarly shallow area of sea floor to the north. It is unknown whether these plateau features are continental fragments or oceanic plateaux. The Bellona Plateau is separated from Australia by the Cato Trough (3 km deep), which is located along the western side of the Lord Howe Rise at the northern end of a chain of seamounts.

STRATIGRAPHY:

Onshore: Coleman (1970) identified three provinces in the Solomon Islands (Figure 7) and the detailed stratigraphy of the islands has been described by Coulson and Vedder (1986):-

(i) Pacific Province: The stratigraphy of the Pacific Province consists of ocean floor rocks, including unmetamorphosed basalts, basal radiolarites, pelagic carbonates of Late Cretaceous to

Holocene age, and a small amount of volcanic material in the post-Eocene sequences. This stratigraphy is interpreted as the distal forearc deposits of an evolving northeast-facing arc and incipient obduction of Ontong Java Plateau. The Pacific Province includes Malaita and Santa Isabel north of the Kia-Korigole-Kaipito Fault System.

The Kia-Korigole-Kaipito fault system runs through the island of Santa Isabel from northwest to southeast. There has been a large amount of left lateral slip along this fault and it is an inferred terrane boundary between the unmetamorphosed Cretaceous and Paleogene ocean floor of the Ontong Java Plateau and the Pacific Province, and the highly tectonised basement underlying the late Eocene to early Miocene island arc rocks of the Central Province. The possible southern extension of the Kia-Korigole-Kaipito fault system is the faulted south west flank of the Indispensable Basin (Coulson & Vedder, 1986).

(ii) Central Province: The cores of the islands of the Central Province are made up of intensely faulted pre-Late Eocene mafic lava, gabbro and diabase, metamorphosed to greenschist and amphibolite facies and serpentinised ultramafics. This basement is interpreted as tectonised ocean floor and is overlain by more than 5 km of biogenic limestone, calcarenite and volcaniclastic sandstone of Early Miocene to Holocene age. The sequence also includes tholeiitic basalt and diorite intrusions of late Oligocene to Early Miocene age related to a late phase of arc volcanism from the southwest. Choiseul, the southern part of Santa Isabel, Florida, Gaudalcanal and San Cristobal are part of the Central Province.

(iii) Volcanic Province: The Volcanic Province is the southwest-facing modern arc. It was generated by the subduction of the Woodlark spreading system of the Australia-India Plate under the Pacific Plate, which began in the Late Miocene. The sequence includes subalkaline basalt and minor andesite and fringing reef deposits. Submarine volcanism is currently active at Karachi in the New Georgia Group. New Georgia, Russell Islands and eastern tip of Gaudalcanal are part of the Volcanic Province, and it extends into the Shortland Islands and Bougainville.

Offshore: There are a number of thick sedimentary basins in the offshore area between the Solomon Islands. Most are part of the intra-arc basin of the Central Solomon Trough and are part of the Central Province. The Indispensable Basin, however is related to the Pacific Province.

Central Solomon Trough: The Central Solomon Trough is an intra-arc basin, that according to Wells (1989), formed in the late Eocene or early Oligocene as a sinistral pull-apart basin during oblique subduction of the Pacific Plate. The basin has the following stratigraphy as described by Bruns and others (1986):-

UNIT D: Quaternary pelagic and hemipelagic sediments, turbidites and volcaniclastics.

UNIT C: Pliocene Pemba Formation composed of a lower calcarenite member and an upper calcisiltite member. The Pemba Formation has been uplifted, gently folded and faulted. Pliocene Mono and Alu Siltstones composed of siltstone, claystone and fine sandstone.

UNIT B: Late Oligocene to Miocene bedded sequence, includes the Mole Formation composed of basal conglomerate, slightly calcareous siltstone and sandstone.

UNIT A: Late Oligocene and older sequences correlated with

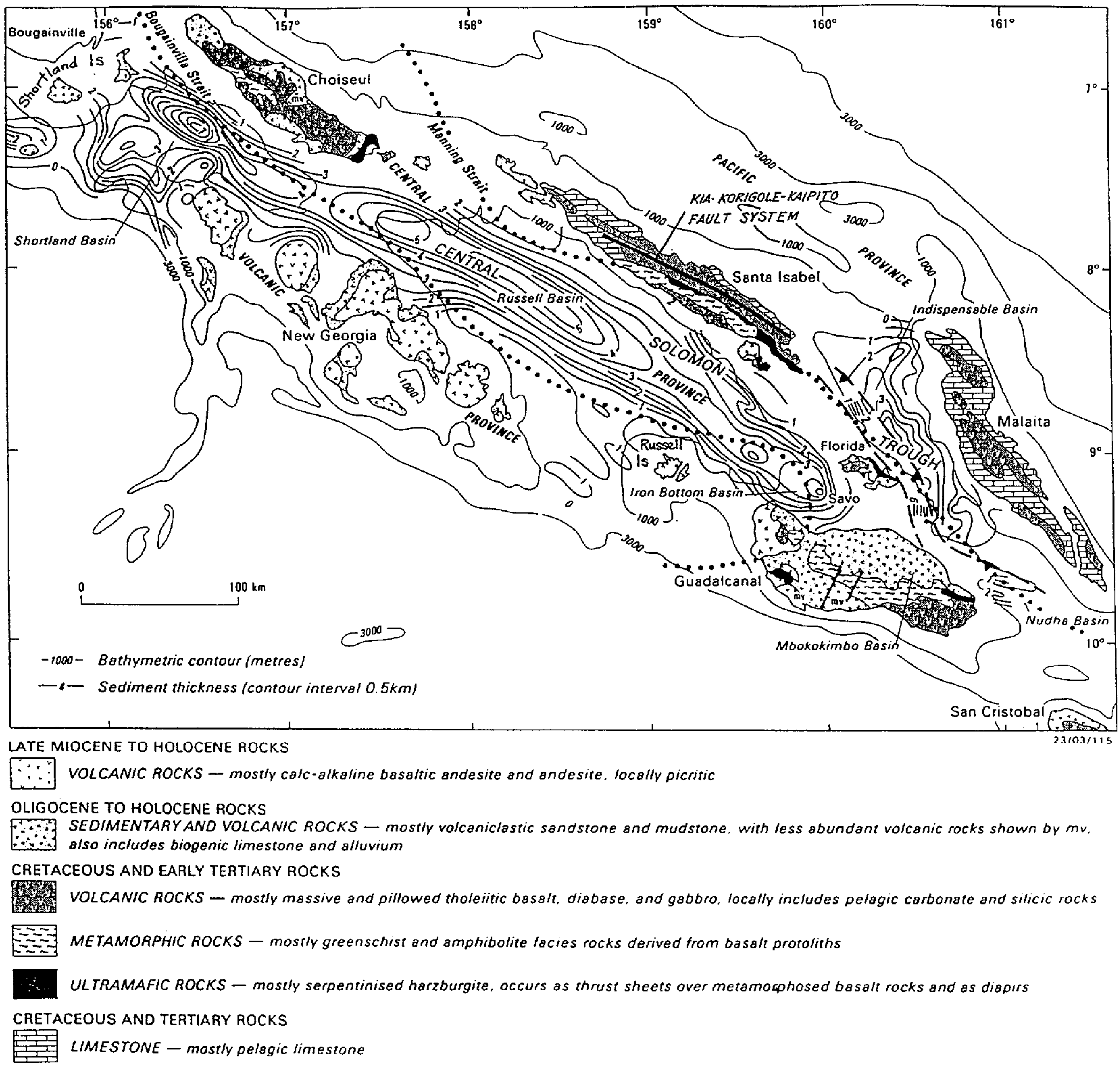

FIGURE 7. Solomon Islands location map (from Falvey & others, 1991).

onshore occurrences of schist and basalt.

The Central Solomons Trough is made up of 4 parts (Figure 7):-

(i) Shortland Basin: depth 1,400 m in the centre, 5.5 km of sediment above Unit A.

(ii) New Georgia Wedge: as shallow as 900 m, has units A to D with the sediment above Unit A being 2.5 to 3 km thick.

(iii) Russell Basin: 1,600 -1,800 m depth, Units A to D, up to 5 km thick.

(iv) Iron Bottom Basin: 1,000 - 1,300 m depth, up to 4.5 km of sediment made up of Units B,C and D - Oligocene to Pliocene volcaniclastics, arenite turbidites and Late Pliocene to Pleistocene carbonate detritus and fore reef deposits. The sediments show growth and slump faults.

<u>Indispensable Basin:</u> The Indispensable Basin is located between Santa Isabel and Malaita (Figure 7). It has up to 4.5 km of sediment above basement and is 1,900 - 1,200 m deep. The southwest flank of the basin is faulted and may be a strike slip or thrust terrane boundary continuous with the Kia-Korigole-Kaipito Fault. The stratigraphy of the Indispensable Basin as described by Bruns and others (1986) is listed below:-

UNIT ICD - Pliocene to Quaternary carbonate debris derived from the erosion of the surrounding islands.

UNIT IB - ?Late Miocene to early Pliocene fine-grained pelagic deposits, deposited rapidly.

UNIT IA - acoustic basement, Cretaceous basalt and Cretaceous to Miocene pelagic and hemipelagic carbonate rocks, radiolarian cherts and siliceous mudstones. Oceanic basement was uplifted and faulted during the Solomons/Ontong Java collision.

Extensions of the Indispensable Basin include the onshore Mbofokimbo Basin on Guadalcanal that contains 4,000 m of Late Miocene to Pliocene poorly sorted fine sandstone, siltstone, minor claystone, coarse sandstone and channel fill conglomerate deposited in fluvial and shelf environments; and the offshore Nudha Basin (Figure 7).

GEOLOGICAL HISTORY:

During the Cretaceous to early Tertiary, the ocean floor of the Ontong Java Plateau was generated on the Pacific plate, and the plateau was moved eastwards. The oceanic basement of the Central Province was also formed at this time.

During the Eocene to early Oligocene ocean floor was metamorphosed to green schist and amphibolite facies due to the incipient southward subduction of the Pacific Plate beneath the Australia-India Plate. In the Late Eocene to early Miocene there was subduction related magmatism and in the latest Oligocene to early Miocene extensive limestone, calcarenite and marl deposition. Miocene uplift occurred due to the oblique impingement of the Ontong Java Plateau on the old forearc. This produced transcurrent structures and folding, and ultimately, arc reversal.

In the Late Miocene (~10Ma) the Ontong Java Plateau collision and arc reversal occurred. A new system of northward subduction was established, the southwestern islands emerged and the Central Solomons Trough developed as an intra-arc basin. Other key references on the evolution of the Solomon Islands include Coleman and Kroenke (1981), Kroenke (1984), Karig and Mammerickx (1972), Halumen and Von Herzen (1973) and Vedder &

Coulson (1986).

HYDROCARBON POTENTIAL:

Exploration history: No wells have been drilled in the Solomon Islands. The nearest exploration well is L'Etoile 1, drilled by Oceanic Exploration in 1975, offshore Bougainville. The well had a total depth of 1682 m, bottoming in lower Miocene volcanics. It was drilled on reef target but no reef was intersected. Despite the lack of drilling, a large amount of seismic information is available for the Solomon Islands (Falvey & others, 1991).

Reservoirs: Most sandstones and conglomerates in the area have poor reservoir potential due to a high volcaniclastic content. Some quartz sediments may occur within the sequence derived from the quartz-veined basement, for example some metabasalts on Guadalcanal contain up to 40% quartz (Van Deventer, 1971). Turbidites of Mio-Pliocene age and karst, vugs and fractures in carbonates are other possible reservoir types. The Central Province has thick Miocene algal foraminiferal reefal calcarenites (Falvey & others, 1991).

Seal: Oligocene to Pliocene clay-rich volcaniclastics would provide a seal facies to underlying units.

Source: There are no known seeps in the Solomons. Source rock analyses from outcrop on Guadalcanal, Malaita and Florida were reported by Buchbinder & Halley (1986). They included 0.94% TOC from the Honiara Beds or an underlying formation; and 0.48% TOC from an unknown Malaita marlstone. Rock-Eval data suggested that the sediments were immature and not oil prone.

