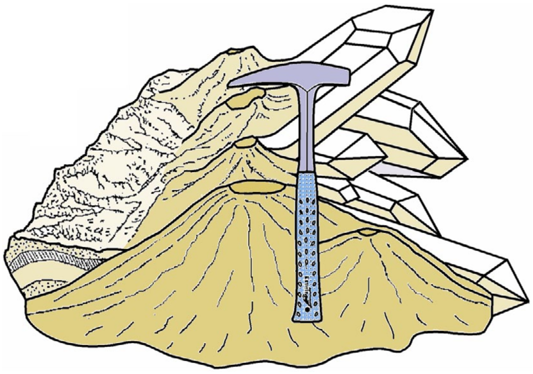

Geocene

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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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THE KAIMANAWA WALL – MAN-MADE OR NATURAL?

Bruce W. Hayward

In the mid-1990s, New Zealand archaeologist Barry Brailsford and American David Childress learned of an apparent man-made stone wall (Anonymous 1996b, Chapple 1996) in the depths of the Kaimanawa forest, east of Lake Taupō in the centre of the North Island. The apparent man-made wall had been recognised by 1990 or even earlier (Ritchie 1996). After their examination, Brailsford and Childress proclaimed the wall was undoubtedly man-made, probably by a pre-Polynesian culture (Waitaha), similar to that which left megalithic structures elsewhere in the Pacific and along the west coast of South America.

Later, many "conspiracy theorists" have claimed it was obviously built more than 2000 years ago by early Celtic, Egyptian or Greek colonisers. In 1996, detailed examinations by several experienced and respected archaeologists and geologists (e.g. Neville Ritchie, Peter Wood) declared that the wall was a natural exposure of ignimbrite with vertical and horizontal cooling joints giving the impression of giant man-made blocks. But even today, there are still many who visit the site and come away convinced the wall is man-made and very old (Ancient origins 2013, Mills 2016, OAP Adventures 2022, Universe inside you 2024, The Archived 2024).

In November 2024, a Geology Club trip (Figs 1–3) was passing through Taupō and decided to see for ourselves what all the fuss was about and assess the various claims:

Arguments that the wall is man-made

1. The wall "looks" man-made and therefore must be.
We could all agree that at first glance the "wall" does indeed have a resemblance to a man-made one. This is the strongest argument in support of the man-made hypothesis.

2. The visible stones in the initial exposure of the wall are all the same proportions (1.9 x 1.6 x 1 m).
Cooling joints (fractures) in ignimbrite commonly occur in parallel sets, parallel to the horizontal cooling fronts (from below and above) and perpendicular to them. Thus, having parallel fractures through an ignimbrite is not uncommon in nature. The six blocks initially visible are indeed approximately the same dimensions (not precisely – Ritchie 1996) but those subsequently exposed a few metres away to the left are not.

3. The contacts between the blocks are perfectly horizontal and vertical.
This may have appeared to be the case in the initial exposure of six blocks, but clearing to the left of these has exposed more blocks where the joins are neither perfectly horizontal nor vertical (e.g. Ritchie 1996).

Fig. 1. The Kaimanawa "wall" viewed from the roadside at the foot of the steeply rising spur.

4. The contacts between the blocks are "far too smooth and perfect to be made by nature".
I would suggest the exact opposite - that the match of surfaces on either side of the joins between blocks is far too perfect to be man-made. Detailed examination shows that the joins are not perfectly smooth but small irregularities along them are mirrored on each side so that the fit is perfect (e.g. Ritchie 1996) – exactly as one would expect in a natural fracture through a rock.

5. There are rocks higher up the hill above that suggest the wall is part of a much larger structure, such as a pyramid.
The "wall" is at the base of a steeply sloping spur in excess of 20 m high. Probing and test pits have recorded at least 1 m of humus and weathered ash over the hard ignimbrite beneath. It is almost impossible to envisage any possible man-made structure being buried beneath this spur, which does not resemble a giant buried pyramid.

Fig. 2. Geoclubbers discuss features of the initial exposure of the Kaimanawa "wall".

6. A hunter has reported a similar wall back in the bush (The Great Golding Adventures 2019), which indicates that this "wall" may be just one of many in this area.
Geologists and others should go out into the ignimbrite country of central New Zealand and accumulate photographic evidence of many more examples of the cross-cutting horizontal and vertical cooling joints. I am sure they are there, but I am now getting too old to look for them.

