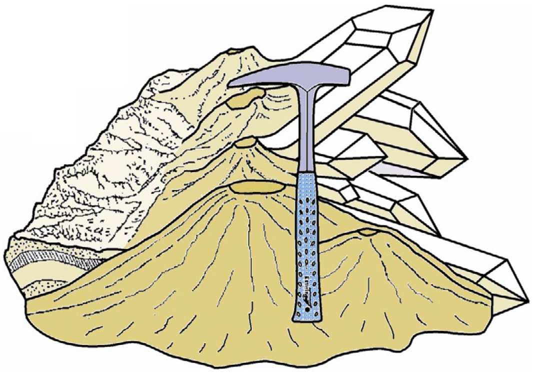

Geocene

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Geocene is a periodic publication of Auckland Geology Club, a section of the Geoscience Society of New Zealand’s Auckland Branch.

Contributions about the geology of New Zealand (particularly northern New Zealand) from members are welcome. Articles are lightly edited but not refereed.

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CYLINDRICAL BUNDLES OF BASALT COLUMNS AT WAITANGI, BAY OF ISLANDS

Bruce W. Hayward & Julian Thomson

In November 2016, during a Geoclub trip to central Northland, members visited and marvelled at the spectacular columnar jointing in a 1.8–1.9-million-year-old (Smith *et al*. 1993) basalt flow on the coast, a few hundred metres north of the Waitangi Treaty House, Bay of Islands (Fig. 1). Public access is allowed down the boundary between the treaty house grounds and the Waitangi golf course and is commonly used by rock fishers.

On a return visit in August 2024, the authors noted something a bit different about some areas of the columnar-jointed flow. In one place there was a 1 m deep, 75 cm wide rock pool that had a perfectly smooth near-circular outline (Fig. 2), which seemed strangely out of place within a rock made of 10–30 cm diameter, vertical basalt columns with a range of polygonal cross-sections. The presence of several rounded basalt cobbles in the bottom of the "pothole" suggested that it had been made by the usual process of pothole formation by internal abrasion, with the cobbles being circulated within by wave action breaking over the near-high-tide-rocks (Fig. 3). But why did the pool have such a smooth subcircular outline, rather than one controlled by the column faces? And how did such a pothole on a horizontal surface get started in the first place?

Our initial thoughts from a distance were that maybe it was the mould of an in-situ tree trunk that had been surrounded by lava and incinerated away. Looking into the pothole water we could see the polygonal pattern of broken/eroded columns across the floor. This was not normal for a tree mould unless it had later been filled with lava and become a basalt cast of the trunk. In all our experiences with tree moulds and casts in basalt in Auckland, and especially at Takapuna Fossil Forest (Hayward & Hayward 1995, Hayward 2019 2021), we have never seen cooling columns extend right up to and around the mould and certainly not formed inside. Always the lava around the mould has a 5–30 cm-wide

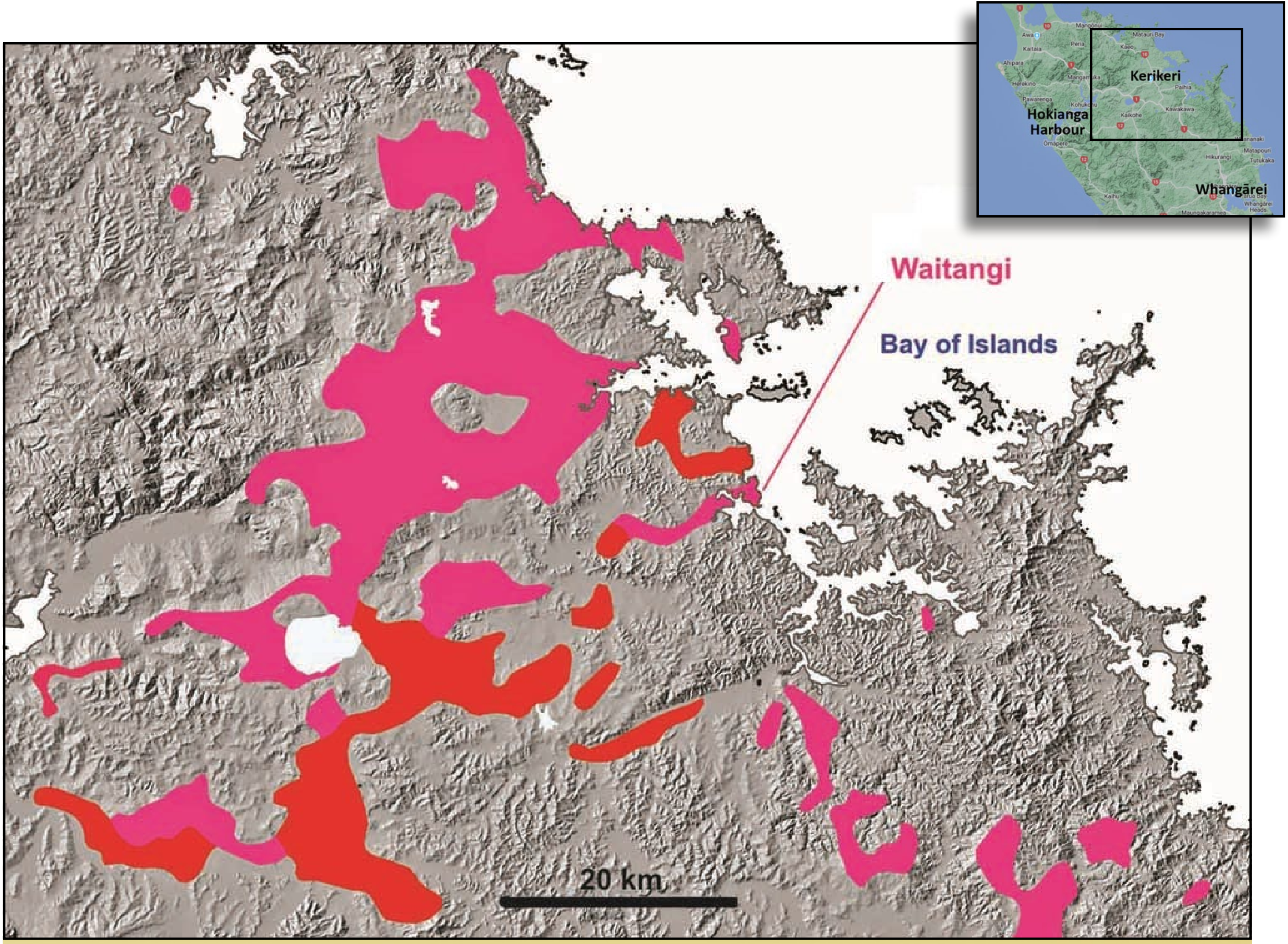

Fig. 1. Map showing the location of the Waitangi coastal section within basalt lava flows (reds) of the Kaikohe-Bay of Islands Volcanic Field. Older, more eroded flows are shown in pink and flows younger than ~1 myrs are shown in red (adapted from GNS Qmap).