The maturation of the sediments is largely unknown. An area of high heat flow is related to the Woodlark spreading ridge. Though heatflow in the Central Solomons Trough is low (0.9 -1.1 HFU), but projecting downwards maturation is possible at 1.5 to 2.6 km sub seafloor (Taylor & Exon, 1987).

Possible source rock facies within the sequence include restricted pockets of lacustrine source rocks developed in tropical swamps, marginal marine facies and finer grained carbonate facies such as restricted back reef micrites and inter reef deposits. Oceanic anoxic events in the Cretaceous may have produced widespread but very thin source rock intervals.

Traps: Possible trap types are bioherms, fans, fault blocks and wrench anticlines. Promising reef targets sealed by enclosing volcaniclastics are reported from the nearshore area of the Iron Bottom Basin (Van Deventer, 1971; Falvey & others, 1991; and Johnson & Pflueger, 1991).

Risks: Deep water, isolation, small land area and a sequence volumetrically dominated by volcanics all mitigate against the discovery of commercial hydrocarbons. Unsealed limestones compose the upper part of the sequence and faulting up to the Pleistocene and later may produce leaky traps. Another risk is the difficulty of differentiating volcanic from reef targets from seismic information (Katz, 1980).

SUMMARY STRATIGRAPHIC COLUMNS & DATA POINTS FOR SOLOMONS REGION

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APPENDIX 1

DATA POINT & DATA AREA DESCRIPTIONS

In this appendix are listed the data point and data area descriptions (Table 2) used to construct the time slice data maps for the south west Pacific. Data areas are represented on the maps by a square, rather than a dot as for data points, and denote information from a general area rather than a specific point such as an island or well location. Lithology, stratigraphic relationships, depositional environment, age and thickness are listed by time slice interval for each data point or area. Table 1 lists the time slice codes and Table 3 lists the environmental codes.

TABLE 1 - TIME SLICE CODES

The linear time scale used is Harland & others, (1982), except for the Cainozoic where Breggern is used, with the K/T boundary at 66.4Ma.

CAINOZOIC		millions of years
Cz7.	Quaternary	0 - 1.7Ma
Cz6b.	Late Pliocene	1.7 - 3.0Ma
Cz6a.	Early Pliocene	3.0 - 5.0Ma
Cz5.	Late Miocene	5.0 - 10.5Ma
Cz4c.	Mid Miocene	10.5 - 15.2Ma
Cz4b.	Early Miocene	15.2 - 22.0Ma
Cz4a.	Earliest Miocene-Late Oligocene	22.0 - 30.0Ma
Cz3.	Early Oligocene	30.0 - 36.5Ma
Cz2b.	Late Eocene	36.5 - 40.0Ma
Cz2a	Middle Eocene	40.0 - 52.0Ma
Cz1.	Early Eocene-Paleocene	52.0 - 66.4Ma
CRETACEOUS		
K11.	Late Maastrichtian	66.4 - 70.0Ma
K10b.	Mid Maast-Mid Campanian	70.0 - 78.0Ma
K10a.	Early Campanian	78.0 - 83.0Ma
K9.	Sant-Coniac-Turonian	83.0 - 91.0Ma
K8.	Cenomanian-Latest Albian	91.0 - 99.0Ma
K7.	Late Albian	99.0 - 104.0Ma
K6.	Mid & Early Albian	104.0 - 110.0Ma
K5.	Earliest Albian-Latest Aptian	110.0 - 114.0Ma
K4.	Aptian	114.0 - 119.0Ma
K3.	Barremian	119.0 - 125.0Ma
K2.	Hautervian-Valanginian	125.0 - 137.0Ma
K1.	Earliest Valanginian-Berriasian	137.0 - 144.0Ma

TABLE 2

LIST OF DATA POINTS & AREAS

TONGA
DSDP 204 - 2001
DSDP 203 - 2002
'Eua - 2203
Tongatapu - 2004
Nomuka Island Group - 2005
Ha'apai Island Group - 2006
Vava'u Island Group - 2007
Tofua Volcanic Chain - 2008
Lau Group - 2016

FIJI
DSDP 285 - 1999
DSDP 205 - 2009
Bligh Water 1 - 2010
Great Sea Reefs 1 - 2011
Viti Levu - 2012
Yasawa Islands - 2013
Vanua Levu - 2014
Koro Sea Islands - 2015

NEW HEBRIDES
Nendo - 2025
Torres Islands - 2024
Espiritu Santo - 2023
Malekula - 2022
Maewo - 2021
Penecost - 2020
Central Chain - 2019
Vitiaz Arc (Mitre Island) - 2018
Matthew & Hunter Islands - 2017

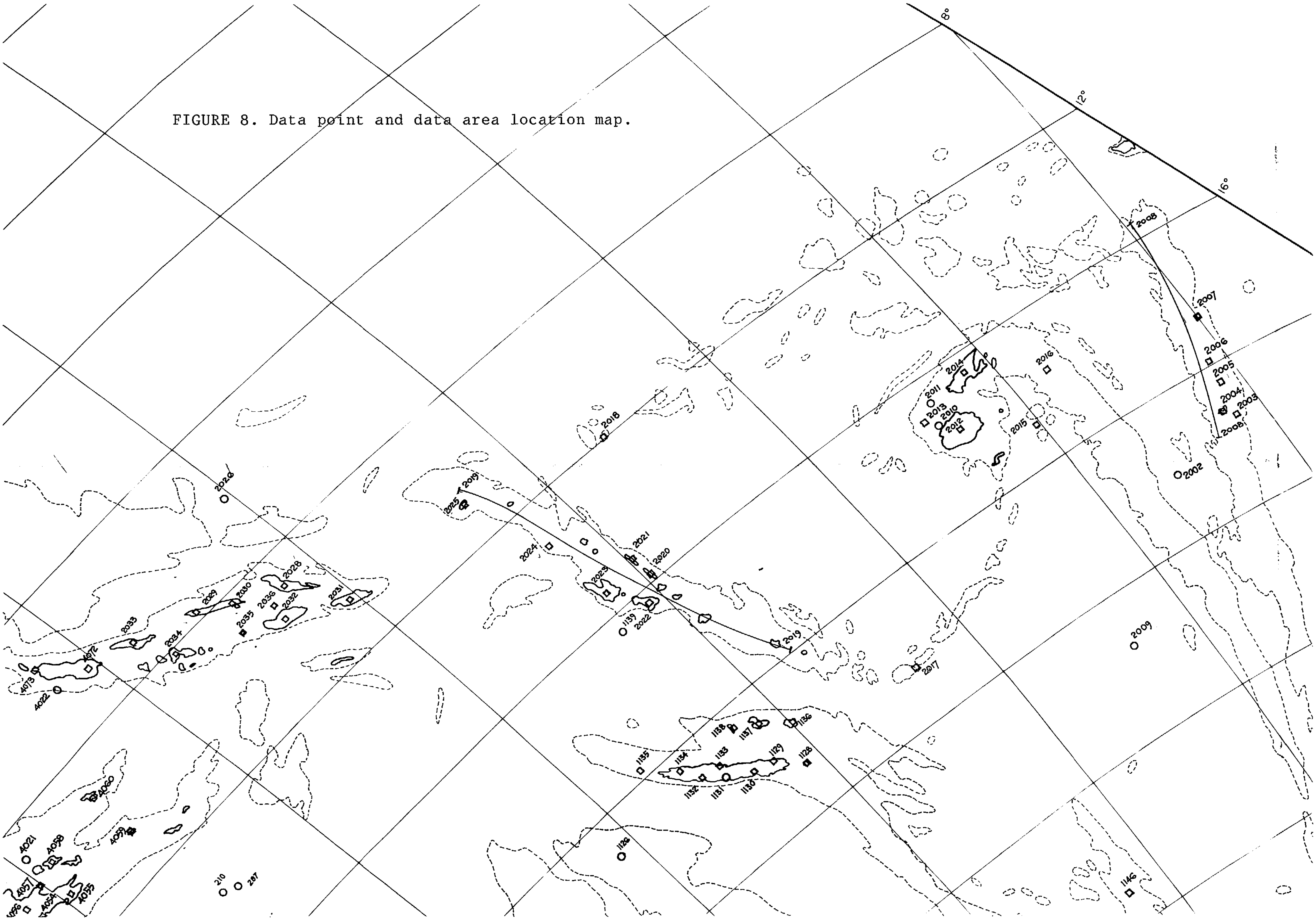
SOLOMONS
DSDP 288 - 2026
DSDP 289 - 2027
Malaita - 2028
Santa Isabel(north) - 2029
Santa Isabel(south) - 2030
San Cristobel - 2031
Guadalcanal - 2032
Choiseul - 2033
New Georgina Group - 2034
Russell Islands - 2035
Florida Group - 2036
Shortland Group - 2037

CORAL SEA
DSDP 287 - 2038
DSDP 209 - 2039

ENVIRONMENT CLASSIFICATION TABLE

Code	Environment	Working definition
Land environments		
LEU	unclassified	Areas with no preserved sediments of time-slice age, interpreted as land. *BROWN*
LEE	erosional	Highland areas of sediment erosion, indicated by palaeocurrents, provenance studies, tectonic setting and the presence of igneous intrusions. *DARK BROWN*
LDU	depositional, unclassified	No indication of specific environment, often includes subaerial volcanics. *LIGHT BROWN*
LDF	depositional, fluvial	River deposits such as alluvial fans, braided and meandering channel deposits and coarser overbank sediments, and sand-dominated continental sequences with no evidence of aeolian or lacustrine deposition. *ORANGE*
LDFL	depositional, fluvio-lacustrine	Sediments deposited in low-energy river environments such as channels, overbanks, backswamps and shallow lakes on low-gradient floodplains; typically sequences dominated by fine-grained sediments and coal, with sheet geometry. *GOLD*
LDL	depositional, lacustrine	Deposits of deep, persistent lakes, usually in tectonically controlled basins. Distinguished from LDFL by thicker shales and more restricted distribution. *YELLOW*
Coastal environments		
CDP	paralic	Deposits of coastal or marginal marine environments. Includes the range of environments situated at the land/sea boundary such as lagoonal, beach, intertidal, deltaic, etc., and is recognised by a variety of depositional facies ranging from coarse cross-bedded beach sand, to sand deposited in tidal deltas, to finely laminated organic sediment deposited in lagoons and estuaries (includes deltaic and intertidal-supratidal environments). *GRASS GREEN*
CDIS	intertidal-supratidal	Sediments deposited in the tidal zone, indicated by the presence of finely interlaminated fine and coarse detritus, herringbone cross-bedding, flaser bedding, evidence of periodic exposure, etc. *EMERALD GREEN*
CDD	deltaic	Deltaic deposits indicated by isopach patterns, upward-coarsening sequences and the map pattern of adjacent environments. Cuspate or lobate form of deltas on maps in some cases follows isopach pattern. *PALE GREEN*
Marine environments		
MU	unclassified	No indication of specific depth of marine environment, often submarine volcanics. *POWDER BLUE*
MVS	very shallow (0–20 m water depth)	Marine sediments with evidence of deposition above wave base and/or occasional emergence, e.g. oolites, cross-bedding. *VERY LIGHT BLUE*
MS	shallow (0–200 m water depth)	Marine sediments deposited on the continental shelf or on flanks of volcanic islands, e.g. sand, mud and limestone containing fossils that typically lived in shallow water; also includes areas along young, active spreading ridges (includes MVS). *LIGHT BLUE*
MBA	bathyal to abyssal (> 200 m water depth)	Marine sediments with indicators of deep-water deposition, e.g. condensed sequences, turbidites, monotonous shale, and the presence of deeper-water organisms (includes abyssal environments). *BLUE*
MA	abyssal (>1000 m water depth)	Distal turbidites, red clays, siliceous and calcareous ooze, ocean floor basalt, includes sediments deposited below the CCD. *DARK BLUE*

FIGURE 8. Data point and data area location map.