7. A sample of the blocks was sent away and analysed in Auckland and came back as rhyolite in composition. The geologists' maps show this whole area to be made of ignimbrite with the nearest rhyolite tens of kilometres away. Undoubted proof the blocks were brought to this locality from far away (Turehu 2017).
If ignimbrite is analysed, it will have a rhyolite composition because it is gas-rich rhyolite lava that was erupted as a pyroclastic flow. The rhyolite on the map was gas-poor rhyolite that was intruded and extruded forming dense rhyolite domes.

8. The wall is perfectly aligned east–west and this makes it significant. *Accurate measurements show it to be 3–8° off truly east–west (Ritchie 1996) and its orientation is likely purely coincidental*.

9. In 2024, a Celtic cross was discovered carved in ignimbrite rock several metres above and to the left of the initial "wall" exposure.
Examination of the fresh-looking carved cross by archaeologists strongly suggests it was made some time after the controversy erupted in 1996 by someone trying to prove the man-made origin of the "wall" (Hutchinson 2024).

10. There are buried "blocks" beneath the ground surface in front of the "wall" that were detected in 2019 by ground penetrating radar, some of which have been exposed in the past few years by unauthorised excavation (Turehu 2019, McIvor 2023).
In nature, the eroding ignimbrite hillside would be expected to extend out beyond the wall. The exposed flat face of the "wall" suggests that some blocks may have been removed from in front of it (roadside) for use by Clements Sawmill, that constructed the road in the mid-20th century.

11. The wall is the only stone to be seen while driving 20–30 km to the site, indicating it has been brought in from afar (Universe inside you 2024).
The whole region is underlain by flat-lying 300,000 year-old ignimbrite mantled by thick deposits of later volcanic ash and humus that accumulated beneath the forests when they grew here. The roads mostly run across the top of the flattish surface and in only a few stream courses has erosion cut down to expose hard fresh ignimbrite rock. The "wall" itself quite likely is not a natural exposure but was probably exposed when the logging operation removed a few blocks from in front of it, which they had exposed when road making.

Fig. 3. A closer view of the initial Kaimanawa "wall" exposure, 2024. Some joints have opened up, possibly as a result of shaking during earthquakes.

12. The nearest outcrop of ignimbrite is at least 6 km away, so these blocks must have been brought in.
As the illicit excavations have shown, the nearest fresh ignimbrite is only 1–2 m beneath the wall and also the tops of blocks exposed on the hillside above.

13. The upper edge of the blocks are bevelled back towards the hillside. In the original face, only the upper blocks are bevelled. This indicates the blocks are part of a pyramid.
The angle of the bevel approximates the slope of the hillside and is likely why the hard ignimbrite beneath the ash and humus has weathered to this angle, producing the "bevels". The presence of the bevel only on the top row of blocks in the initial face provides further support for the suggestion that blocks have been removed by the sawmill operations in front of the "wall".

Questions not answered by the man-made proponents

1. Why was this structure located here in the depths of what would have been dense forest in the middle of the North Island, well away from the coast or major waterways or lakes?
This is indeed an unanswerable mystery that does not favour the man-made hypothesis, unless it was built here because it is beside a road. The logging road is no more than 100 years old and it is because "the wall" is beside the road that it was "found", of course.

2. Why are the blocks all aligned one on top of each other (i.e. vertical joins run through the rows) and not offset as is normal for much greater strength in a wall?
Not mentioned by protagonists of the man-made hypothesis.

3. Why does the surface texture on the face of the wall pass horizontally from one block to the other, indicating that the whole face is made from a single rock unit and not blocks brought in from different parts of a rock unit? (e.g. Ritchie 1996).
Not acknowledged by protagonists of the man-made hypothesis.

Conclusion

I can do no better than repeat DoC archaeologist Neville Ritchie's (1996) conclusion following his and geologist Peter Wood's investigations: *"The conclusions of the Department of Conservation investigation into the "Kaimanawa Wall" are straightforward and unambiguous. The "wall", despite its remarkable symmetry at first glance, is a small part of a large ignimbrite outcrop created some 330,000 years ago. It is not a megalith. Neither the "wall" nor its parent outcrop appear to have been modified by human activity, but the possibility that some loose blocks have been removed from the front of the "wall section" (most likely in European times) cannot be totally ruled out. The "wall" is not a unique natural feature. Similar block-like jointing patterns are known to exist in other ignimbrite outcrops in the Kaimanawa-Taupō region."* I recommend you read his full report on-line.