Fig. 2. 1 m deep, cylindrical pothole with 75 cm diameter, smooth, circular outline in near-high-tide columnar basalt, Waitangi. Note some adjacent smooth arcuate joints and elliptical bundles of joints.

Fig. 3. Columnar-jointed basalt lava flow forms the coastline adjacent to Waitangi Golf Course, just north of Waitangi Treaty Grounds (boundary fence on left). The high-tide pothole discussed in the text is circled in white.

Fig. 4. Basalt lava mould that formed around the base of a standing tree at Takapuna Fossil Forest. Note the usual wide circular band of solidified basalt that formed around the cold tree trunk, which was incinerated away.

band of basalt with circular banding (Fig. 4), reflecting the advance of the cooling and solidifying front away from the tree. Similar banding also occurs inside the basalt cast of a tree branch at Takapuna (Hayward *et al*. 2011, figure on p. 20). No circular cooling bands are seen at Waitangi. At the pothole the flow is at least 5 m thick and possibly more. Seldom would we expect to find a tree trunk of this diameter still standing and not knocked over and rafted away or completely incinerated away within a flow of this magnitude. For the above reasons we exclude the hypothesis of this and other cylindrical bundles at Waitangi as having anything to do with tree moulds.

Closer examination of the pothole showed that the smooth subcircular outline coincided with a subcircular, vertical joint (Fig. 2) that had encircled a bundle of columns. Indeed, it appeared that this strong joint had controlled the erosion and formation of the pothole, with parts of individual columns within presumably breaking off and being washed out and away. These observations were reinforced by examination of the basalt columns within 50 m of the pothole, in which a number of cylindrical bundles of 10–20 basalt columns could be identified, with each bundle surrounded by a strong vertical joint with an elliptical to subcircular outline in cross-section, 0.5–2 m in diameter (Figs 5–8). The sides of the columns inside and outside each bundle formed either side of these joints (Figs 5–6) and clearly indicated that these cylinders had been formed during cooling and solidification as the columns were taking shape and not at some later date.

There have been a number of studies world-wide that relate the formation and size of columnar cooling joints in igneous rocks such as these to the speed of propagation of a sharp shrinkage front that drives the

Fig. 5. A bundle of irregular polygonal basalt columns with an irregular elliptical cross-section defined by a curved joint that is wider than most of the other joints between the columns. Foot at top of photo for scale.

Fig. 6. Strong, irregular arcuate joints within the polygonal columnar joints often, but not always, encircle a bundle of basalt columns.

Fig. 8. View down over intertidal basalt lava flow showing that most of it in this locality is composed of 1–2 m diameter cylindrical bundles of cooling columns. Some bundles appear to be more quadrangular than elliptical in cross-section. Fisher (top left) for scale.

ordering of contraction cracks. The front is due to thermal contraction as the lava cools and solidifies. It is often said that "*the hexagonal shape of basalt columns is the result of a natural geometrical response to the stress of contraction. As lava contracts, it tries to form shapes that reduce stress, and hexagons are the most efficient way to achieve this while maintaining a consistent shape and minimising surface area.*" We know that in many places columns are often also pentagonal and here at Waitangi they are of variable size and polygonal shapes. The cylindrical bundles of columns have only been seen by us within a portion of the lava flow and are absent from other parts.

Fig. 7. Part of the high tide foreshore showing a cross-section through the irregular, vertical, polygonal basalt columns, which in many places can be seen (just) to be grouped into cylindrical bundles by the strong elliptical or arcuate joints.

The question now posed is: How were these stronger arcuate/subcircular joints, which have bundled the columns into vertical cylinders containing many columns, formed? Could it be that these were formed near the middle of the flow by the interaction of two cooling fronts? Larger diameter columns often form more slowly in the lower parts of flows than more rapidly cooled smaller diameter columns in the upper part. Perhaps the partly formed larger columns were invaded by the more rapidly cooling columns advancing downwards from above? We have been unable to find a description of anything similar on the web but surely this phenomenon must be present elsewhere and would have been documented. Please contact us if you know of anything similar or have a plausible hypothesis for its formation.

Acknowledgment

We thank Vince Neall and Graham Leonard for their helpful comments on the manuscript.

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VIEWABLE BIVALVE EVIDENCE FOR UPLIFT DURING 1931 HAWKES BAY EARTHQUAKE

Bruce W. Hayward

When showing visitors around Napier, the most tangible remaining evidence of the devastating Hawkes Bay Earthquake in 1931 is the flat low-lying land that was the tidal flats of Ahuriri Lagoon prior to the earthquake uplift (Fig. 1). This is best viewed from Hospital Terrace on the west end of Scinde Island where visitors can be shown an old photo of the lagoon prior to the earthquake uplift to compare with today (Figs 2–3). During the recent (November 2024) Geoclub field trip to Hawkes Bay, that is exactly what we did. After that, however, we descended to the northern side of the entrance to the remnant Ahuriri Lagoon, to a site I discovered in 2004 while studying the pre-1931 earthquake history of the lagoon by coring the lagoon sediment (e.g. Hayward *et al.* 2016).

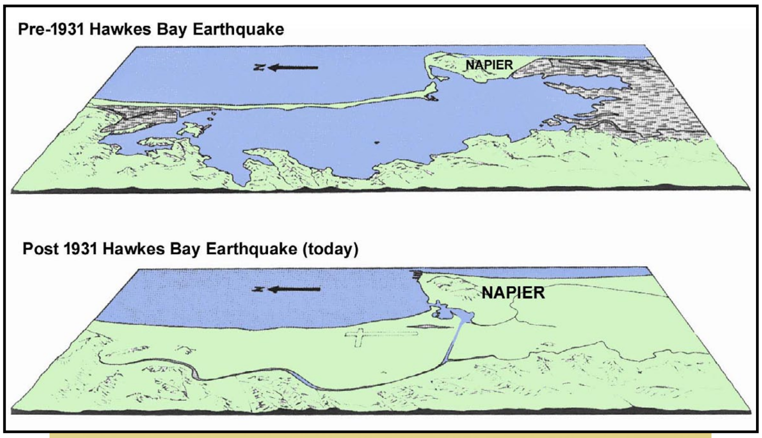

Fig. 1. Sketches of how Ahuriri Lagoon was changed by the uplift during the 1931 Hawke's Bay Earthquake. Modified from Cox & Hayward (1999).

Fig. 2. Historic photograph over the entrance to Ahuriri Lagoon prior to its uplift in the 1931 Hawke's Bay Earthquake. Photo taken from northwestern slopes of Scinde Island.

Fig. 3. Panoramic photo from the northwestern end of Scinde Island (Hospital Terrace) taken in 2021, showing the same view as in figure 2 but after the earthquake uplift.