APPENDIX 1 DATA POINTS & DATA AREAS

TONGA REGION

DATA POINT: 2001 DSDP 204, Pacific Plate east of Tonga Trench
LONG: 174 06.69 W
LAT: 24 57.27 S
REFERENCE: Burns, Andrews & others (1973)

Cz7 - Cz4a
Lithology: dark brown, red and greenish grey abyssal clay and ash.
Strat relations: overlies Cretaceous sandstone unconformably
Environment: below CCD, near active volcanism, MA
Age: Quaternary to early Miocene/Oligocene?
Thickness: 103 m

Cretaceous?
Lithology: lithified, tuffaceous sandstone and conglomerate
Strat relations: unconformable on tuff
Environment: high energy, steep paleoslope near volcanic source, MU
Age: Cretaceous? (Inoceramus)
Thickness: 23 m

Cretaceous?
Lithology: vitric tuff, dark greenish grey, with shards of basaltic and andesitic glass
Strat relations: bottom of hole
Environment: deposited from extrusive activity of nearby volcanoes, Louisville Ridge?, MU
Age: Cretaceous?
Thickness: 10 m penetrated, oceanic layer ~1600 m depth

DATA POINT: 2002 DSDP 203, Lau Basin
LONG: 177 32.77 W
LAT: 22 09.22 S
REFERENCE: Katz, 1986

Cz7
Lithology: nanno ooze, volcanic ash and cobbles.
Strat relations: beneath sea floor
Environment: near local intermittent volcanic source, MBA
Age: NN21-NN18, Pleistocene
Thickness: 238 m

Cz6b
Lithology: nanno ooze, volcanic ash and cobbles.
Strat relations: underlies Pleistocene,
Environment: near local intermittent volcanic source, MBA
Age: NN16, Late Pliocene
Thickness: more than 171 m, oceanic basement not reached in hole

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DATA POINT: 2003 'EUA
LONG: 174 55 W
LAT: 21 23 S
REFERENCE: Ewart & others, 1977; Cunningham & Anscombe, 1985; Gatliff, 1990

Cz7
Lithology: coral reef limestone
Strat relations: unconformable on older rocks
Environment: MS
Age: Pleistocene, Holocene

Cz6a/Cz6b
Lithology: coral reef limestone
Strat relations: disconformable on older rocks, three terraces.
Environment: initially open marine deep water, shallowing up to shelf and reef facies, MBA/MS
Age: Early to Late Pliocene?
Thickness: 20 m

Cz6a
Lithology: volcaniclastic sandstone and bioclastic wackestone.
Strat relations: channels cut into Eocene Limestone and Euan Volcanics
Environment: submarine channels, MBA/MS
Age: Early Pliocene

Cz6a/Cz5/Cz4c
Lithology: volcaniclastics and thin micritic limestones, well-bedded lithic sandstone, siltstone, mudstone
Strat relations: overlies Eocene limestones
Environment: open deep marine, MBA
Age: late middle Miocene to early Pliocene

Cz3
Regression, exposure, karstic event, channel fill deposits, low stand fans, LDU,MU

Cz2a/Cz2b/Cz3?
Lithology: tropical limestones, basal conglomerate with igneous clasts, foram/algal wackestone-packstone; cemented with secondary calcite, cavernous porosity.
Strat relations: overlies volcanics
Environment: 0-20 m, protected shelf, to deeper shelf. MS/MVS.
Age: Mid to Late Eocene, may extend into Oligocene
Thickness: 90 m

Cz2a
Lithology: Euan Volcanics - basalt flows, agglomerates, tuffs; cut by numerous dykes.
Strat relations: underlies limestones, has undergone low grade metamorphism.
Environment: island arc tholeiites, MU/MS/LDU
Age: Middle Eocene, 46.6 Ma & 46.1 Ma (Ar40/Ar39), Ewart & others (1977).

DATA POINT: 2004 TONGATAPU
LONG: 175 10 W
LAT: 21 10 S
REFERENCE: Cunningham & Anscombe, 1985; Gatliff, 1990

Cz7/Cz6b
Lithology: coral reef limestone, leached coral boundstone, grainstone & packstone
Strat relations: at surface
Environment: MS
Age: Plio-Pleistocene
Thickness: 247 m (from well control)

Cz6a
Lithology: fine to coarse volcaniclastics, few thin limestones
Strat relations: underlies limestone
Environment: MBA
Age: Early Pliocene
Thickness: ~50 m (from well control)

Cz5
Lithology: fine to coarse volcaniclastics, few thin limestones
Strat relations: underlies limestone
Environment: MBA
Age: Late Miocene
Thickness: ~400 m (from well control)

Cz4c
Lithology: fine to coarse volcaniclastics, few thin limestones, dykes
Strat relations: underlies Late Miocene
Environment: land or very shallow inner shelf, volcaniclastic pile nearly built to sea level. MS/MVS/LDU?
Age: Middle Miocene, dyke dated at 13.9 + 1 Ma
Thickness: ~500 m (from well control)

Cz4b
Lithology: fine to coarse volcaniclastics, few thin limestones, dykes
Strat relations: underlies Middle Miocene
Environment: outer neritic (90-180 m), MS
Age: Early Miocene, dyke dated at 21.3 + 0.4 Ma
Thickness: ~600 m (from well control)

Cz4a
Lithology: fine to coarse volcaniclastics, few thin limestones
Strat relations: underlies Early Miocene
Environment: MS
Age: Late Oligocene?, sparse and poorly preserved fauna
Thickness: ~600 m (from well control)

Cz3
Possible hiatus

Cz2b
Lithology: fine to coarse volcaniclastics, few thin limestones
Strat relations: underlies Oligocene, intruded by Miocene

dykeThough politically part of Fiji, the Lau Group islands are described in the Tongan section of this paper.s **Environment:** MS
Age: Late Eocene?, sparse and poorly preserved fauna
Thickness: more than ~400 m (from well control, full unit not penetrated)

DATA POINT: 2005 NOMUKA ISLAND GROUP
LONG: 174 46 W
LAT: 20 15 S
REFERENCE: Cunningham & Anscombe, 1985; Gatliff, 1990

Cz7
Lithology: coral reef limestone
Strat relations: unconformable on older rocks
Environment: MS
Age: Pleistocene

Cz5/4c
Lithology: volcaniclastics, coarse breccia, conglomerate, turbidite sandstones, calcareous mudstones, tuffs
Strat relations: outcropping, or underlying Pleistocene limestones
Environment: volcanic piles and their debris, MS/MBA
Age: Middle to Late Miocene
Thickness: 30 m exposed on Nomuka Iki, 90 m exposed on Mango, 100 m exposed on Fonoifua & Tanoa.

Cz4c
Lithology: foram algal limestone
Strat relations: outcrops on Mango
Environment: pinnacle reef growing around volcanic piles, MS
Age: Mid-Miocene
Thickness: 90 m exposed

DATA POINT: 2006 & 2007 HA'APAI & VAVA'U ISLAND GROUPS
LONG: 174 20 W to 175 W
LAT: 20 10 S to 18 20 S
REFERENCE: Cunningham & Anscombe, 1985; Gatliff, 1990

Cz7
Lithology: coral limestone, clay and ash, pyroclastics
Strat relations: outcropping as sub-horizontal terraces, unconformable on older rocks.
Environment: MS
Age: Pleistocene

Cz6b?
Lithology: foram and coral limestone, some volcanic debris
Strat relations: unconformably underlying Pleistocene, 20 degree dip (in part stratigraphic).
Environment: reef slope deposits, MBA/MS
Age: Pliocene or younger
Thickness: 245 m

DATA AREA: 2008 TOFUA VOLCANIC CHAIN (Ata to Tafaki)
LONG: 176 10 W to 173 55 W
LAT: 22 35 S to 15 52 S
REFERENCE: Cunningham & Anscombe, 1985; Gatliff, 1990

Cz7
Lithology: volcanics, basaltic andesite
Strat relations: outcropping, origin of islands
Environment: MU
Age: Holocene & Pleistocene, most recent eruptions:- Late 1854, Metis Shoal 1967-8, Tofua 1906, Falcon 1927.

Cz6b/Cz6a
Lithology: volcanics, basaltic andesite
Strat relations: forms Niua Toputapu
Environment: MU
Age: 3 Ma (K-AR), Late Pliocene/Early Pliocene boundary

Cz5
area north of Vava'u may be a Miocene arc?

DATA POINT: 2016 LAU GROUP
LONG: 180 20 W to 179 50 W
LAT: 16 40 S to 19 40 S
REFERENCE: Rodda (1982), Katz (1986)

Cz7
Lithology: alkali basalt volcanoes on Mango, ?Vanua Mbalavu; Fulanga Limestone on Fulanga, coral-algal reef
Environment: MU/MS

Cz6a/Cz6b
Lithology: olivine basalt, pyroxene andesite, hornblende andesite on Vanua Mbalavu
Environment: MU
Age: 4.0-2.9Ma

Lithology: limestone on Vanua Mbalavu, Avea, Tuvutha
Age: Pliocene

Cz5
Lithology: basalt and andesite (Lau Volcanics)
Age: 9.5-6.5Ma

Lithology: widespread limestone
Age: uppermost Tertiary f, Late Miocene

Cz4c
Lithology: Futuna Limestone on Vanua Mbalavu, bedded foram limestone with volcanic detritus
Environment: MS? MU?
Age: late Middle Miocene, N13/N14

Lithology: volcanics on Nayau and Yacata, basaltic andesites and dacites
Environment: MU?
Age: Nayau - 12.45Ma, Yacata - 14.55Ma, middle Miocene

Cz2b
Lau Group likely to have Eocene basement similar to Tonga

FIJI REGION

DATA POINT: 1999 DSDP 285, South Fiji Basin
LONG: 175 48.24 E
LAT: 29 49.16 S
REFERENCE: Site 285 Shipboard Scientific Party (1975); Katz (1986)

Cz7/Cz6b/Cz6a
Lithology: abyssal red clay, dark reddish-brown iron oxide clay rich in glass shards, includes an ash bed
Environment: MA
Age: Pliocene to Recent
Thickness: 18 m

Cz6a
Lithology: nanno ooze, with some volcanic shards
Environment: MA
Age: early Pliocene
Thickness: 6 m

Cz5
Lithology: nanno and radiolarian ooze, with some volcanic shards
Environment: MA
Age: Late Miocene
Thickness: 50 m

Cz4c
Lithology: volcaniclastics and biogeneic ooze, glass shards, volcanic rock fragments, pumice, micro-crosslaminated sand/silt cycles
Environment: derived from Lau-Colville Ridge, submarine current reworking, MBA/MA
Age: lower to upper Middle Miocene
Thickness: 379 m

Cz4c
Lithology: clastic cycles of sandy silt and silt composed of glass shards and nannos
Environment: derived from Lau-Colville Ridge, submarine current reworking, MBA/MA
Age: lower Middle Miocene
Thickness: 112 m

Lithology: intrusive diabase sill
Strat relations: base of hole
Age: unknown
Thickness: 20 m penetrated

DATA POINT: 2009 DSDP 205, South Fiji Basin
LONG: 177 53.95 E
LAT: 25 30.99 S
REFERENCE: Katz (1986)

Cz7/Cz6b/Cz6a
Lithology: abyssal red clay, dark reddish-brown iron oxide clay rich in glass shards, includes an ash bed

Environment: MA
Age: Pliocene to Recent
Thickness: 30 m

Cz5
Lithology: nanno ooze, with some volcanic shards
Environment: MA
Age: Late Miocene
Thickness: 37 m

Cz4c
Lithology: volcaniclastics and biogeneic ooze, glass shards, volcanic rock fragments, pumice,
Environment: derived from Lau-Colville Ridge, MA
Age: Middle Miocene
Thickness: 209 m

Cz4b
hiatus

Cz4a
Lithology: nannofossil ooze with volcanic ash
Environment: MA
Age: Latest Oligocene to early Miocene
Thickness: 61 m

Cz3/Cz4a
Lithology: finely crystalline, vesicular basalt flow
Environment: ocean floor basalt MS/MBA?
Age: Oligocene, late middle to late Oligocene

DATA POINT: 2010   BLIGH WATER 1, Bligh Water Basin
LONG: 177 40 W
LAT: 17 20 S
REFERENCE: Falvey & Greene (1988)