Concluding observation

In his 2019 book "*Beyond the boundaries of time*", Barry Brailsford accepts that the Kaimanawa Wall is a natural feature and not man-made, but many others still like to dream. Brailsford (2019) writes *"Sense prevailed when a small, unofficial team of archaeologists and geologists turned up with sharp spades and settled the case after a day's illegal toil. I didn't initiate this endeavour but happened to be on site when it unfolded. And I've forgotten the names of those involved. They carefully dug a trench along the front of the wall that allowed them to track the face of the stone deep into the ground. Two metres down it merged with the bedrock. The huge blocks belonged where they stood and had not been shifted or shaped by humans."*

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MATAKOHE ISLAND, WHANGĀREI, 13 APRIL 2025 - SOME PERSONAL IMPRESSIONS

Bernhard Spörli

Fig. 1. South section, at the cement works ruins, with our trip leader, Bruce. Beds dip north.

Fig. 2. North section, beds dip south.

The rain stopped as the 'Waipapa' docked at the picturesque ruins of the cement works (Fig.1).

We came to one of the least disturbed sections of the Oligocene Mahurangi muddy limestone I have seen in the Northland Allochthon. The east side of the island clearly shows a gentle synclinal structure (Figs 1 & 2). Greensand clastic dikes on the NW side, such as those in Fig. 3, could either be sourced from the Eocene glauconitic Ruatangata Formation,

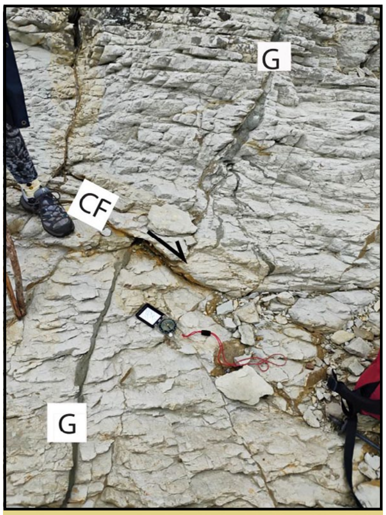

Fig. 3 Greensand dike (G) offset by calcite-veined fault(CF). Compass mirror points N.

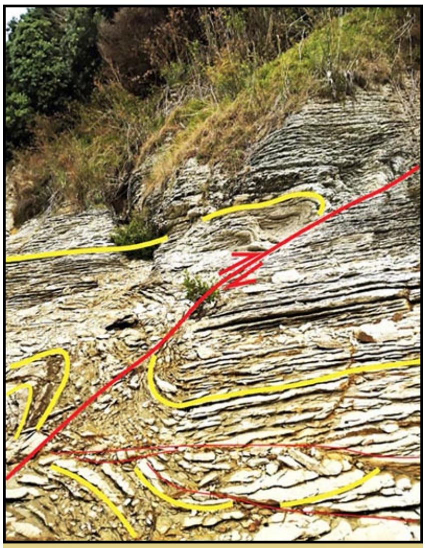

Fig. 4 Top-to-S thrust. Bedding = yellow, faults = red.

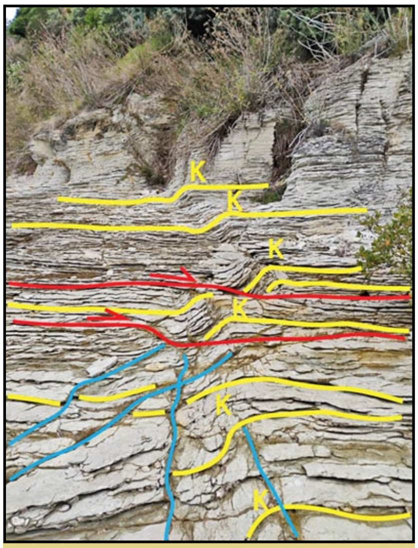

Fig. 5 A top-to-N kink fold (K) moved top-to-S along bedding faults (red). Blue: calcite veins.