Uplifted subtidal bed of the oblong venus clam, *Ruditapes largillierti*

A bed of in-situ conjoined shells of *Ruditapes* occurs along the eroding edge of the high tide saltwort (*Sarcocornia australis*) marsh on the north side of the wide entry to modern Ahuriri Lagoon (Fig. 4), only 2–10 m from the public board walk across the marsh from Meeanee Quay to the railway line walkway (Fig. 5). The exposed bed

Fig. 4. Modern satellite view of the entrance to Ahuriri Lagoon with the site of the uplifted *Ruditapes* bed shown with a yellow cross.

Fig. 5. The eroding bed of in-situ *Ruditapes* is exposed in the low eroding edge of the saltwort marsh close to the wooden walkway alongside the tidal entrance to Ahuriri Lagoon.

Fig. 6. The in-situ *Ruditapes* are in life position oriented with their long axes vertical while buried in the sediment on the sea floor.

Fig. 7. Sometimes in-situ shells are rather well-spaced out.

Fig. 8. In places the uplifted bed of in-situ *Ruditapes* is quite dense.

is no more than 100 m walk from parking alongside Meeanee Quay. The in-situ shells are oriented upright with their long axes vertical as they are when living (Fig. 6). Sometimes there are only 3–5 in-situ shells per linear metre along the eroding low bank (Fig. 7) but often they are moderately dense (Fig. 8). As well as the in-situ, vertically oriented, conjoined shells, there are many single valves eroding out of the deposit. Occasionally also present are in-situ, vertically oriented, coarse-ribbed dosina clam, *Dosina mactracea* (Fig. 9). The shells are held in place by the muddy fine pebble gravel (Figs 6–9), which would have been the substrate they were living in when the earthquake struck.

Both *Ruditapes largillierti* and *Dosina mactracea* live today at or below mean spring low tide level and sometimes form dense living shell beds in strong current-swept locations such as in the shallow (0–10 m depth) entrance channel to a harbour (e.g. Whangateau Harbour, near Warkworth, northern Auckland - Gribben *et al*. 2001, Morley 2004). Here at Ahuriri, the dead, oblong, venus clam bed sits at ~MHW level but must have been at low tide or lower when living prior to the 1931 earthquake uplift. The amount of uplift at this site was surveyed by using the railway line as a benchmark (Hull 1990) and was 1.5–2 m (Fig. 10). The tidal range at Napier is 1–1.9 m, average 1.5 m. Thus, the bivalve bed was living at about 0–0.5 m below MLWS prior to uplift.

Here at the mouth of the present Ahuriri Lagoon is the only place I know where you can actually see tangible evidence of the amount of uplift that occurred in 1931 in the form of a subtidal shell bed that died soon after it was uplifted up to high tide level.

Fig. 9. In-situ dead shell of *Dosina mactracea* that is inferred to have been living when uplifted during the 1931 Hawkes Bay Earthquake.

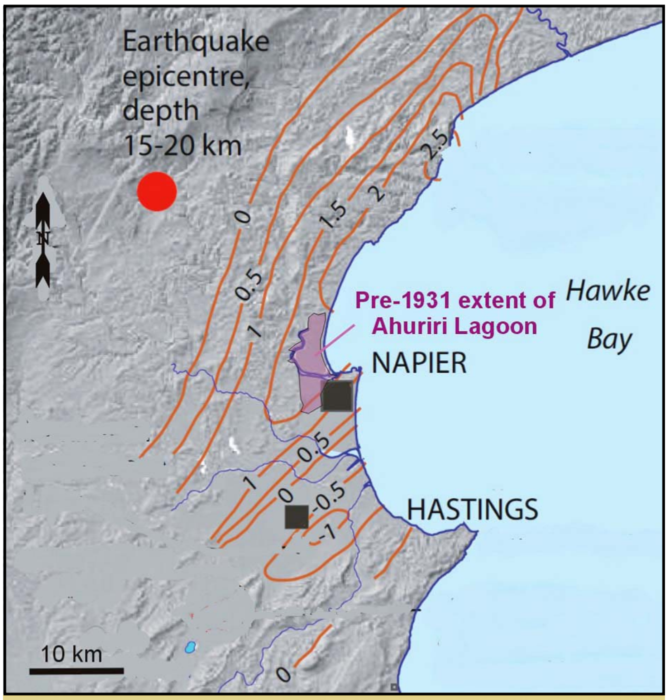

Fig. 10. Map showing uplift and subsidence contours (in 0.5 m intervals) of vertical displacement of the land that occurred during the 1931 Hawkes Bay Earthquake. Modified from Ballance (2017).

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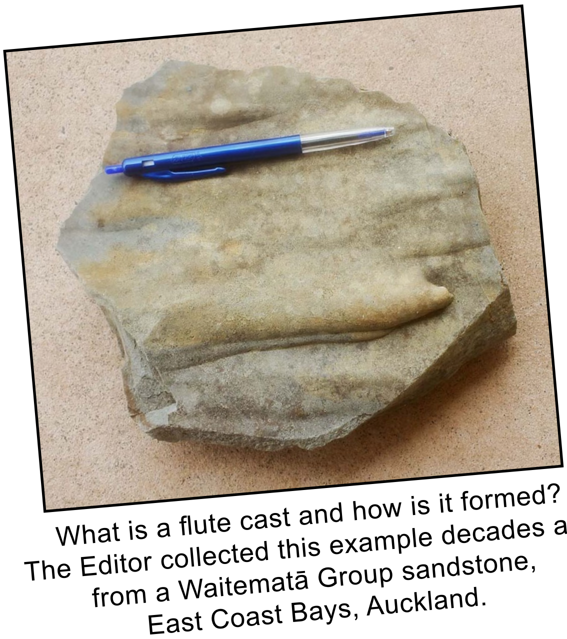
Task from the Editor



What is a flute cast and how is it formed?
The Editor collected this example decades ago
from a Waitematā Group sandstone,
East Coast Bays, Auckland.

LAVA LAKE IN WAITOMOKIA CRATER, MĀNGERE, AUCKLAND

Bruce W. Hayward

Introduction

Waitomokia Volcano is a large maar crater in the South Auckland suburb of Māngere (Fig. 1). It is surrounded by a 20-m-high tuff ring and had three small scoria or spatter cones in the centre, but these have been removed by quarrying (Hayward 2019). Last year, Foote *et al.* (2023) published a paper reconstructing the volcanic history of the volcano, recognising ten or so volcanic landforms (craters and scoria cones) created in different areas of the maar at about the same time.

No lava flows were recorded by earlier geologists (e.g. Hochstetter 1864, Firth 1930, Searle 1959). Foote *et al*. (2023) did note, however, rare "blocks of lava with rubbly and ropy surfaces" (Fig. 2) that "have been excavated and repurposed for decorative uses and marking road boundaries for Wedding's Quarry". Foote *et al*. suggest that "the limited size and thickness of the lava found at Waitomokia suggests any lava flow deposits were thin and limited in flow length".