Cz7
Lithology: limestone
Strat relations: conformable on Cz6b
Environment: MS??
Age: Pleistocene

Cz6b
Lithology: claystone
Strat relations: unconformable on Cz6a/Cz5
Environment: MBA
Age: Late Pliocene/Pleistocene

Cz6a/Cz5
Lithology: claystone
Strat relations: unconformable on Cz4b/Cz4a
Environment: MBA
Age: Early Pliocene/late Miocene
Thickness: composite Cz7, Cz6b, Cz6a & Cz5 ~ 1570 m

Cz4c
No deposition, Colo Orogeny

Cz4b
Lithology: claystone
Strat relations: conformable on Cz4a
Environment: MBA
Age: Early Miocene

Cz4a
Lithology: limestone, tuff agglomerate
Strat relations: at TD
Environment: MBA
Age: Earliest Miocene/Late Oligocene
Thickness: composite Cz4b & Cz4a ~1200 m

DATA POINT: 2011 GREAT SEA REEFS 1, Bligh Water Basin
LONG: 178 05 E
LAT: 16 40 S
REFERENCE: Falvey & Greene (1988)

Cz7/Cz6b
Lithology: limestone
Strat relations: unconformable on Cz6a/Cz5
Environment: MS??
Age: Pleistocene/Late Pliocene

Cz6a/Cz5
Lithology: claystone
Strat relations: unconformable on Cz4c/Cz4b
Environment: MBA
Age: Early Pliocene/Late Miocene
Thickness: composite Cz7, Cz6b, Cz6a & Cz5 ~ 1300 m

Cz4c/Cz4b
Lithology: claystone
Strat relations: conformable on Cz4a
Environment: MBA
Age: Middle Miocene/Early Miocene

Cz4b/Cz4a
Lithology: tuff
Strat relations: conformable on Cz4a
Environment: MBA
Age: Early Miocene

Cz4a
Lithology: limestone, tuff
Strat relations: at TD
Environment: MBA
Age: Earliest Miocene/Late Oligocene
Thickness: composite Cz4a,Cz4b & Cz4a ~1600 m

DATA POINT: 2012 VITI LEVU
LONG: 178 E
LAT: 18 S
REFERENCE: Rodda (1967, 1982), Katz (1986)

Cz7
Lithology: alluvium
Environment: Rewa and other deltas, LDF/CDP/MS
Thickness: 185 ft+ (60 m) Navua Delta

Cz6b
Lithology: Verata Sedimentary Group - basal conglomerate, sandstone, lapilli tuff, marly sandstone in north.
Strat relations: overlies Mendrausuthu Group gradational to unconformably.
Environment: MU?
Age: Late Pliocene (Tertiary h)

Lithology: Thuvu (Cuvu) Sedimentary Group - marl, limestone (Volivoli Limestone), minor basal conglomerate and sandstone (Voua Sandstone).
Strat relations:deposited on Pliocene erosion surface
Environment: MS, deposited during transgression
Age: Late Pliocene (Tertiary h) Voua Sandstone - N.18 - Miocene/Pliocene boundary (reworked??)

General emergence of Viti Levu shortly before N.21 - Late Pliocene

Cz5/Cz6a/Cz6b
Lithology: Mba (Ba) Volcanics - basalt, andesite, sediments, andesitic breccia, tuff. Au-Ag-Te mineralisation at Tavua Volcano
Strat relations: overlies Ra Group
Environment: four main volcanic centres, largely submarine MU
Age: Late Pliocene (Tertiary h), radiometric dates on Tavua volcano 5.1-4Ma, 9Ma andesite from Vatia centre, 5.5-4.9Ma Sambeto Volcano (McDougall, 1963), 3.7Ma Rakivaki Volcano.
Thickness: 3000 ft (~1000 m)

Cz6a/Cz6b
Lithology: Koroimavua Andesitic Group - andesite, large monzonite plug, volcaniclastics and sediments (Vuda Beds) - sandstones, limestone, conglomerate
Strat relations: unconformable on Nandi Group
Environment: LDU/MS
Age: andesite - 5.3-5.4Ma, plug - 4.8-5.0Ma (McDougall, 1963); Forams Late Pliocene or Pleistocene.

Cz5/Cz6a
Lithology: Mendrausuthu (Medrausucu) Andesitic Group - includes Namosi Andesite composed of pillow lava, normal flows, volcanic breccia and conglomerate, tuff. Higher in sequence sandstone, mudstone, marl, limestone - Veisari Sandstone, Lami Limestone, Suva Marl.
Strat relations: basal conglomerates with Colo clasts
Environment: Veisari sandstone - MBA, Lami Limestone - patch reefs MS, Suva Marl - MBA
Age: Late Miocene-Early Pliocene (Tertiary g). Namosi Andesite

5.9 & 5.7Ma (Gill & McDougall, 1973). Veisari Sandstone - N.17, Late Miocene. Lami Limestone - Tertiary f, N.19, Early Pliocene.

Lithology: Nandi Sedimentary Group - mainly monotonous, buff grey, well bedded volcanic sandstones, but ranges from basal polymictic conglomerate, through sandstone to limestone and marl, plus andesite. Sediments in places rather rich in quartz, generally very calcareous, with some carbonaceous and coaly lenses, current bedding occurs.
Strat relations: overlies Singatoka Group
Environment: MU/MS
Age: Late Miocene-Early Pliocene (Tertiary g), N.17 Late Miocene.
Thickness: 1000 m

Lithology: Navosa Sedimentary Group - sandstone, mudstone, limestone (brown, impure, well bedded), some andesite flows and volcaniclastics.
Strat relations: basal conglomerates with Colo clasts
Environment: MU/LDU?
Age: Late Miocene-Early Pliocene (Tertiary g)

Cz5
Lithology: Colo (Tholo) Plutonic Suite - stocks of olivine gabbro, diorite, hornblende tonalite, biotite tonalite, trondhjemite. Deposits of gold and sulphides associated with the stocks.
Strat relations: Colo intrudes Wainimala Group but not Late Miocene and younger sediments which often have basal conglomerates of Colo clasts. Stocks occupy the crest of the ENE trending anticlinorium that crosses the island, the plutons are synorogenic.
Environment: Colo Orogeny related to rotation of island
Age: Colo - 11-8Ma;

Lithology: Ra Sedimentary Group - in north - sandstone, mudstone, minor limestone; in south conglomerate with abundant plutonic clasts, rich molluscan faunas, carbonised wood, pyrite, heavy mineral concentrations.
Environment: MS/CDP
Age: Late Miocene from mollusc and forams

Cz4c
Lithology: Savura Volcanic Group - clastic & volcanic rock types, polymictic conglomerate to mudstone, volcaniclastics, lavas, pillow lava, pillow breccia; basalt to rhyolite. Andesitic conglomerate and breccia most common
Strat relations: unconformably overlies Wainimala Group
Environment: MU?
Age: Miocene

Cz4b/Cz4c
Lithology: Singatoka Group - sandstone, mudstone, limestone (white to grey, massive to crystalline), volcanic at base.
Strat relations: conformably overlie and in part equivalent with upper Wainimala Group, ?unconformable on lower Wainimala.
Environment: MU?
Age: Early and Middle Miocene (Tertiary e & f).

Cz4a/Cz4b/Cz4c
Lithology: upper Wainimala Group - volcanic conglomerate, tuff, pillow lava, pillow breccia, minor sandstone, limestones more common at top; basalt and andesite. Sequence is thinner and finer grained to the north. Local development of phyllite and augen gneiss where intruded by Colo plutons, metamorphism to greenschist facies widespread.
Strat relations:intruded by Colo Plutonic Suite
Environment: volcanic arc intermittently fringed by shallow water limestones with a deep water basin to the north. MU/MS/MBA
Age: Late Oligocene, Early to Middle Miocene (Tertiary e & f)
Thickness: Wainimala Group estimated at 10km

Cz3
Lithology: tonalites
Strat relations: near Nandi tonalite stock intrudes lower Wainimala Group
Environment: Wainimala Orogeny
Age: dated at 34Ma (McDougall, 1963).

Cz2b
Lithology: lower Wainimala Group (Yavuna Group) - se of Nandi, andesite, basalt, dacite, some limestones.
Strat relations: oldest rocks
Environment: MU
Age: Late Eocene

DATA POINT: 2013 YASAWA GROUP ISLANDS
LONG: 177 20 E
LAT: 17 10 S
REFERENCE: Rodda (1982), Katz (1986)

Cz5/Cz6a
Lithology: Koromasoli Sandstone on Waya, volcaniclastic sandstone to volcanic breccia
Strat relations: correlated with Nandi Sedimentary Group on Viti Levu
Environment: MU?
Thickness: 1000 m

Lithology: Epiclastic sandstone, dacitic tuff on Naviti
Environment: MU?
Thickness: >1200 m

Cz4c
Lithology: volcanics and limestones, sandstones, tuffs. On Sawa-i-Lau massive micrite and underlying muddy calcarentie with coral fragments, large forams
Environment: on Sawa-i-Lau fore-reef, MBA
Age: Tertiary f, NN.7, Middle Miocene

DATA POINT: 2014 VANUA LEVU
LONG: 179 20 E
LAT: 16 30 S
REFERENCE: Rodda (1982)

Cz6a/Cz6b/Cz7
Lithology: Faun Harbour Conglomerate, Vunilangi Marl and unnamed limestone, deposited in sequence on Thakaundrove Peninsula.
Environment: deposited on flank of main volcanic chain, MS
Age: N18, N19, N21, N22, Early Pliocene, Late Pliocene, Early Pleistocene.

Emergence of bulk of submarine volcanoes around 3.5Ma, late early Pliocene (Middle Pliocene). Thakaundrove Peninsula emerged in Pleistocene.

Cz6a
Lithology: Nasarowangga Formation, of Nararo Formation Group, Ndreketi Basin, volcaniclastic grit to mudstone.
Environment: partly derived from andesitic spines of the Nambuna Volcano. LDU?
Age: N18 or N19, Early Pliocene
Thickness: 80 m

Lithology: Mbua (Bua) Basalt of Mbua Volcanic Group, hawaiitic basalt to trachyte
Environment: flows from Seatura Volcano, LDU
Age: Middle Pliocene, 3.4Ma Seatura Volcano
Thickness: 20 m

Pliocene uplift

Cz5/Cz6a
Lithology: Mathuandrove (Macuadrove) Supergroup - basalt, andesite, dacite, volcaniclastics, breccias
Strat relations: forms the base of the island
Environment: submarine volcanism MU
Age: 8-3.7Ma, Late Miocene to Early Pliocene

Lithology: sediments in Lambasa area, epiclastic volcanic grit, sandstone & siltstone.
Environment: MU?
Age: Tertiary f, N17, N18, N 19, N20 - late Miocene to early Pliocene.

Cz5
Lithology: Natua Formation of Natewa Volcanic Group, Ndreketi Basin, pillowed and massive flows, reworked lapillistone, tuff.
Environment: MU
Age: from forams- N17 or N18, Late Miocene/Earliest Pliocene.

DATA POINT: 2015 KORO SEA VOLCANIC ISLANDS
LONG: 178 to 180 E
LAT: 18 30 to 17 30 S
REFERENCE: Rodda (1982), Katz (1986)

Cz7
Taveuni, Mbengga, Yanutha, Kandavu, Koro

Cz6a/Cz6b
?Taveuni, Kandavu

NEW HEBRIDES/VANUATU

WESTERN BELT

DATA POINT: 2024 TORRES ISLAND GROUP
LONG: 166 40 E
LAT: 13 20 S
REFERENCE: Macfarlane & others (1988)

Cz7:
Lithology: Torres Reef Limestones
Strat relations: flat lying cap on older rocks.
Environment: MVS/CDP
Age: Quaternary.