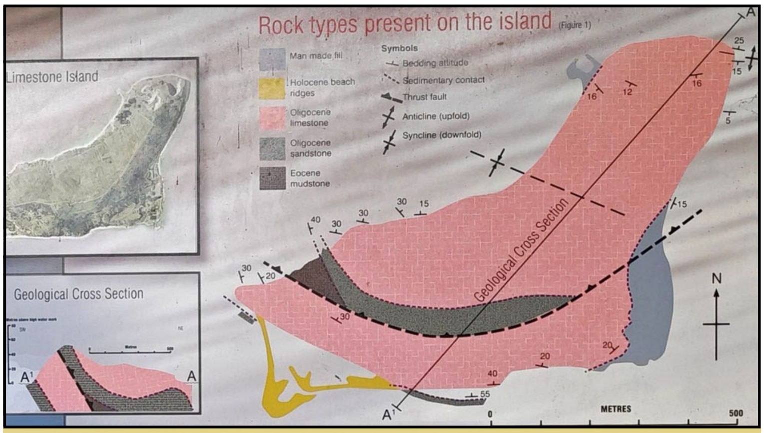

Fig. 6. Geological map and cross section by Fred Brook from the information shelter. Brown: Ruatangata Fm. Dk grey: Oligocene sandstone. Pink: Mahurangi limestone. Light grey+yellow: surface deposits.

which we saw underlying the Mahurangi deep-water limestone on the south side of the island, or (more likely) one of the glauconitic sandstone sections within the limestone. Further along the west side there are local structural complications in the limestone (Figs 4 & 5). Because it is more intensively deformed, the thrust in Fig. 4 must predate the gentle syncline shown in Figs 1 & 2. The shears at low angles to bedding associated with this thrust are probably equivalent to those offsetting the northward kink folds in Fig. 5, thus indicating that the kinks are older than the thrust. This thrust could be a manifestation of the structural repetition shown in the geological map and cross section by Fred Brook (Fig. 6), which is part of the impressive display in the shelter at the cement work site. His map also shows the syncline of Figs 1 & 2.

One member of our group spied a Kiwi at the top of the island. The rain started again as we cruised back to the Whangarei Town Basin.

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GEOLOGY OF AUCKLAND'S COAST TO COAST WALKWAY

Bruce W. Hayward

For a number of decades, Auckland Council has promoted and labelled a walking route across the Tāmaki Isthmus through urban streets and parks (Figs 1 & 2). It is also a section of the Te Araroa Trail that stretches from North Cape to Bluff. It is 16 km long and takes about 4.5 hours to walk, or can be undertaken in three separate parts. The various web sites that describe the route often mention the trees, birds and panoramic views en-route, but only minimal mention of the geology, e.g. "passes five volcanic sites". You can walk the route in either direction with a southern terminus on the Manukau Harbour and a northern terminus beside the Waitematā Harbour at the ferry steps in downtown Auckland. You can leave vehicles at either end or take trains, buses, ferries or ubers from one or other end, which is less of a hassle.

Here I provide numbered geological points (from north to south) along the way that might have geological interest. Page numbers given are from Hayward (2019) *Volcanoes of Auckland. A field guide*. Auckland University Press.

Leave edge of Waitematā Harbour.

1. The flat land of the downtown area was originally intertidal or shallow subtidal but has been reclaimed with fill since European colonisation.