Geophysical surveys by Cassidy *et al*. (2007) recorded a subsurface magnetic anomaly beneath Waitomokia. They inferred this to be caused by a body of dense solidified basalt up to 150 m thick extending beneath at least the central half of the crater. Both Cassidy *et al*. (2007) and Foote *et al*. (2023) envisaged this to be a result of magma ponded inside the conical neck of the volcano beneath the scoria cones (Fig. 3).

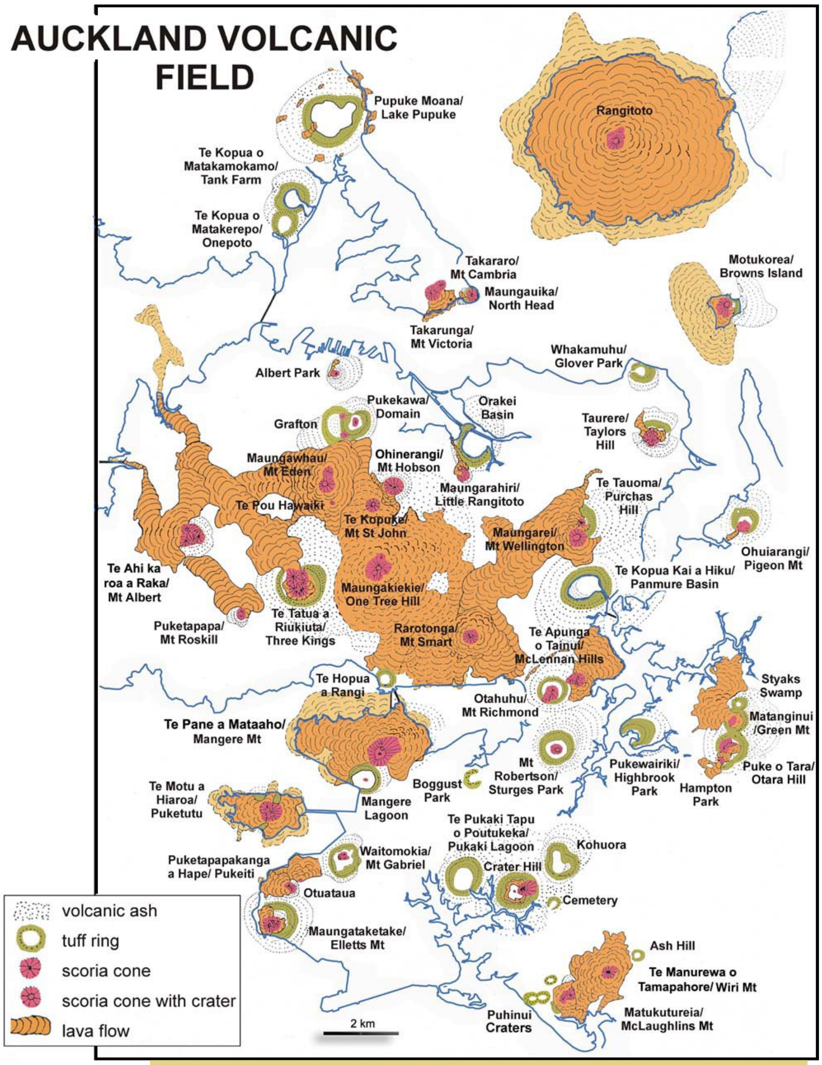


Fig. 1. Auckland volcanic field with volcanoes named (Hayward 2019).

Fig. 2. Large block of rubbly basalt lava that has been excavated from around the base of the quarried away scoria cones at Waitomokia.

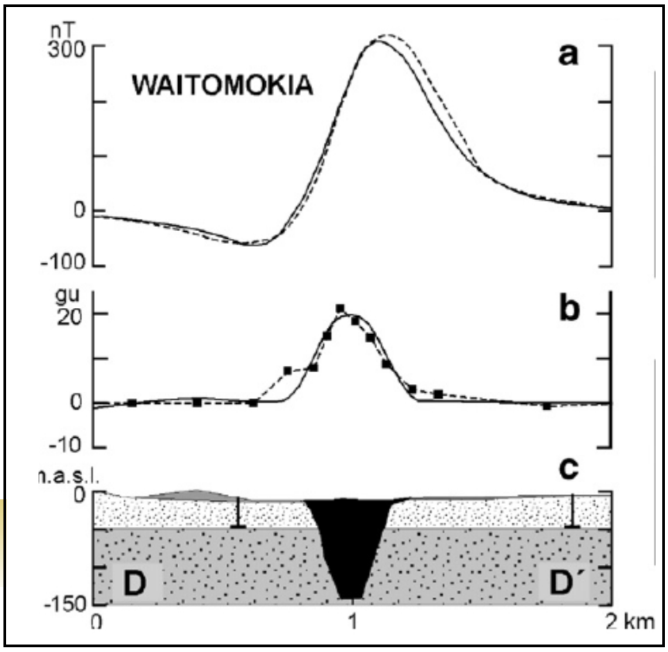


Fig. 3. Gravity (upper) and aeromagnetic (middle) anomaly values along a transect across Waitomokia. The lower section shows the modelled size and shape of dense basalt (black) within the Waitomokia crater (from Cassidy *et al*., 2007).

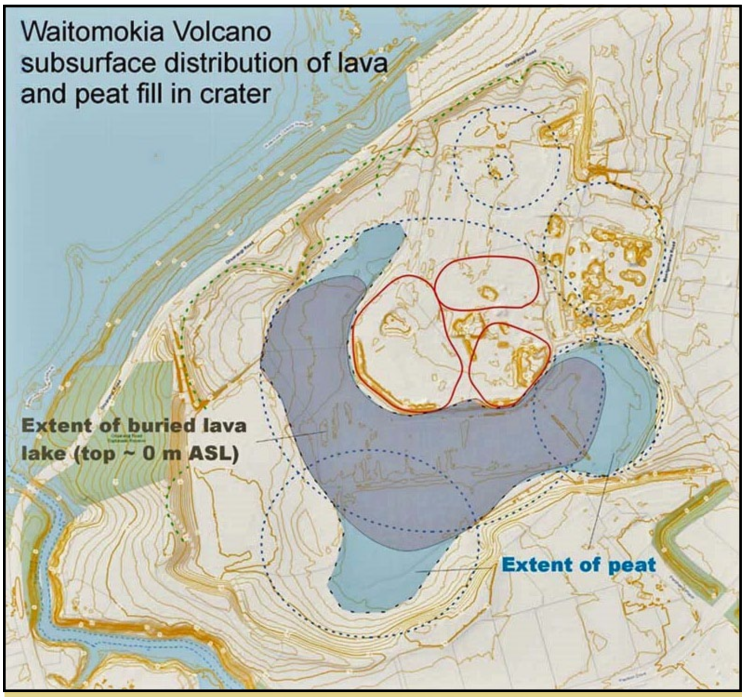


Fig. 4. Map showing distribution of subsurface lava lake (grey) in Waitomokia Crater, based on borehole results (from Hayward 2022).