Cz6a & Cz5:
Lithology: South Hui Formation, volcanic breccia, Globigerina ooze, manganese (condensed section?).
Strat relations: gradational on Torres Volcanics
Environment: MBA.
Age: Late Miocene to early Pliocene, foram Sphaeroclinella implies Pliocene-Pleistocene age and water depth of 365 m.
Thickness: 10 m

Cz4a:
Lithology: Torres Volcanics, autobrecciate and massive lavas, pyroclastics, tuffs. Andesitic to olivine basalt.
Strat relations: oldest unit.
Environment: MU to LDU.
Age: 39 and 37Ma from K/Ar (Kroenke, 1984), but forams Austrotrillina and Borelis imply Late Oligocene to early Miocene age, 25 - 20Ma.

DATA POINT: 2022 MALEKULA
LONG: 167 E
LAT: 16 S
REFERENCE: Macfarlane & others (1988); Katz (1988).

Cz7:
Lithology: Tenmaru and Plateau Limestones, coral-algal limestones, beach and forereef deposits.
Environment: MVS/CDP
Age: Quaternary

Cz6b/Cz6a:
Lithology: Wintua and Malua Formations, basal conglomerate, calcareous shelly sandstones and mudstones, thin limestones, cross-bedded sandstone, thin conglomerates, calcirudites, biocalcarenites.
Strat relations: angular unconformity on Matanui Group and Port Sandwich Formation.
Environment: Wintua - CDP (lagoon, sw of island), Malua - MS.
Age: Forams indicate Pliocene age.
Thickness: Wintua - 200 m, Malua - 150 m.

Cz5

Volcanic event on se Malekula dated 10.7-7.5Ma (Gorton, 1974, reported in Greene & others, 1988).

Cz4c
Lithology: intrusions of basalt-andesite composition, gabbro and microdiorite. Port Sandwich Formation - basinal turbidites, variably coloured sandstone and siltstone, foram calcareous bands, tuffs, agglomerates, volcanic conglomerates, wood debris, bioturbated, graded and convolute bedding, ripple marks.
Strat relations: unconformable on Matanui Group.
Age: 20-14Ma K/Ar date on intrusions. Orbulina universa in Port Sandwich Formation indicates early Middle Miocene.
Environment: MBA
Thickness: 700 - 2,500 m

Cz4b/Cz4a:
Lithology: Matanui Group, volcanics, volcaniclastics and carbonates - volcanic breccias, conglomerates, greywacke, limestone, mudstone, carbonised wood fragments, pyritised sandstone, carbonaceous siltstone, ooze, chert, marl, tuffs, dacitic pumiceous agglomerates. Andesite and basaltic andesite.
Environment: MU/MS/LDU
Age: Eulepidina-Spiroclypeus assemblages imply latest Oligocene to early Miocene. 20-14 Ma K/Ar dates from dykes cutting volcanics (Mitchell, 1971; Gorton, 1974).
Thickness: 7 km in north, 3 km in south.

Cz3/Cz4a:
Lithology: Red Mudstone Formation, well indurated dark-red and chocolate brown mudstone with volcanic fragments and plagioclase crystals, with sandstone and limestone laminae. No fossils.
Environment: MA, 4 to 6 km deep.
Age: presumed latest Oligocene - early Miocene age, fault contact with dated Matanui Group but has zeolite metamorphic grade (Mitchell, 1971).
Thickness: >200 m

DATA POINT: 2023 ESPIRITU SANTO
LONG: 167 E
LAT: 15 S
REFERENCE: Macfarlane & others (1988); Katz (1988).

Cz7:
Lithology: Navaka sands Formation - southern ES, unconsolidated grey silts and sands, well-rounded cobble and pebble conglomerates, coquinas.
Eastern Plateau Limestone - eastern half of ES, coral-algal biolithites, beach and forereef deposits.
Holocene sediments - clay soils, beach deposits, alluvium.
Environment: Navaka - LDF/CDP/CDD/MS. Eastern Plateau Limestone - MVS/CDP
Age: Navaka - Globorotalia truncatulinoides indicates no older than Pleistocene, 25,280 + 460 yrs C14.
Thickness: Eastern Plateau Limestone - 400 m

Cz6b/Cz7:
Lithology: Sale Formation - sw end of Big Bay, semi-consolidated

grey, green and brown silts with sands and pebble horizons, shells, plant remains.
Environment: MS (100-200 m).
Age: N19 to N23 (Pliocene to Quaternary) but thought to be confined to late Pliocene and early Pleistocene.
Thickness: 200 m.

Cz5/Cz6a:
Lithology: Tawoli Formation - calcilutites, hemipelagites, fore-reefal calcarenite, lithic sandstone, volcanic boulder conglomerate.
Environment: MS
Age: N17 to N22, late Miocene to earliest Pleistocene.
Thickness: 200 - 1,600 m

Cz4c:
Lithology: Kerewai Formation - well stratified volcaniclastics, breccias, basaltic, thin sandstones with plant remains, reef-derived calcarenties and calcilutite.
Pua Formation - west central ES, reefal limestone and calcareous sandstones overlain by volcaniclastic sandstones and breccias, andesitic and basaltic.
Peteao Greywacke Formation - restricted to central and nw Cumberland Peninsula, massive limestone blocks, calcarenites, siltstones, sandstones; highly friable dark-grey and black siltstone and mudstone, pyrite, shells, coral/algal, carbonised wood, tuff.
Pelapa Greywacke Formation - submarine mass flow deposits, deeper water equivalents of Pua and Peteap, outcrop Cumberland Peninsula; volcaniclastic sandstones and siltstones, tuff, calcarenite and calcirudite.
Wambu, Matanwai & Kerevinopu formations - s & sw ES, coarse volcanic breccias, andesite and basalt.
Ilava Volcanic Complex - Cumberland Peninsula, coarse epiclastic paraconglomerates, basaltic breccias, calcirudites, pillow lavas, tuffs.
Early to Middle Miocene intrusions - basalt, basaltic breccia, andesite, microdiorite, gabbro.
Pialapa Greywacke - turbiditic sandstones, paraconglomerate, calcirudite and calcarenite; constituents are epiclastic angular crystals and andesitic scoria.
Wailapa Formation - volcaniclastic sandstones and breccias, calcilutites.
Environment: Kerewai - MBA/MS/LDU. Peteao - MS. Pelapa - MBA. Wambu etc - MU. Ilava - MBA/MS. Pialapa & Wailapa- MBA.
Age: Kerewai - <u>Miogypsina thecideaeformis, M. polymorpha, Lepidocyclina cf. L. martini, Cycloclypeus cf. C. indopacificus</u> indicate early middle Miocene.
Pua - <u>Austrotrillina sp. cf. A. lowchini</u> indicates early or early middle Miocene.
Pelapa - <u>Orbulina suturalia</u>, N9, early middle Miocene
Peteao - on forams N9, early middle Miocene.
Wambu etc - on strat relations probably late early to early middle Miocene.
Ilava - <u>Orbulina suturalis, Praeorbulina glomerosa, Globorotalia peripheroronda</u> indicate an early middle Miocene age around 15Ma, K/Ar date of 21 Ma from clast though to be derived from older

unit (Carney and Macfarlane, 1985).
Pialapa - N9 to N10, 14 -15Ma, early middle Miocene.
Wailapa - Forams - middle Miocene, N11-N14.
Thickness: Kerewai - 900 m, Pua - 3,300 m, Peteao - 1,500 m, Pelapa - >2000 m, Ilava - 500 - 2,500 m, Pialapa - 2,500 - 3,000 m, Wailapa - 800 - 4,00 m.

Cz4a/Cz4b:
Lithology: Vakola, Batekala & Buvo formations - coarse, massive and monolithic submarine volcanic breccias, andesitic and basaltic, graded sandstones, minor limestone bands.
Ora Limestone Formation - lenses of algal nodule limestone.
Environment:MU/MS.
Age: Eulepidina-Spiroclypeus fauna indicates latest Oligocene earliest Miocene.
Thickness: volcanics - 3,000 m in north, 1,000 - 2,000 m in east; Ora Limestone- 200 m.

EASTERN BELT

DATA POINT: 2021 MAEWO
LONG: 168 10 E
LAT: 15 S
REFERENCE: Macfarlane & others (1988)

Cz7:
Lithology: Raised Limestone Group
Strat relations: overlie peneplaned older rocks.
Environment: MS/CDP atoll and lagoon.
Age: Pleistocene and Holocene, last 500,000 years

Cz6b/Cz7:
Lithology: Nasawa Formation - fossil Globigerina and pteropod oozes (sandstones, mudstones & calcilutites); 5-15% volcanic contribution.
Strat relations: angular unconformity on Marino Formation.
Environment: MS (uplift and tilting).
Age: N21 to lower N22, 3.0-1.6Ma, late Pliocene early Pleistocene.

Cz6a/Cz6b:
Lithology: Marino Formation - massively bedded grey or pale buff foram calcareous mudstones, 10% volcanic component - microlapilli, chloritized pumice, glass and crystal fragments.
Strat relations: in S conformable on Bosgoli, in N ?unconformable on Wustorogha Formation of Sighotara Group.
Environment: MBA
Age: N17 to N20, late Miocene to Pliocene, 7-3Ma, but on strat relationship, overlying Maewo Group thought to be predominantly early to late Pliocene.
Thickness: 60-100 m.

Cz5:
Lithology: Maewo Group, Bwatigau Formation - basal unit, submarine volcanics and volcaniclastics, pillow lavas, intrusions, basalts and basaltic andesites.

Maewo Group, Mbulumbulu Formation - sw Maewo, reworked fine tuffs and fossil Globigerina ooze.
Maewo Group, Avavanvai Formation - w & s, medium to fine grained palagonitized tuffs and coarse breccias.
Maewo Group, Bosgoli Formation - north, fine grained reworked and well sorted tuffs and mudstones.
Strat relations: Unconformable on older Miocene units, thins and abuts Sighotara Group in N and E.
Environment: Bwatigau - MA (2000 - 3000 m). Other formations - MU/MBA.
Age: N17 to N18, middle late Miocene to earliest Pliocene, 5-7Ma, K/Ar date on Bwatigau pillow 7Ma.
Thickness: Maewo - 700-800 m, Bwatigau - 800 m, Mbulumbulu - 40 m, Avavanvai - 80-100 m, Bosgoli - 80-100 m.

Cz5:
Lithology: Tafwutmuto Formation - massively bedded foraminiferal mudstones (fossil Globigerina oozes), micritic limestones, tuff.
Strat relations: conformable on Sarava Formation.
Environment: MA (2,000 - 3,000 m)
Age: N16 - N18, Late Miocene
Thickness: 60-120 m.

4b/Cz4c/Cz5:
Lithology: Sighotara Group - Sarava and Wustorogha formations; cobble conglomerates, tuffaceous siltstones and sandstones (turbidites), pyroclastic breccias, pelagic mudstones (foram rich)
Strat relations: oldest units on Maewo, contains Late Eocene clasts.
Environment: MBA
Age: Lepidocyclina martini, L. radiata, Operculina complanata indicate base at least early middle Miocene, probably late early Miocene; top N16 to N18, 10 to 5Ma, Late Miocene.
Thickness: 600 m

DATA POINT: 2020 PENTECOST
LONG: 168 10 E
LAT: 15 40 S
REFERENCE: Macfarlane & others (1988)

Cz6b/Cz7:
Lithology: Raga Group - reef and reef-derived limestones with thin ash beds.
Strat relations: unconformable on older rocks.
Environment: MS/CDP patch reef and atoll
Age: upper N19 to lower N21, late Pliocene, (3-2.8Ma), upper limestones thought to be late Pleistocene in age.

Cz5/Cz6a:
Lithology: Pentecost Group - lava piles and pyroclastics; pillow basalts, basaltic and andesitic breccias, volcaniclastic sandstones, turbidite sandstones and siltstones, foram calcilutites.
Strat relations: conformable on Olambe Formation, two eruptive cycles.

Environment: MBA
Age: Upper N17?, N18-N19, late Miocene to middle Pliocene (6-3Ma); K/Ar 6-3Ma (Gorton, 1974).
Thickness: 450-950 m first cycle, 120-1800 m second cycle.