2. Point Britomart was a Waitematā Sandstone point sticking out into the harbour before it was removed in

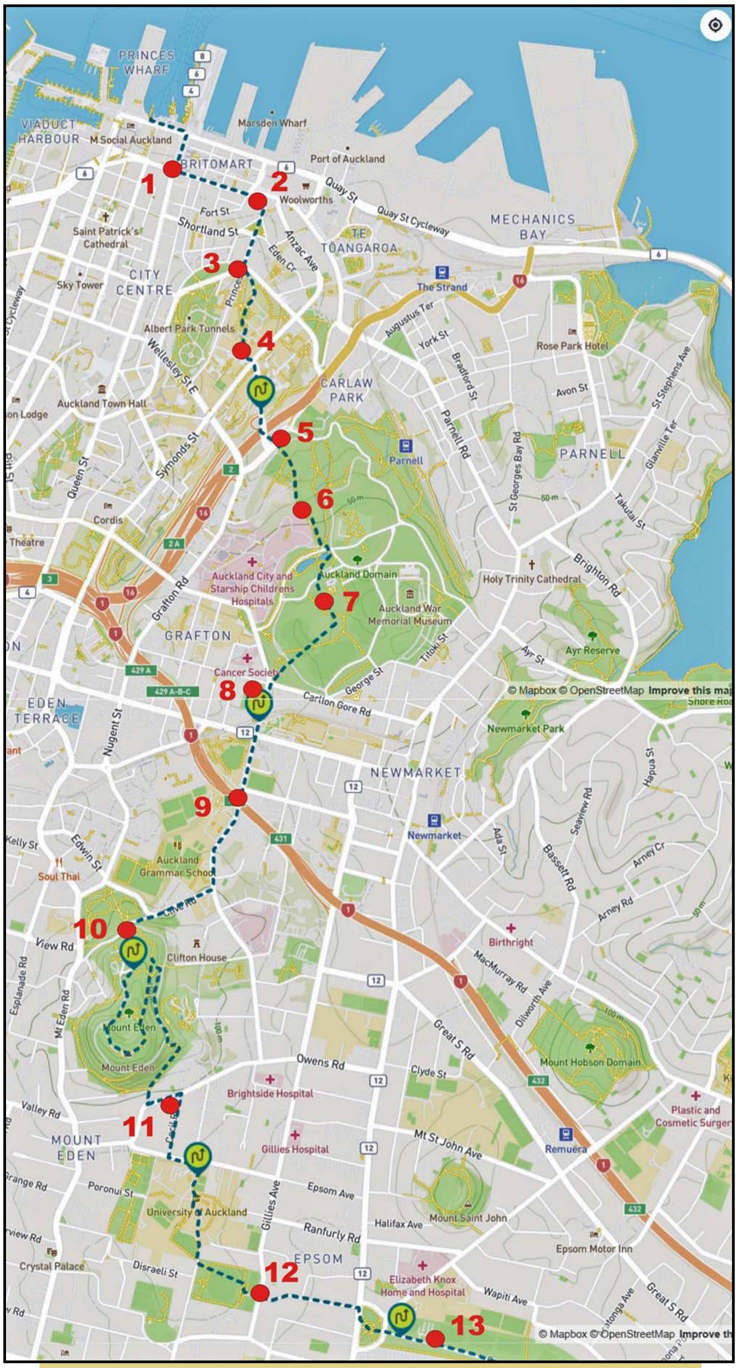

Fig. 1. Map of northern half of coast-to-coast walkway, Auckland (dashed blue line).
Numbered red points have geological interest.

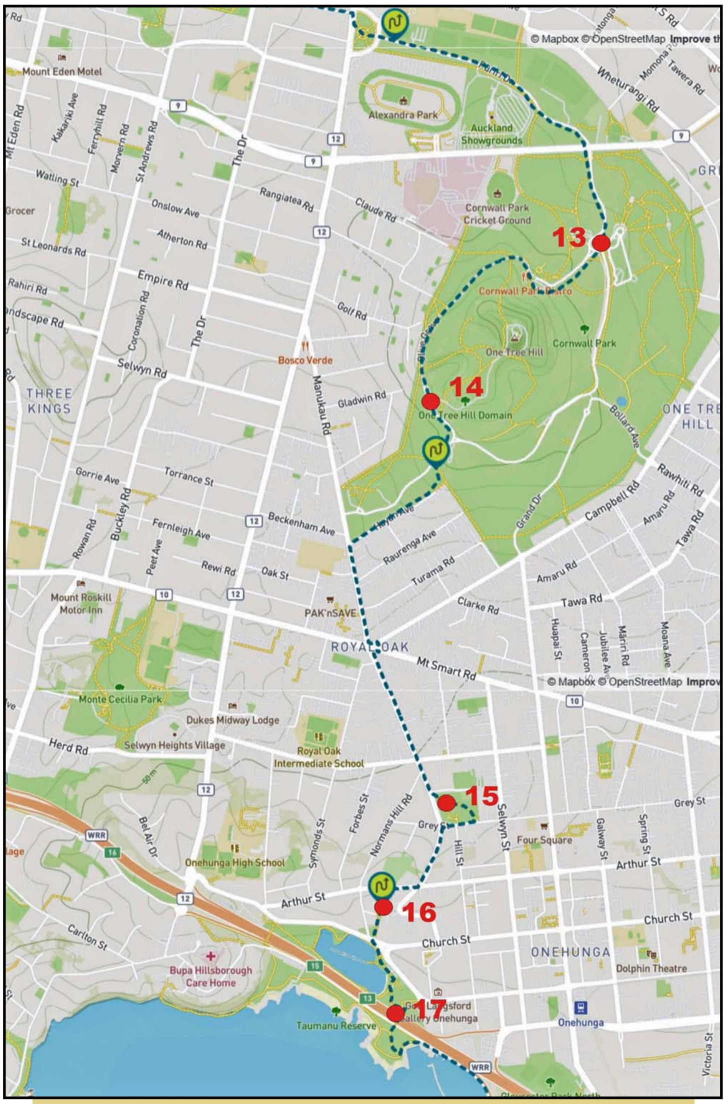

Fig. 2. Map of southern half of coast-to-coast walkway, Auckland (dashed blue line).
Numbered red points have geological interest.

the 1880s to create some of the reclaimed land. At the intersection of Customs St and Emily Pl, was formerly the beach at the foot of the rise up onto the sandstone hill now occupied by the University precinct.