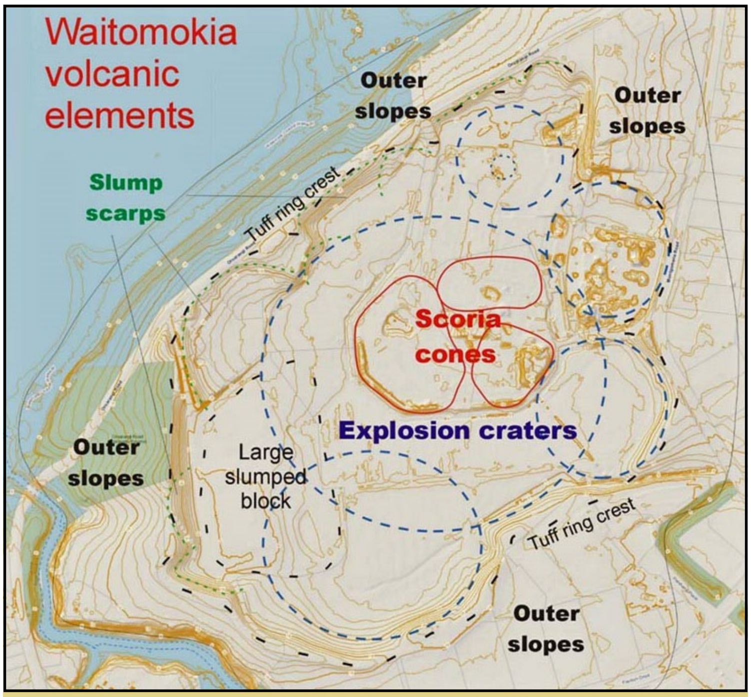


Fig. 5. Contour map of Waitomokia Volcano showing inferred locations of craters (dashed blue), scoria cones (red lines), tuff ring crest and large slumped block (dashed black) (from Hayward, 2022).

Lava lake

I re-interpreted (Hayward *et al*. 2011b, Hayward 2019) the dense body of magma as "a solidified lava lake (ponded lava flows) that exuded up into the crater with associated fiery explosive eruptions above the vents, throwing out ragged scoriaceous lumps of magma that built the cones on top of the lava lake's solidified crust" (Hayward 2019, p. 266). I postulated that after cessation of eruptions, the crater (and lava lake) partly filled with water to become a swamp, which accumulated peat that buried the underlying basalt lava surrounding the central cones.

In the absence of publicly-available deep borehole data it was impossible to determine which hypothesis for the source of the magnetic body of rock was correct. In preparation for planning an industrial subdivision inside the southern half of Waitomokia, a number of drillholes were bored in 2019–2020. The detail of these has not been made publicly available but a summary of the results has been released (Auckland City Council Plan Change 105 Appendix 11 – Geoheritage Report) in a map (Fig. 4) that I produced based on borehole results (Hayward 2022).

The boreholes show that at least the southern half of the maar crater is filled with basalt lava surrounding (and possibly underlying) the scoria cones. The surface of this lava is approximately at present mean sea level and has an average thickness of ~6 m of peat and silt over it. In the deepest borehole, the lava was 12 m+ thick with the bottom not reached. As well as being in the main crater, the lava lake appears to have half filled (by area) two smaller maar craters inside and overlapping with the southern half of the main Waitomokia crater (Fig. 5).

The inside of the southwestern part of the main crater had a steep arcuate scarp in the tuff ring, which appears to be the scarp around the head of a large slump of tuff ring material that slid back into the crater before the lava lake was formed, as basalt lava was not encountered here in

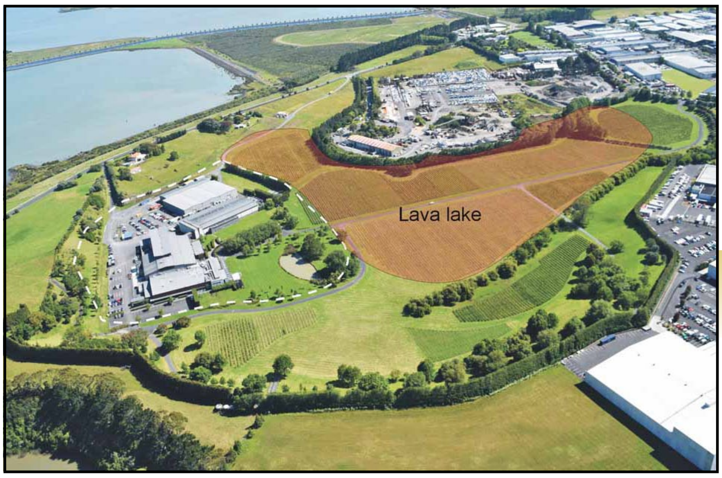


Fig. 6. 2018 aerial view northwards over Waitomokia crater showing extent of lava lake (orange shaded) and large slump block (dashed white outline).

boreholes. This inferred tuff ring slump is now the site of the former Villa Maria winery buildings, mostly slightly higher than the peat floor of the rest of the southern part of Waitomokia crater (Figs 5, 6).

Based on topography, both Foote *et al*. (2023) and Hayward (2022) identified 4–5 smaller explosion craters located around the south, east and north sides of the larger central maar crater (Fig. 5), with Foote *et al*. (2023) inferring an order of eruption interspersed with the scoria cone production.

Although uncommon, lava lakes are now recognised to be present within at least six of Auckland's maar craters – Crater Hill (Firth 1930), Waitomokia, Grafton (Hayward *et al.* 2011a), Pukewairiki (Cassidy *et al*. 2007), Auckland Domain (Cassidy *et al*. 2007) and Three Kings (Hayward and Kenny 2009). In the first four, the lava lakes were contained within the maar, but in the latter two the lava lake burst out over a low portion of the tuff ring as a flow.

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PLIOCENE FOSSIL FAUNA OF ST LUKE'S ANGLICAN CHURCH, PAKIPAKI, HAWKES BAY

Bruce W. Hayward, Glenys Stace and Eric Scott

Introduction

In November 2024, an Auckland Geology Club field trip made a stop at the Anglican Church in Pakipaki, Hawkes Bay (Fig. 1). While there, we all circumnavigated the outside of the church, marvelling at and identifying the rich molluscan fossils displayed in the building stones it is made from. The church was completed in 1923. It is made of local Pliocene limestone with red brick facings and terracotta roof (Fig. 2). Historical documents suggest it was made from "a mix of Pakipaki and Napier limestone", which suggests some blocks could be from the Pleistocene Scinde Island limestone as well (https://nzhistory.govt.nz/memorial/st-lukes-anglican-church-memorial-pakipaki).