Cz4c/Cz4b:
Lithology: Olambe Formation - massive polymictic breccia conglomerates overlain by fine bedded volcaniclatsic sandstones, siltstones; pyroclastic, andesitic and basaltic clasts; towards top of unit pillow basalts cut by dolerite dykes.
Environment:MS/MBA
Age: K/Ar dates, 12 + 5Ma (Mallick & Neef, 1974) and 6Ma (Gorton, 1974), on dolerite dykes give minimum age. Forams late early Miocene to early middle Miocene.
Thickness: 300 m.

Cz4a/Cz3/Cz2b?
Lithology: Basement Complex - ophiolite suite - ultramafics, saxonite, serpentinite, dunite, banded felspathic peridotite, gabbroic stocks and dykes; submarine pillow basalts.
Strat relations: emplaced diapirically into younger lithologies, latest Miocene to middle Pleistocene.
Environment: ocean floor MBA?
Age: 35 + 2Ma and 28 + 6Ma dates indicate early Oligocene age for the amphibolite metamorphism, and a late Oligocene or early Miocene age for the ultramafics and metalavas. 13.6Ma age (Gorton, 1974) from gabbro dyke related to waning Vitiaz Arc magmatism extruded onto and intruded into older Oligocene oceanic crust.

DATA AREA: 2019 CENTRAL CHAIN - VOLCANIC CENTRES
LONG: 167 - 170 E
LAT: 11 - 20 S
REFERENCE: Macfarlane & others (1988)

Cz7:
Erromango - 1.2-1.1Ma, 0.3Ma, andesite, LDU
Tanna - 1.7-0.6Ma, 0.2Ma, 2,000-3,000 yrs ago, basaltic stratovolcanoes, LDU.
Banks Islands - 1.8-0.4Ma, 0.2-0Ma, LDU
Santa Maria - 1.8-0.8Ma, shield volcano, LDU
Vanua Lava - 0.5Ma, Holocene
Mota Lava - 0.4Ma, Holocene
Mere Lava - Holocene
Aoba - 0.7Ma, 0.3Ma, shield volcano, LDU
Ambrym - 1.8-0.5Ma, 0.3Ma, shield volcano,LDU
(Aoba & Ambrym located on fractures related to the subduction of the D'Entrecasteaux Zone)
Efat - 1.6-1.4Ma, MU; 0.2-0Ma
Merig - 1.1Ma
Epi - 0.7-0.4Ma, MU; 0.07-0Ma
Tongoa - 1.3Ma, 0.07-0Ma

Cz6b:
Erromango - 2.6-2.3Ma, subaerial andesitic lavas & pyroclastics, LDU.
Tanna - 2.5-2.4Ma, basaltic cones partly submerged, LDU/MU

Futuna - ~1.8Ma, submarine basaltic cone and late stage intrusion, MU.
Aniwa - ?Pliocene volcano
Banks Islands - 1.8-0.4Ma, LDU
Santa Maria - 1.8-0.8Ma, shield volcano, LDU

Cz6a:
Erromango - 4.1-3.4Ma, subaerial ankaramitic basalt to basaltic andesite lavas, plus submarine volcanism (dredge sample Colley & Ash, 1971; Bellon & others, 1984; Dugas & others, 1977); LDU/MU.
Vot Tande - 3.5Ma (Ash & others, 1980).

Cz5:
Erromango - 5.8-5.3Ma, submarine explosive volcanism, basaltic and andesitic pyroclastics, MU

DATA POINT: 2018 MITRE ISLAND (VITIAZ ARC)
LONG: 170 12 E
LAT: 11 55 S
REFERENCE: Macfarlane & others (1988)

Cz4c:
Active volcano, 12.7Ma (Jezek & others, 1977).

DATA AREA: 2017 MATTHEW & HUNTER ISLANDS
LONG: 171 - 172 E
LAT: 22 30 S
REFERENCE: Macfarlane & others (1988)

Cz7:
Intermittently active Holocene andesitic volcanoes.

DATA POINT: 2025 NENDO
LONG: 166 E
LAT: 11 S
REFERENCE: Hughes, 1982

Cz7
Lithology: Coral reef limestone
Strat relations: unconformable on older rocks
Environment: MS
Age: Pleistocene

Cz6b/6a
Lithology: Malue Beds interbedded calcarenties and calcisiltites
Strat relations: overlie volcanic basement
Environment: MU
Age: late early Pliocene to early late Pliocene

Cz6a/Cz4b
Lithology: Luemaondo Reef Limestone
Strat relations: overlie volcanic basement
Environment: MS
Age: early Miocene to Pliocene

Cz4b/Cz4a
Lithology: volcanics
Strat relations: basement, occurs in eastern part of island
Environment: MU
Age: Late Oligocene to middle Miocene

SOLOMONS

DATA POINT: 2026   DSDP 288, Ontong Java Plateau
LONG: 161 49.53 E
LAT: 5 58.35 S
REFERENCE: Site 288 Shipboard Scientific Party (1975)

Cz7
Lithology: foram and nanno ooze
Strat relations: unconformable on Pliocene
Environment: MBA
Age: Pleistocene
Thickness: ~10 m

Cz6b
Lithology: foram and nanno ooze with vitric ash and pumice
Strat relations: unconformable on Miocene
Environment: MBA
Age: late Pliocene
Thickness: ~70 m

Cz6a
unconformity

Cz5
Lithology: foram and nanno ooze and chalk
Strat relations: conformable on middle Miocene
Environment: MBA
Age: late Miocene
Thickness: ~50 m

Cz4c
Lithology: nanno chalk
Strat relations: unconformable on early Miocene
Environment: MBA
Age: middle Miocene
Thickness: ~100 m

Cz4b/4a
Lithology: nanno chalk and foram nanno chalk
Strat relations: overlies early Oligocene
Environment: MBA
Age: early Miocene to late Oligocene
Thickness: ~210 m

Cz3
Lithology: nanno chalk with chert
Strat relations: unconformable on Paleocene
Environment: MBA
Age: early Oligocene
Thickness: ~60 m

Cz2b/2a
unconformity

Cz1
Lithology: nanno-foram chalk with chert
Strat relations: unconformable? on mid Maastrichtian

Environment: MBA
Age: Paleocene
Thickness: ~50 m

K11
unconformity

K10b
Lithology: nanno chalk, nanno-foram ooze and chert
Strat relations: unconformable on early Campanian
Environment: MBA
Age: mid to early Maastrichtian
Thickness: ~100 m

K10a
Lithology: nanno chalk
Strat relations: unconformable on Santonian
Environment: MBA
Age: early Campanian
Thickness: ~40 m

K9
Lithology: nanno chalk grading to limestone, chert, vitric siltstone and claystone
Strat relations: unconformable on middle Cenomanian
Environment: MBA
Age: Santonian to early Turonian
Thickness: ~190 m

K8/7/6
Lithology: limestone, chert, claystone
Strat relations: conformable on Aptian
Environment: MBA
Age: middle Cenomanian to Albian
Thickness: ~100 m

K5/4
Lithology: silicified limestone, chert, glass shards
Strat relations: bottom of hole
Environment: MBA
Age: Aptian
Thickness: ~8 m

DATA POINT: 2027 DSDP 289, Ontong Java Plateau
LONG: 158 30.69 E
LAT: 00 29.92 S
REFERENCE: Site 289 Shipboard Scientific Party (1975)

Cz7
Lithology: nanno-foram ooze
Strat relations: conformable on late Pliocene
Environment: MBA
Age: Quaternary
Thickness: ~30 m

Cz6b

Lithology: nanno-foram ooze
Strat relations: conformable on early Pliocene
Environment: MBA
Age: late Pliocene
Thickness: ~60 m

Cz6a
Lithology: nanno-foram ooze
Strat relations: conformable on Miocene
Environment: MBA
Age: early Pliocene
Thickness: ~75 m

Cz5
Lithology: nanno-foram ooze and chalk
Strat relations: conformable on middle Miocene
Environment: MBA
Age: late Miocene
Thickness: ~150 m

Cz4c
Lithology: nanno-foram ooze and chalk
Strat relations: conformable on early Miocene
Environment: MBA
Age: late Miocene
Thickness: ~175 m

Cz4b
Lithology: nanno-foram chalk and limestone
Strat relations: conformable on late Oligocene
Environment: MBA
Age: early Miocene
Thickness: ~170 m

Cz4a
Lithology: nanno-foram chalk and limestone
Strat relations: conformable on early Oligocene
Environment: MBA
Age: late Oligocene
Thickness: ~230 m

Cz3
Lithology: nanno-foram chalk and limestone
Strat relations: unconformable on late Eocene
Environment: MBA
Age: early Oligocene
Thickness: ~80 m

Cz2b
Lithology: radiolarian limestone, siliceous limestone, nanno-foram chalk and limestone, chert
Strat relations: conformable on middle Eocene
Environment: MBA
Age: late Eocene
Thickness: ~70 m

Cz2a
Lithology: radiolarian limestone, siliceous limestone, nanno-

foram chalk and limestone, chert
Strat relations: unconformity between middle and early Eocene, unconformable on late Paleocene
Environment: MBA
Age: middle and early Eocene
Thickness: ~45 m

Cz1
Lithology: radiolarian limestone, siliceous limestone, nanno-foram chalk and limestone, chert
Strat relations: unconformity between late and early Paleocene, unconformable on middle Maastrichtian
Environment: MBA
Age: late and early Eocene
Thickness: ~70 m

K11
unconformity

K10b
Lithology: radiolarian limestone, siliceous limestone, nanno-foram chalk and limestone, chert
Strat relations: unknown lower contact, poor core recovery
Environment: MBA
Age: middle and early Maastrichtian
Thickness: ~50 m

K10a/9/8/7/6??
Lithology: radiolarian limestone, siliceous limestone, nanno-foram chalk and limestone, chert
Strat relations: unknown lower contact, poor core recovery
Environment: MBA/MA
Age: Campanian to Albian (nannos)
Thickness: ~30 m

K5/4
Lithology: limestone, chert and tuff
Strat relations: overlies oceanic basement
Environment: MBA
Age: Aptian
Thickness: ~20 m

pre K4
Lithology: extrusive basalt
Strat relations: bottom of hole
Environment: oceanic basement, MU
Age: pre Aptian
Thickness: 9 m penetrated

DATA POINT: 2028 MALAITA
LONG: 161 E
LAT: 9 S
REFERENCE: Nixon & Coleman, 1978; Hughes, 1982; Coulson & Vedder, 1986; Pound, 1986: Vedder & others, 1986; Wells, 1989

Cz7

Lithology: Rokera Limestone, recrystallised reef and back reef
Strat relations: unconformable on older units, on Small Malaita
Environment: MS
Age: Quaternary
Thickness: 100 m

Cz7
Lithology: Hauhui Conglomerate, subrounded cobbles of limestone, basalt & chert
Strat relations: unconformable on older rocks, in south central Malaita
Environment: LDF?
Age: Quaternary
Thickness: 200 m

Cz6b/6a/5
Lithology: Tomba Silts, tuffaceous siltstone, marl and limestone
Strat relations: basal gradational contact with Suaba Chalk, equivalent of Hada Calcisiltite, occurs in northwest Malaita
Environment: MU
Age: Pliocene to late Miocene
Thickness: 265 m

Cz6b/6a/5/4c
Lithology: Hada Calcisiltite, calcilutite and calcisiltite with 5 m thick brown mudstone beds, minor calcarenite
Strat relations: basal gradational contact with Haruta Calcisiltite, occurs in Small Malaita, plus equivalent of unnamed calcisiltite in south central Malaita.
Environment: MU
Age: Pliocene to middle Miocene

Cz4c/4b
Lithology: Suaba Chalk
Strat relations: basal gradational contact with Alite Limestone, equivalent of lower Hada Calcisiltite and upper Haruta Calcisiltite, occurs in northwest Malaita.
Environment: MBA
Age: middle to early Miocene

Cz4c/4b/4a/3
Lithology: Haruta Calcisiltite, calcilutite and calcisiltite with abundant thin mudstone beds
Strat relations: gradational basal contact with Alite or Apuloto limestones, occurs in south central Malaita and on Small Malaita
Environment: MU
Age: Middle Miocene to Oligocene

Cz4a/3/2b/2a/1/K11/K10b/K10a
Lithology: Alite Limestone, pelagic limestone, radiolarian chert near top and base
Strat relations: overlies Kwara'ae Mudstone, intruded by alnoitic breccia, equivalent of lower Haruta Calcisiltite and upper Apuloto Limestone, occurs in northwest and south central Malaita
Environment: MU
Age: earliest Miocene to Campanian
Thickness: 825-1000 m

Cz3 to Albian?
Lithology: Apuloto Limestone, massive pelagic limestone, thin beds, nodules and lenses of chert, contains thickly interbedded flows of alkali basalt (Malaita Volcanics, younger basalts)
Strat relations: underlies Haruta Calcisiltite, overlies volcanic basement.
Environment: MU
Age: Oligocene to Albian?