3. A slight detour down Bowen Ave will take you to the site of small Albert Park Volcano, now completely quarried away and hidden beneath city buildings (p. 106–107).

4. In the University grounds, beside the library on Alfred St, is a section of the old barracks wall made of basalt blocks and constructed between 1846 and 1852 (Fig. 3). Source of basalt unknown – possibly Mt Eden lava flows.

Fig. 3. The walkway passes the remaining portion of the Albert Barracks' wall in the university grounds.

5. Junction of Grafton Rd and Stanley St. This area has been built up with much fill but was the beach in the 1840s. Several large spherical concretions on the grass verge come from Cretaceous sedimentary rocks of the Northland Allochthon that were excavated from the Whangaparāoa interchange.

6. Your first major climb takes you up the slopes of Auckland Domain tuff ring (p. 112–115). Pass by the duck ponds, part of the overflow of freshwater out of the underground reservoir that fills the voids in scoria and lava filling the large crater.

7. On the western slopes of the small scoria cone in the centre of the Domain crater, beneath the oaks, a 1 m long fusiform volcanic bomb of basalt can be seen protruding from the grass (Fig. 4).

8. Exit the Domain via the path leading to the junction of Park and Carlton Gore roads. Diagonally across the road is Outhwaite Park (Fig. 5), site of a small, levelled off scoria cone that erupted from Grafton Volcano (p. 108–111).

9. Across Khyber Pass, Mountain Rd climbs steeply up the front of some of the younger, more viscous and thick lava flows that form a pedestal right around Mt Eden. See some of the large basalt cooling columns alongside the Southern Motorway as you take the bridge across it. Note all the basalt stone walls and buildings made from the local rock in the vicinity of Auckland Grammar School.

10. Ascend Maungawhau/Mt Eden from Clive Rd, passing up along the route of the breach in the northern crater (p. 118–123), continue on up to the summit for panoramic views of many other volcanoes in the Auckland Volcanic Field.

11. Enter the old training college gates off Epsom Ave beside the three-storey car park building that has been built in the quarry where small Te Pou Hawaiki Volcano once stood (Fig. 6) (p. 116–117).

12. Pass through Melville Park, created out of rubbly Te Pou Hawaiki lava flow field and quarry pits in the 1930s

Fig. 4. This large fusiform volcanic bomb can be seen exposed on the side of the small scoria cone in the middle of Auckland Domain Volcano's crater.

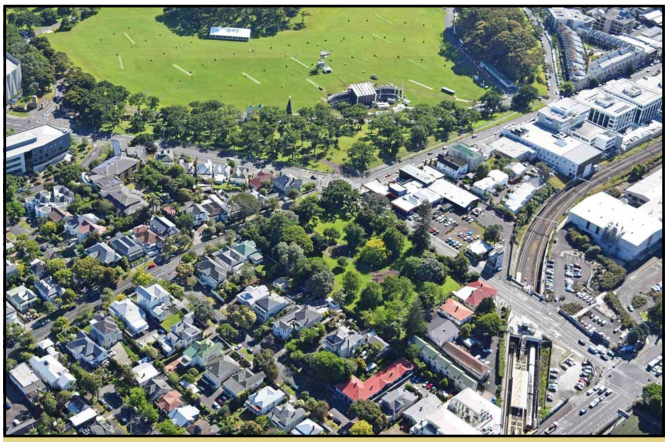

Fig. 5. The walkway passes from top left to bottom right though the west side of the Domain Volcano crater. In the centre foreground is Outhwaite Park, the flattened remains of a small scoria cone of Grafton Volcano (off to the left).

Fig. 6. The walkway passes through the gates of the former Teachers Training College on Epsom Ave (bottom right). The parking building (centre) fills the quarry hole on the site of Te Pou Hawaiki Volcano.

and past Epsom Community Centre in two old basalt houses in Gillies Ave (location of Geoclub's monthly meetings).

13. Enter Cornwall Park, walk the length of Puriri Dr, cross Greenlane Rd and pass the sunken garden in the middle of the roundabout (Fig. 7). Walk up to the Huia Lodge information centre along the crest of one of the youngest lava flows from One Tree Hill Volcano (p. 134–143). Throughout this area the ground is smooth because the uneven rubbly surfaces of the One Tree Hill lava flows have been buried by thick ash erupted from Three Kings Volcano.