The majority of the building stones (of irregular shapes up to 60 cm across) contain recognisable moulds and casts of mollusc fossils (Fig. 3). In most instances the shell has dissolved away but the moulds and casts are usually identifiable. This is one of the best places in Hawkes Bay to see a suite of identifiable mollusc fossils in fresh limestone faces. Pakipaki Anglican Church is the only building BWH is aware of that has been made from the local Pliocene and Pleistocene limestones in Hawkes Bay or, for that matter, in New Zealand (Hayward 1987).

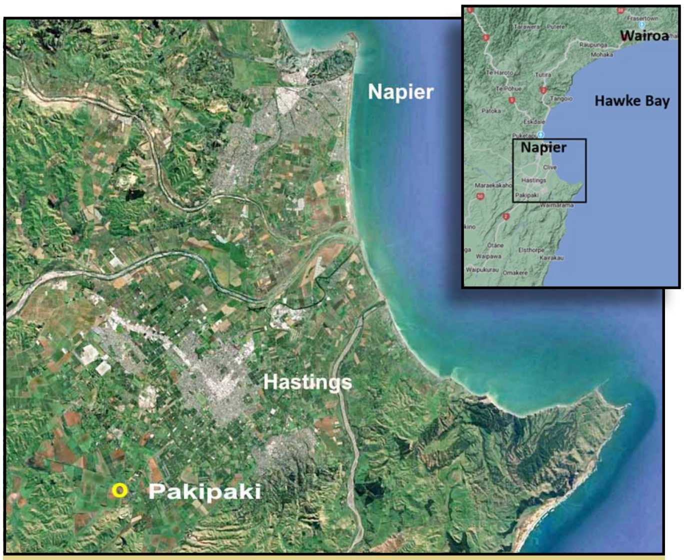

Fig. 1. Location of Pakipaki church, Hawke's Bay.

Fig. 2. St Luke's Anglican Church, Pakipaki, photographed in 1987, is made of local limestone, red brick facings and terracotta roof.

Fossil fauna

Several different fossil faunal associations are recognisable and recur in different blocks. One association is dominated by several species of trough shells (Mactridae) such as *Spisula* and *Eumarcia* (Figs 3–5). Sometimes occurring

Fig. 3. The limestone blocks that were used for the church are of variable shape and size with many containing rich Pliocene mollusc fossil moulds and casts. The block on the left is dominated by trough shells (Mactridae) such as *Eumarcia*.

Fig. 4. Casts of the surf trough shell, *Eumarcia ?plana* (bottom left), and probably *Paphies* cf. *subtriangulata* (top centre).

with these are the smaller morning star shell *Tawera*, small dog cockle *Glycymeris modesta* (Fig. 6), rare tuatua, *Paphies ?subtriangulata* (Fig. 4), long trough shell *Scalpomactra scalpellum* (Fig. 6) and scimitar shells *Zenatia acinaces* (Fig. 5).

In sandier horizons we could recognise several species of the scallop family (Pectinidae), plus several sunset shells, *Gari ?stangeri* and one ostrich shell *Struthiolaria vermis* (Figs 7–9). Another association seen in a number

Fig. 5. Casts of the trough shell, *Spisula* (bottom left), and scimitar shell, *Zenatia acinaces* (centre).

Fig. 6. Casts of small dog cockle, *Glycymeris modesta*, and long trough shell, *Scalpomactra scalpellum* (upper right), and sunset shell, ?*Gari stangeri* (lower right centre).

Fig. 7. A broken scallop shell in fine shelly sandstone, Pakipaki church.

Fig. 8. A broken ostrich shell snail, *Pelicaria vermis* (left centre), in shelly sandstone, Pakipaki church.

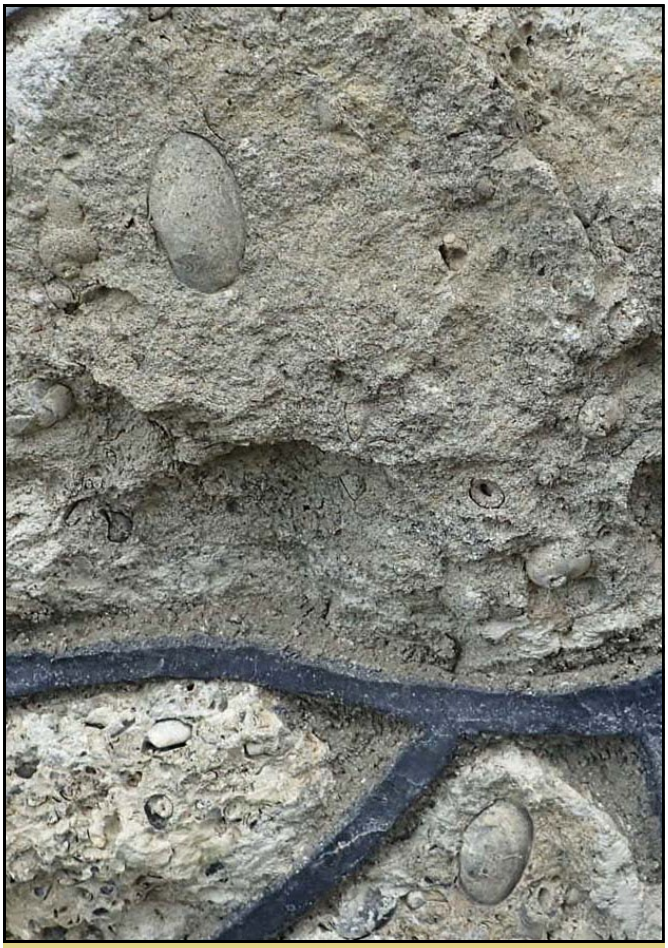

Fig. 9. Sunset shell casts (?*Gari stangeri*) in two adjacent blocks of shelly sandstone, Pakipaki church.

of the church blocks was dominated by the shallow sand-dwelling wheel shell, *Zethalia zelandica* (Figs 10–11). Sometimes associated with these were shells of the green-lipped mussel *Perna canaliculus* and even rock borers *Pholadidea* (Fig. 10).

All these fossils and their associations typically live in shallow, high energy environments at inner shelf depths (intertidal to 50 m depth) (e.g., Morley 2004) and have probably been mixed together by waves or bottom currents and accumulated on shallow shell banks, well offshore from land (e.g., Beu *et al*., 1980).

Fig. 10. Moulds and casts of the wheel shell *Zethalia zelandica*, cast of a rock borer, *Pholadidea* cf. *suteri* (bottom right), and mould of a large trough shell of the genus *Spisula* (top right), Pakipaki church.

Also present but not photographed were, slipper shells *Sigapatella novaezelandiae* and extinct *Maoricrypta radiata*.

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Fig. 11. Casts and moulds of small wheel shells, *Zethalia*, and a mussel (top centre), Pakipaki church.