Cz3
Lithology: Alnoitic intrusive breccias, contains mantle xenoliths
Strat relations: intrudes Alite Limestone, pipe-like intrusion
Environment: related to passage of Ontong Java Plateau over Samoan hot spot (Wells, 1989)
Age: 34 Ma U/Pb (Nixon & Coleman, 1978)

K9 to K4
Lithology: Kwara'ae Mudstone, lithified radiolarian ooze
Strat relations: overlies volcanic basement
Environment: greater than 4000 m, MA
Age: Aptian to Santonian?

K4 to K1?
Lithology: Malaita Volcanics oceanic tholeiitic basaltic flows, massive and pillowed, and minor associated pyroclastic beds
Strat relations: basement
Environment: ocean floor, MU
Age: early Cretaceous
Thickness: 675 m

DATA POINT: 2029 SANTA ISABEL (north)
LONG: 159 E
LAT: 7 30 S
REFERENCE: Hughes, 1982; Pound, 1986; Vedder & others, 1986

Cz7
Lithology: alluvium, reef deposits
Strat relations: overlies older units
Environment: MS, LDF
Age: Pliocene

Cz6b/6a
Lithology: Tanakau Group, younger calcarenites
Strat relations: gradational contact on volcaniclastics
Environment: MS
Age: Pliocene

Cz5/4c/4b??
Lithology: Tanakau Group, interbedded volcaniclastics, sandstones, siltstones, plant remains
Strat relations: overlies older calcarenites
Environment: MS/CDD/LDU?
Age: older than Pliocene, younger than early Miocene

Cz4b
Lithology: Tanakau Group, older calcarenites, tuffaceous
Strat relations: grades up into volcaniclastics

Environment: MS?
Age: early Miocene (Burdigalian)

Cz4a/3
Lithology: Tanakau Group, non-calcareous volcaniclastics
Strat relations: underlies early Miocene calcarenites, overlies basal pelagites
Environment: MU
Age: older than early Miocene (Burdigalian)
Thickness: total for Tanakau Group 900 m

Cz3/2b/2a/1
Lithology: basal pelagites, contains forams, recrystallised
Strat relations: part of basement, deposited within and above Sigana Volcanics
Environment: MBA
Age: late Paleocene to early Oligocene

Cz2a/1
Lithology: Sigana Volcanics, pillowed and massive basaltic lava of oceanic tholeiitic composition, minor tuff
Strat relations: basement, intercalated upwards with basal pelagites, intruded by ultramafic rocks along the Kia-Korigole-Kaipito fault system
Environment: MU
Age: Paleocene to Eocene?, K/Ar 66Ma
Thickness: 600-3500 m

DATA POINT: 2030 SANTA ISABEL (south)
LONG: 159 30 E
LAT: 8 30 S
REFERENCE: Hughes, 1982; Pound, 1986.

Cz7
Lithology: reef limestone
Strat relations: conformable on older units
Environment: MS
Age: Pleistocene

Cz6b/6a
Lithology: calcareous, tuffaceous sandstones and shale
Strat relations: gradational basal contact with greywackes
Environment: MS
Age: Pliocene

Cz5/4c
Lithology: volcanogenic greywackes
Strat relations: overlies Rob Roy Beds
Environment: MU?
Age: late and middle Miocene

Cz4b/4a
Lithology: Rob Roy Beds, siltstones containing forams and ultramafic debris
Strat relations: gradational basal contact on Loguhutu & Bero Beds

Environment: MU
Age: early Miocene (Aquitanian)

Cz4a?
Lithology: Loguhutu & Bero Beds, grits, coarse lithic volcanic sandstones merging upwards into tuffaceous sandstone
Strat relations: ?unconformable on Sigana Volcanics
Environment: MS?
Age: older than early Miocene (Aquitanian), Oligocene

Cz2b/2a/1?
Lithology: Sigana Volcanics, basaltic pillow lava
Strat relations: ?unconformable on basement complex
Environment: MU
Age: Eocene to Paleocene
Thickness: >200 m

K11/K10??
Lithology: Basement Complex, schistose amphibolitic and granulitic rocks derived from andesitic lavas and sediment, microgabbro intrusion and serpentinised ultramafic lenses
Strat relations: intruded by Vitoria Microgabbros and cut by Kolomola Ultramafics, serpentinised ultramafic lenses lying within the basement parallel to and within fault zones
Environment: MU
Age: Age unknown, Cretaceous?
Thickness: >200 m

DATA POINT: 2031 SAN CRISTOBEL
LONG: 162 E
LAT: 10 30 S
REFERENCE: Hughes, 1982; Pound, 1986

Cz7
Lithology: Arosi Beds, reef limestone
Strat relations: unconformable on Pliocene
Environment: MS
Age: Pleistocene

Cz6b/6a/5/4c/4b/4a
Lithology: San Cristobel Group, calcareous siltstone and fine grained lithic volcanic sandstones
Strat relations: overlies gradationally Ravo Limestone
Environment: MU
Age: Pliocene to early Miocene

Cz6a/Cz5
Lithology: Uki Beds, calcisiltites, siltstones, muddy sandstones
Strat relations: outcrop on island of Uki in Masi, folded in anticline
Environment: MU
Age: Pliocene to Upper Miocene

Cz4c
Lithology: Ruawai Beds, mudstone, calcareous wackes, pelagic limestone

Strat relations: basal part of San Cristobel Group in west, overlies Hautarau limestone
Environment: MBA
Age: Middle Miocene

Cz4c
Lithology: Hautarau limestone, pelagite
Strat relations: part of Ruawai Beds, basal unit
Environment: MBA
Age: Middle Miocene

Cz4c/4b/4a
Lithology: Hariga Conglomerate with calcareous tuffaceous matrix
Strat relations: part of San Cristobel Group, basal unit in east
Environment: MBA
Age: Middle Miocene to late Oligocene

Cz4a/3/2b/2a/1
Lithology: Ravo Limestone, porcelaneous limestone
Strat relations: lenses within Warahito Lavas
Environment: MBA
Age: early Miocene to Paleocene
Thickness: <180 m

Cz3/2b/2a/1
Lithology: Warahito Lavas, basaltic flows intruded by gabbro and slivers of metamorphosed ultrabasic rocks, Wainoni Ultrabasics
Strat relations: basement
Environment: MU
Age: Oligocene to Paleocene

DATA POINT: 2032 GUADALCANAL
LONG: 160 E
LAT: 9 30 S
REFERENCE: Hughes, 1982; Pound, 1986

Cz7
Lithology: Honiara Beds, reef limestone
Strat relations: outcropping
Environment: MS
Age: Pleistocene
Thickness: 60 to 80 m

Cz7/6b
Lithology: Vatumbulu Beds, othoconglomerate
Strat relations: coarser grained equivalent of Mobokokimbo Beds
Environment: LDF?
Age: barren of fossils, on stratigraphic location late Pliocene/Pleistocene in age
Thickness: >700 m

Cz7/6b
Lithology: andesitic lava and tuff
Strat relations: in northwest of island
Environment: LDU?
Age: late Pliocene/Pleistocene?

Thickness: 900 m

Cz6b/6a
Lithology: calcarenites
Strat relations:
Environment: MS?
Age: Pliocene

Cz6b/6a
Lithology: Kolula Diorite, quartz diorites, gabbro diorite
Strat relations: two stage intrusive complex
Environment: subsurface
Age: Pliocene, K/Ar 2.4 & 4.5 Ma

Cz6a
Lithology: lignite beds
Strat relations: in southwest of island
Environment: CDP
Age: early Pliocene

Cz6b/6a/5
Lithology: Mobokokimbo Formation, thick extensive interbedded mudstone, muddy sandstone, conglomerate
Strat relations: in east of island; in part equivalent to Lungga Beds
Environment: LDU/MU
Age: late Miocene to late Pliocene/early Pleistocene
Thickness: >5050 m

Cz6a/5/4c
Lithology: Lungga Beds, greywackes, pyroclastic beds, andesitic lava, poorly calcareous clastics
Strat relations:
Environment: in deep basinal areas, MBA
Age: middle Miocene to Pliocene

Cz6b/6a/5/4c
Lithology: Toni Formation, volcaniclastic rudite and arenite, pyroclastics, lavas and biogenic limestone
Strat relations: in part equivalent of Lungga Beds, intruded by Gold Ridge Volcanics and Mbausuma Gabbro
Environment: MS?
Age: middle Miocene to Pliocene
Thickness: volcanics <800 m, limestone 100 m,
sandstone 200-800 m

Cz4c/4b
Lithology: Kavo Greywacke Beds, foram and felspathic greywacke, and erosional products of Suta Volcanics
Strat relations: overlies Suta Volcanics, intruded by Mbalisuma Gabbro
Environment: MS?
Age: middle to early Miocene
Thickness: >2500 m

Cz4c
Lithology: Charikangge Grit, poorly bedded volcanic greywacke
Strat relations: overlain by Toni Formation

Environment: LDU?
Age: middle Miocene
Thickness: 80 m

Cz4c/4b
Lithology: Tangareso Beds, poorly sorted fine grained arenite
Strat relations: overlain by Charikangge Grit, unconformable on Tina Calcarenite
Environment: LDU/MU?
Age: early to middle Miocene
Thickness: <800 m

Cz4b
Lithology: Tina Calcarenite, well-bedded calcarenite with terrigenous material
Strat relations: unconformably overlain by Tangareso Beds
Environment: MS
Age: early Miocene
Thickness: 100-300 m

Cz4b
Lithology: Mbetilonga Limestone, recrystallised biostromal limestone
Strat relations: conformable on Suta Volcanics, overlain by Tina Calcarenite
Environment: MS
Age: early Miocene
Thickness: 200-400 m

Cz4a
Lithology: Poha Diorite
Strat relations: intrudes Suta Volcanics
Environment: subsurface
Age: K/Ar 24.4 + 0.3 Ma, early Miocene
Thickness: 200-400 m

Cz4a/3
Lithology: Suta Volcanics, basaltic and andesitic pillowed and massive flows, pyroclastic material, crystal and lithic tuff
Strat relations: intruded by Kolula, Poha and Lungga diorites, fault contact with basement complex
Environment: MU?
Age: early Miocene to Oligocene
Thickness: >2500 m

K11/10b/10a/9
Lithology: Basement Complex, basic volcanic rocks, gabbro, dolerite and limestone and their metamorphic equivalents; greenschist to amphibolite grade, serpentinised ultramafic rocks
Strat relations: basement
Environment: tectonised ocean floor?
Age: late Cretaceous, K/Ar 92 + 20 Ma
Thickness: >1200 m

DATA POINT: 2033 CHOISEUL
LONG: 157 E
LAT: 7 S
REFERENCE: Hughes, 1982; Pound, 1986

Cz7
Lithology: Nukiki Limestone, reef limestone, massive recrystallised limestone with minor mudstone beds
Strat relations: forms elevated platforms
Environment: MS
Age: Pleistocene
Thickness: 80 m

Cz6b
Lithology: Mbani Calcisiltite Member, Pemba Formation
Strat relations: in north of island
Environment: MU
Age: late Pliocene
Thickness: <120 m

Cz6b/6a
Lithology: Maetambe Volcanics, andesitic lava, breccia and tuff
Strat relations: unconformably underlies Nukiki Limestone, gradational basal contact with Mole Formation
Environment: LDU?
Age: Pliocene
Thickness: <500 m