Fig. 7. The walkway passes the sunken circular "road island" in Cornwall Park and up the road beyond, which runs along the crest of one of the youngest lava flows (towards obelisk) from Maungakiekie Volcano.

14. Feeling energetic, then take the detour up the road to the top of Maungakiekie/One Tree Hill for panoramic views, especially to the south. On the way, view the three fire-fountaining craters (two breached and one intact) from which fountains of frothy lava were ejected to build the maunga's scoria cone.

15. Walk down Manukau Rd and across to Jellicoe Park, all the way walking over smooth ash-covered lava flows from One Tree Hill. At Jellicoe Park there is a triple arch, presumably made from local One Tree Hill basalt. It was built in two phases to commemorate those who lost their lives in WW1 and later WW2. In 1859, Hochstetter inferred that Jellicoe Park hill was a volcano, but subsequent studies indicate it is not.

16. The descent from Jellicoe Park to the Manukau Harbour is down the slopes of a weathered Waitematā Sandstone hillside. On reaching Beachcroft Rd you are on the site of the former beach. Subsequent reclamation has shifted the coastline to the south side of the motorway amongst the tongues of basalt flows (from One Tree Hill) and basalt riprap walls.

17. Crossing Taumanu Bridge over the Southwestern Motorway, look east 500 m and you can make out the circular shape of Te Hōpua/Gloucester Park Volcano's maar crater and low tuff ring with the motorway passing through the middle (Fig. 8) (p. 162–165). Directly across the Māngere Arm of the harbour rises the large scoria cone of Māngere Mountain (p. 244–248).

You have made the Manukau Harbour terminus – congratulations.

Fig. 8. The Coast-to-Coast walkway finishes at the basalt flow-lined shoreline of the Manukau Harbour at Onehunga (centre). The circular park bisected by the motorway in the foreground is the maar crater of Te Hōpua Volcano.

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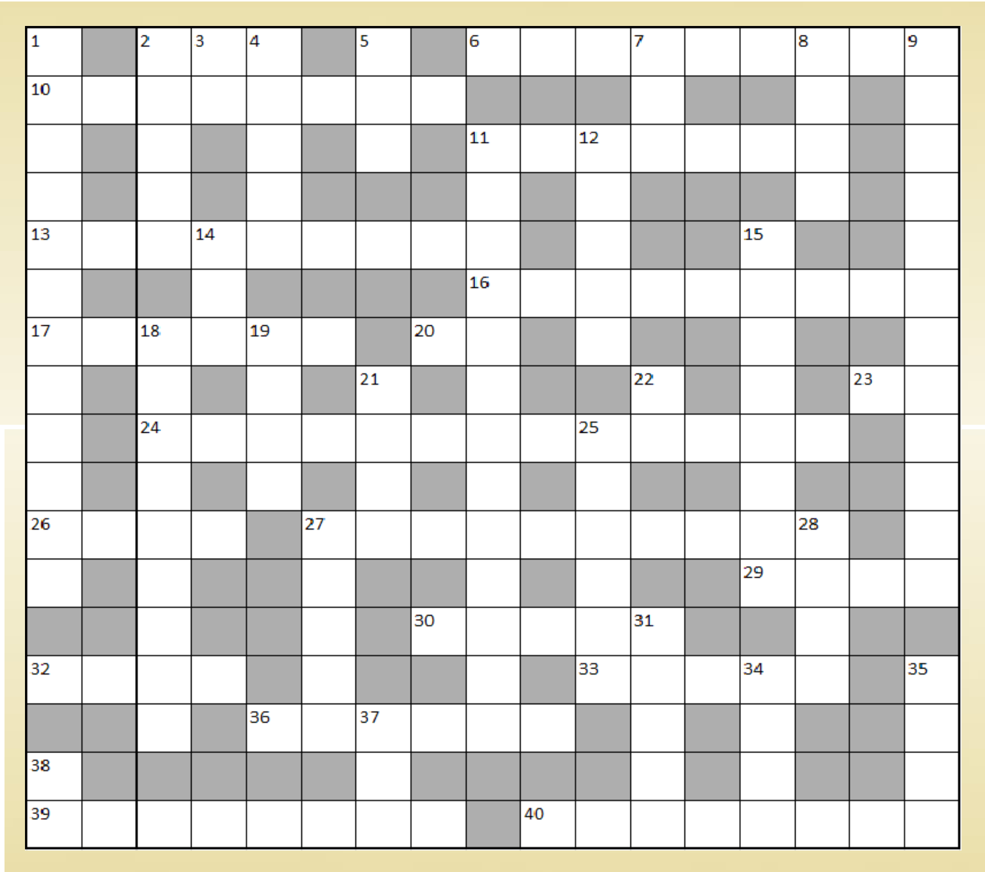
GEOLOGICAL CROSSWORD