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CORAL REEF PLATFORMS AT TANNA ISLAND, VANUATU, REVEAL LATE QUATERNARY HISTORY OF SEA LEVEL MAXIMA IN THE SOUTHWEST PACIFIC

Bruce W. Hayward

In 2016, my wife and I had a short holiday at White Grass Ocean Resort (19°26'27"S 169°13'22"E) on Tanna Island, Vanuatu (Fig. 1 insets). The main reason for being there was to witness the crater eruptions inside the world's most active volcano, Mt Yasur. At low tide in front of the resort (Fig. 1), I explored the coral reef flat and noticed there were three coral reef platforms. I immediately thought of coastal terraces around northern New Zealand, where we can often recognise three coastal terraces if one includes the modern wave-cut intertidal platform (e.g. Hayward & Morley 2014).

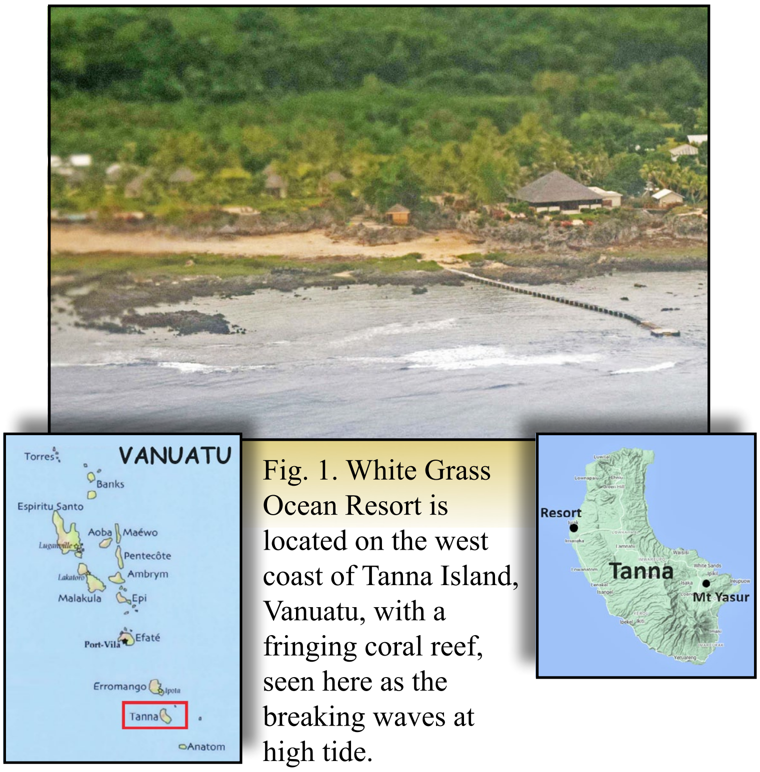

Fig. 1. White Grass Ocean Resort is located on the west coast of Tanna Island, Vanuatu, with a fringing coral reef, seen here as the breaking waves at high tide.

Fig. 2. Vertical google photo of the foreshore in front of White Grass Ocean Resort, Tanna Island at mid tide. The typical locations of the three coral reef platforms are labelled from youngest and lowest (1) to oldest and highest (3).

The coral reef platforms were from lowest to highest (Fig. 2):

1. Modern, living reef at an elevation of between low tide and mid tide, which is largely composed of ponded living coral microatolls (Fig. 3) that are live around the outsides but dead on top because they cannot live above this tidal elevation.
2. An eroding dead reef platform at the back of the modern one, partly surrounded by mangroves, at an elevation of ~ 1.5 m above the modern platform (Fig. 4). I infer that this has a mid-Holocene age of about 5000–3000 years, like the dated mid-Holocene high-stand terraces in northern New Zealand (e.g. Schofield 1960, Dougherty & Dickson 2012, Hayward 2023).

Fig. 3. View over the ponded modern coral platform with living circular microatolls of the coral *Porites*. Note the upper surfaces of each microatoll is dead because of tidal elevation limitations and the outsides are living (orange).

Fig. 4. At low tide, Glenys stands on the modern coral reef platform (1) with, behind her, the eroded 1.5 m high cliff around the seaward edge of coral reef platform (2) of inferred mid Holocene age.

3. An older terrace level exists at the top of eroding cliffs at an elevation of ~4 m above platform 2 and 5–6 m above the modern platform (Fig. 5). Rock exposures in the cliff clearly shows it to be underlain by a mix of reef debris and reef coral in situ (Fig. 6). I infer that this reef was formed during the Last Interglacial high stand (MIS5e), about 130,000–120,000 years ago.

Discussion

Instinctively, I had assumed that an island with an active volcano would have been tectonically active and to find these coral reef proxies for former sea levels so close to the modern was a surprise. Northern New Zealand is known to be tectonically stable at present and as we all know, has numerous low coastal terraces of mid-Holocene age (5000–3000 years) at 1–2 m above present sea level (e.g. summarised in Hayward 2017). To see almost precisely the same elevation above present for platform 2 at Tanna suggests similar tectonic stability there. The elevation of the highest coral platform at Tanna at 5–6 m is also coincident with the elevation of a number of coastal terraces and deposits of inferred Last Interglacial age around stable parts of northern North Island (e.g. Nicholl 2002, Hayward 2018).

The question now posed is: are these similarities in elevation between Vanuatu and northern New Zealand a coincidence or do they reflect a regional history of maximum sea-level elevations in the Last Interglacial and mid Holocene throughout the Southwest Pacific? A quick search of the literature on Google found that along the east coast of Australia, the northern end has been subsiding for at least the last 100,000 years and the southern end (Tasmania) has been rapidly rising (Bryant 1992). In the middle, in the vicinity of New South Wales and Victoria, the land is considered to be stable and has a record of a Holocene high stand at ~6000–4000 years of ~1–2 m above present and a Last Interglacial high stand of ~4–6 m above present (Bryant 1992, Goodwin *et al*. 2023), essentially the same as Tanna and northern New Zealand. There is some debate whether Fiji is tectonically stable or not, but I note that many of the islands have coral microatoll- and high-tide notch-based elevations of 1–2 m above present in the mid-Holocene, and an estimated 4.5–7 m elevation in the Last Interglacial (Nunn *et al.* 2002). A recent review of the Holocene sea level record from other islands in the central South Pacific also indicates a mid-Holocene high stand or stands of ~1–2 m above present, although more detailed research is necessary (Tan *et al*. 2023).

My Conclusion

The Tanna Island coral reef platforms (Fig. 7) provide an excellent proxy for sea level maxima in the Southwest Pacific in the Last Interglacial and mid Holocene and provide corroboration for similar levels known from the tectonically stable parts of northern New Zealand.

Fig. 5. Photo of the three coral platforms at different elevations, with the modern platform in the foreground, the dark eroding low cliff of the second (2) and the white eroding cliffs capped by the highest platform (3) above.