Cz6b/6a
Lithology: Komboro Volcanics, andesitic breccia and tuff with pebbles of schist and ultramafic rocks
Strat relations: unconformably underlies Nukiki Limestone, overlies Vaghena Formation
Environment: LDU?
Age: Pliocene
Thickness: <80 m

Cz6a
Lithology: Sui Calcarenite Member, Pemba Formation
Strat relations: in north of island, gradational basal contact with Mole Formation
Environment: MS
Age: early Pliocene
Thickness: 250 m

Cz6a
Lithology: Vaghena Formation, arenaceous, some calcareous units, mudstone
Strat relations: in south of island, unconformable on Siruka Ultrabasics
Environment: submarine shelf, MS
Age: early Pliocene
Thickness: 40-200 m

Cz6a/5/4c/4b/4a
Lithology: Mole Formation, interbedded microbreccias, grits, laminated and colour banded siltstone and sandstone, mudstone; more calcareous upwards; includes Koloe Breccia, a volcaniclastic

rudite deposited within basement depressions
Strat relations: unconformable on Voza Lavas
Environment: MU/MBA
Age: middle Pliocene to early Miocene/late Oligocene
Thickness: 180-100 m

Cz4c
Lithology: Mount Vuasa Limestone, coralgal reef
Strat relations: part of Mole Formation
Environment: coralgal reef on flanks of possibly emergent Choiseul Ridge, MS/LDU?
Age: middle Miocene
Thickness: 100 m

Cz4a
Lithology: Siruka Ultrabasics, serpentinised harzburgite and lherzolite
Strat relations: unconformably overlain by Vaghena Formation, faulted contact with Voza Lavas
Environment: tectonised ocean floor?
Age: early Miocene to late Oligocene
Thickness: <560 m

Cz4a/3
Lithology: Voza Lavas, pillowed, massive, brecciated and sheared basalt and minor associated pyroclastics intruded by minor gabbro and doleritic dykes; contains some pods of serpentinised ultramafic rocks
Strat relations: basement, gradational contact with Choiseul Schist
Environment: ocean floor, MBA
Age: early Miocene to Oligocene
Thickness: 360-800 m

Cz4a/3
Lithology: Choiseul Schist, greenschist to amphibolite grade
Strat relations: basement, metamorphic equivalent of Voza Lavas
Environment: metamorphosed ocean floor
Age: Oligocene to Paleocene?, K/Ar 44 + 18Ma
Thickness: 260 m

DATA POINT: 2034   NEW GEORGIA GROUP
LONG: 157 30 E
LAT: 8 30 S
REFERENCE: Hughes, 1982; Pound, 1986

Cz7
Lithology: limestone reefs, alluvium
Strat relations: overlies Konggu Formation
Environment: MS/ LDF
Age: Pleistocene

Cz6b/6a
Lithology: Konggu Formation, limestone and sandstone
Strat relations: overlain by Quaternary
Environment: MS?

Age: Pliocene, foram

Cz6a
Lithology: pyroclastics
Strat relations: overlain by Konggu Formation
Environment: MU/LDU?
Age: early Pliocene

Cz7/6b/6a/5
Lithology: lavas, pyroxene olivine basalt, horneblend basalt and picritic basalt
Strat relations: overlain by pyroclastics, basement
Environment: MU/LDU?
Age: Pleistocene to Pliocene and late Miocene, K/Ar 2.3 + 1 Ma

Cz6b
Lithology: shelf sediments
Strat relations: on Vella Lavella
Environment: MS
Age: late Pliocene

DATA POINT: 2035 RUSSELL ISLANDS
LONG: 159 29 E
LAT: 9 S
REFERENCE: coulson & Vedder, 1986

Cz7
Lithology: reef limestone and siltstone
Strat relations: uplifted rim around volcanic core
Environment: MS
Age: Pleistocene

Cz7/6b/6a/5
Lithology: basaltic andesite breccia overlain by basalt lavas
Strat relations: core of the islands
Environment: emergent island volcano, LDU
Age: Pleistocene to late Miocene? from comparison with New Georgia

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DATA POINT: 2036 FLORIDA GROUP
LONG: 160 20 E
LAT: 7 S
REFERENCE: Hughes, 1982; Pound, 1986

Cz7
Lithology: alluvium
Strat relations: unconformable on older units
Environment: LDF
Age: Pleistocene

Cz6a
Lithology: Florida Limestone
Strat relations: unconformable on Ghumba Beds

Environment: MU
Age: early to middle Pliocene
Thickness: 200-250 m

Cz6b/6a/5/4c
Lithology: Mboli Beds, volcaniclastic arenite, lutite and minor epiclastic rudite
Strat relations: gradational basal contact with Soghonara Lavas
Environment: MU
Age: Pliocene to middle Miocene
Thickness: 600 m

Cz5/4c
Lithology: Ndandala Sandstone, finely laminated
Strat relations: overlies Ghumba Beds
Environment: MU
Age: late to middle Miocene
Thickness: 280 m

Cz4c/4b/4a
Lithology: Soghonara Lavas, massive and pillowed andesite with leucogabbro feeder dykes
Strat relations: unconformable on Hanesavo Beds, intercalated with basal Mboli Beds
Environment: MU
Age: middle to early Miocene

Cz4b/4a
Lithology: Siota & Ghumba Beds, rudites, arenites, calcarenites, pillow lava lenses, contains nannos and forams
Strat relations: faulted contacts with ultramafics
Environment: MU
Age: early Miocene to late Oligocene
Thickness: Siota Beds 550-850 m, Ghumba Beds 1000-1500 m

Cz3/2b/2a
Lithology: Hanesavo Beds, mineralised radiolarian chert, tuff and minor lava, underlain by greenschist and zeolite facies basic lava and high titanium alkali basalt
Strat relations: underlain by Vatilau Microgabbro and Gabbro
Environment: MU
Age: Oligocene to Eocene
Thickness: 2800 m

Cz2a
Lithology: Vatilau Microgabbro and Gabbro
Strat relations: faulted contact with ultramafics, intrude overlying strata in places
Environment: subsurface
Age: early Eocene?
Thickness: 2800 m

Cz2b/2a
Lithology: ultramafics, serpentinised, deformed harzburgite, dunite, wehrlite, minor gabbro, pillow lava and melanged sedimentary rocks
Strat relations: faulted contacts
Environment: tectonised ocean floor

Age: Eocene, K/Ar 35.2 + 1.4 to 44.7 + 2.1 Ma
Thickness: 2800 m

DATA POINT: 2037 SHORTLAND GROUP
LONG: 156 E
LAT: 7 S
REFERENCE: Pound, 1986

Cz7
Lithology: alluvium, reef limestone
Strat relations: unconformable on older units
Environment: LDF/MS/CDP
Age: Pleistocene
Thickness: 150 m

Cz7/6b/6a
Lithology: Togha Pyroclastics - tuff, tuff breccia, agglomerate, minor prophyritic andesite and basalt
Strat relations: occurs on Fauro, underlies Quaternary limestone, unconformable on Koria Sandstone
Environment: LDU
Age: Pleistocene to Pliocene
Thickness: 600 m

Cz6b/6a
Lithology: Mono Siltstones on Mono; Kulitanai Siltstones on Alu - silt, clay, minor conglomerate and calcarenite
Strat relations: Mono overlies Kolohe Limestone, Kulitanai unconformable on Kamaleai Pyroxene Andesite
Environment: LDF
Age: Pliocene
Thickness: Mono - 300 m, Kulitanai - 600 m

Cz6a
Lithology: Kolohe Limestone coralgal limestone
Strat relations: occurs on Mono, overlies Kughala Limestone
Environment: MS
Age: early Pliocene
Thickness: 80 m

Cz6a/5
Lithology: Koria Sandstone - reworked volcanogenic sandstone, andesitic and dacitic crystal tuff with minor andesitic lava and ash flow tuff, minor limestone at base
Strat relations: occurs on Fauro, unconformable on Tauna Microdiorite
Environment: LDU/MU?
Age: early Pliocene to late Miocene
Thickness: 1500 m

Cz6a/5/4c
Lithology: Kughala Limestone - pelagic limestone with thin brown tuffaceous beds
Strat relations: occurs on Mono, faulted contact with basaltic pillow lava
Environment: MS/MBA?

Age: early Pliocene to late and middle Miocene
Thickness: 150 m

Cz6a/5/4c
Lithology: Kamaleai Pyroxene Andesite
Strat relations: occurs on Alu, isolated intrusions into the Alu Basalts, possible related to the Hisiai Complex
Environment: LDU
Age: late Miocene

Cz4c/4b
Lithology: Hisiai Complex - diorite
Strat relations: occurs on Alu, dioritic intrusion into the Alu Basalts
Environment: subsurface
Age: middle to early Miocene

Cz4c/4b
Lithology: Tauna Microdiorite and Fauro Dacite
Strat relations: occur on Fauro, Tauna Microdiorite is a volcanic plug, Fauro Dacite has faulted and intrusive contacts with the Masamasa Volcanics
Environment: LDU, andesitic volcano
Age: middle to early Miocene

Cz4c/4b/4a
Lithology: basaltic pillow lava and pelagic limestone
Strat relations: occurs on Mono, overlies basement pillow lava
Environment: MBA?
Age: middle to early Miocene, middle Miocene date from forams
Thickness: 300 m

Cz4a/3
Lithology: Alu Basalts - altered tholeiitic basaltic and andesitic lava
Strat relations: basement on Alu
Environment: MU?
Age: early Miocene to Oligocene
Thickness: >400 m

Cz4a/3
Lithology: Masamasa Volcanics - massive, pillowed and brecciated flows of icelandite and tholeiitic dacite, pervasively altered
Strat relations: basement on Fauro
Environment: MU?
Age: early Miocene to Oligocene
Thickness: >500 m

Cz3
Lithology: basaltic pillow lava
Strat relations: basement on Mono, underlies pillow lava with limestone
Environment: MU?
Age: Oligocene

DATA POINT: 2038 SITE 287, Coral Sea
LONG: 153 15.93 E
LAT: 15 54.67 S
REFERENCE: Site 287 Shipboard Scientific Party (1975)

Cz7/6b
Lithology: turbidites, graded cycles of silt and clay with interbedded nanno ooze
Strat relations: upper unit penetrated
Environment: MBA
Age: lower Late Pliocene to Pleistocene
Thickness: 132 m

C6b/5/4c/4b/4a??
Lithology: unfossiliferous olive to green clay with brown silty clay in bottom metre
Strat relations: overlies Late Oligocene
Environment: condensed section, MA
Age: undated, lies between Oligocene and late Pliocene
Thickness: 40 m

C4a
Lithology: nanno ooze
Strat relations: unconformable on middle Eocene
Environment: MBA
Age: Late Oligocene
Thickness: 8 m

Cz3/2b
Unconformity

Cz2a/1
Lithology: nanno chalk with interbedded chert
Strat relations: overlies oceanic basalt Eocene
Environment: MBA
Age: early to middle Eocene
Thickness: 57 m

Cz1?
Lithology: porphyritic basalt
Strat relations: bottom of hole
Environment: oceanic basement, MU
Age: undated, early Eocene or older
Thickness: 57 m

DATA POINT: 2039 SITE 209, Queensland Plateau
LONG: 152 11.27 E
LAT: 15 56.19 S
REFERENCE: Site 209 Shipboard Scientific Party (1973)

Cz7/6b/6a/5/4c/4b/4a
Lithology: foram ooze and nanno ooze
Strat relations: upper unit penetrated
Environment: MBA
Age: Pleistocene to late Oligocene
Thickness: 140 m

Cz3
Unconformity, nondeposition or very slight marine erosion

Cz2b/2a
Lithology: sand-bearing foram ooze and chert
Strat relations: unconformable upper contact, gradational loweer contact
Environment: MBA
Age: late to middle Eocene
Thickness: 135 m

Cz2a
Lithology: sand-rich foram limestone with secondary chert filling voids
Strat relations: bottom of hole
Environment: relatively shallow water on continental margin, MS
Age: middle Eocene
Thickness: 69 m