Fig. 6. Exposure of in-situ reef corals and debris in the eroding cliff beneath the highest coral reef platform (3) of inferred Last Interglacial age (130–120,00 years old) in front of White Grass Ocean resort.

Fig. 7. The three coral reef platforms in front of White Grass Ocean resort, Tanna Island, Vanuatu, appear to provide a reliable record of sea level maxima in the Southwest Pacific during the Last Interglacial (platform level with buildings) and mid-Holocene (grass-covered above dark eroding cliff) with respect to modern sea level (foreground microatoll lagoon).

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Any geologists or beachcombers out there know what this is, or should I just accept that as it's 2024, of course rocks have grown teeth, and move on?

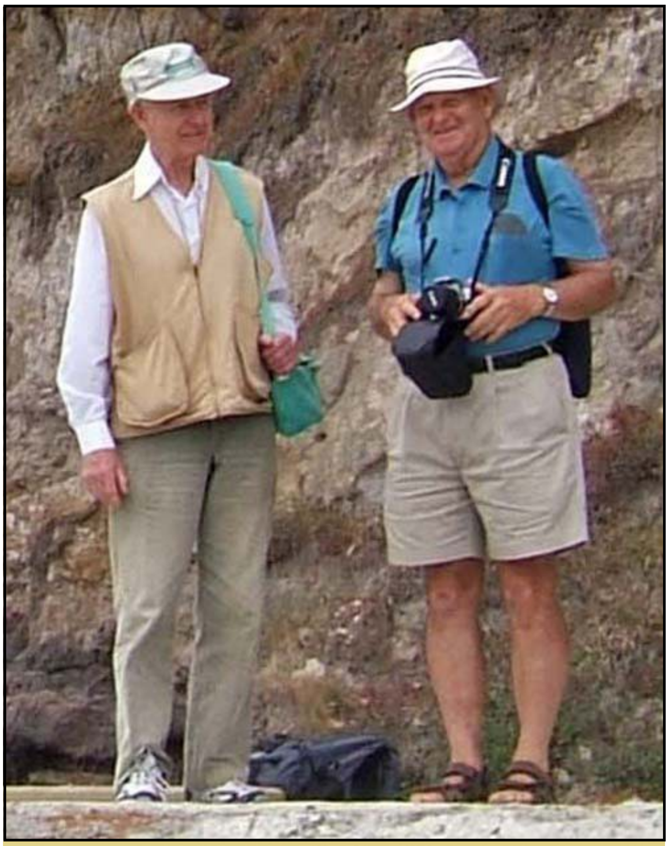
REMEMBERING MORE FORMER GEOCLUBBERS

Bruce W. Hayward

Keith and Colleen Eyre, Geoclubbers 1993–2012, seen here lunching at New Chums Beach, Coromandel Peninsula in 1998. Attended numerous one day and multiday trips with searching questions for trip leaders.

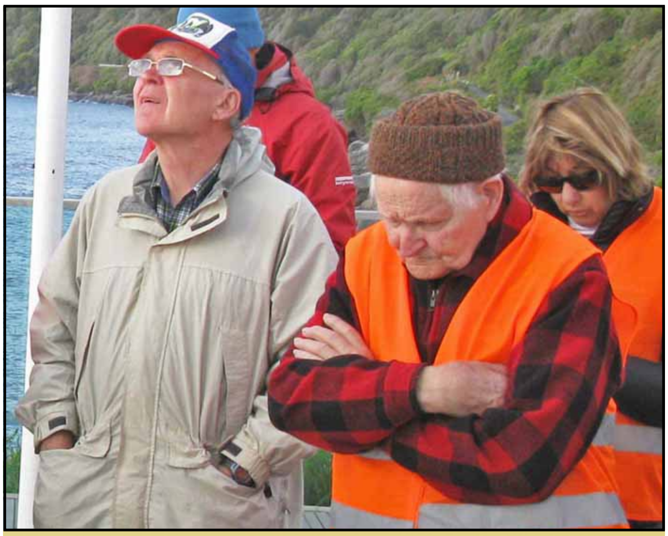
Colleen Eyre, Coromandel Field trip, 1998.

Keith Eyre at Mangere Lagoon in 2005.



Keith Eyre and Warren Spence at St Kentigern cliffs, Tamaki Estuary, 2007.

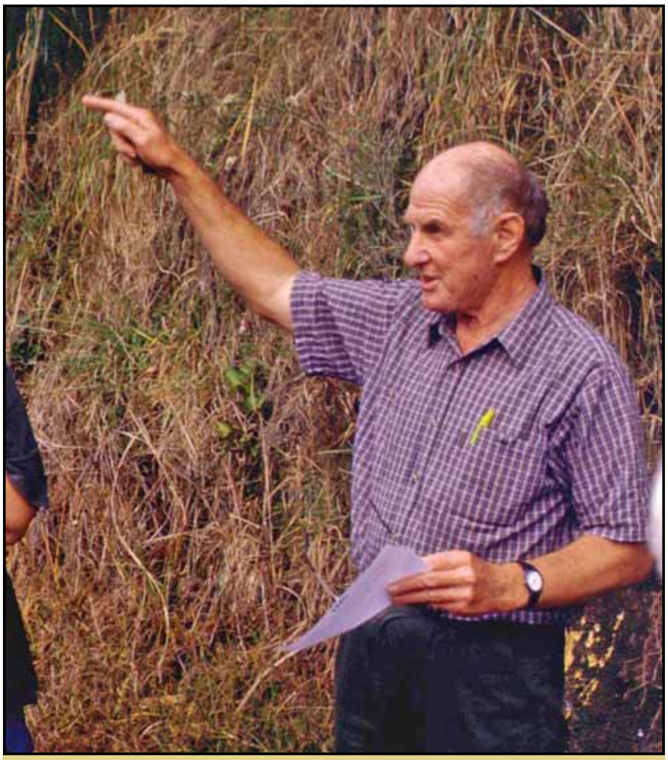
Peter Stewart was a larger-than-life Scotsman who was an active member of Geoclub, 2003–2015. Photo at Butchers Dam, Central Otago, 2009.



Peter Stewart (centre) with Peter Scott and Liz Hoskin at Stirling Pt, Bluff, 2012.

Cherry Gordon lunching at the back of Patarau Beach, west coast of Northwest Nelson, 2007. Cherry was a Palmerston North-based Geoclub member who came on many of our longer trips, 2007–2019.

Cherry Gordon in Oparara Caves, 2008.



Bill Wingate, a farmer in Opotiki, came on many of the longer Geoclub trips while a member of the club in the 1990–2000s. Here Bill is explaining the local tephrostratigraphy near Whakatane, 2002. Bill was a brother of long-time Geoclub member George Wingate.

Bill Wingate (white shirt) with Peter Daymond-King, and Rhiannon Daymond-King and Kath Prickett behind, Bowentown, Bay of Plenty, 2005.

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