ACROSS
2 This relic is not up Mt Ararat (3)
6 Main openings in mollusc shells (9)
10 Co-author of seminal paper in 1979 entitled "Northland Allochthon" (8)
11 An abundant New Zealand Triassic bivalve - a favourite of Jack Grant-Mackie (7)
13 A method discovered by Ernest Rutherford (9)
16 Alumuminosilicate mineral found in silica-poor igneous rocks (9)
17 Megalania (*Varanus priscus*) was a giant Pleistocene monitor what? (6)
20 Chemical symbol for iron (2)
23 Chemical symbol for arsenic (2)
24 Mechanically weak and ductile region of the upper mantle (13)
26 Country now occupying much of ancient Mesopotamia (4)
27 Looks like pencil drawing on slate (10)
29 Protected by safety glasses (4)
30 A noble gas (5)
32 A distinct sheetlike body of crystallised minerals within a rock (4)
33 Shape of fossil tiger's tooth (5)
36 Ignimbrite of such high temperature it forms rock (6)
39 A visitor from inner space (8)
40 In grain size analysis, anything larger than cobbles (8)

DOWN
1 Very deep seafloor (7, 5)
2 Fossilised blue-green _ _ _ _ _ mats are known as stromatolites (5)
3 Surveying term 'reduced level' for the vertical distance between a survey point and the adopted datum surface, such as sea level (abbrev.) (2)
4 Landscape shaped by the dissolution of soluble carbonate rocks (5)
5 The solid state of H2O (3)
7 7th letter of the Greek alphabet (3)
8 Reddish-brown hydrated ferric oxide (4)
9 Polished shear surfaces that show the direction of slip on a fault plane (12)
11 A region of space surrounding an astronomical object in which charged particles are affected by that object's magnetic field (13)
12 A large sheetlike body of rock (thrust sheet) that has been moved above a thrust fault from its original position (5)
14 Valley in Central Otago east of the Manuherikia Valley (3)
15 A mineral that represents the Mohs scale of hardness value of 4 (8)
18 The 8th continent (9)
19 The amount of sedimentation per length of time (4)
21 David was Director of the New Zealand Geological Survey from 1967 to 1974 (4)
22 Measure of acidity/alkalinity (2)
25 One of the Martian moons (6)
27 A deep vertical crack formed in limestone pavements due to the action of water (5)
28 Huge (usually dry) lake in South Australia (4)
31 Island nation famous for phosphate mining (5)
34 The outer finely crystalline layer of pillow lava resulting from the rapid cooling of the lava when it comes into contact with the cold seawater (4)
35 This loch is part of the Great Glen Fault bisecting Scotland (4)
37 Roman numeral for 61 (3)
38 A radioactive alkaline earth on the periodic table (2)

(Answers on last page) Return to contents page

A COAST OF MANY COLOURS – A VISIT TO PURERUA–MATAROA PENINSULA, NORTHERN BAY OF ISLANDS

Chris Booth, Amaru Booth, Seabourne Rust *

Mataroa (Purerua) Peninsula lies in the tribal boundaries of Ngāti Rehia in the west and Ngāti Torehina / Te Hikutu to the east. The boundary is defined by the Ngā Kiriparauri Stream, which runs roughly north to south starting at Te Waihapuku on the Pacific Ocean and exiting via the Opeti / Pokoura rivers into the Poukoura Inlet.

The peninsula is largely comprised of Waipapa Terrane basement rocks (Spörli 1978, Adams & Maas 2004, Hayward 2017) and younger basalts of the Kaikohe-Bay of Islands Volcanic Field (Edbrooke & Brook 2009). The area was mapped by Meshesha in the 1980s, who recognised both volcanic and sedimentary components to the Waipapa Terrane, including basaltic pillow lavas, Permian age (approximately 270–250-million-year-old) sediments - greywacke-sandstones, argillites, cherts and limestones (Meshesha & Black 1989). Also noted were distinctive mélange zones containing broken formation and mixed clasts of these lithics. Similar strata can be seen elsewhere in eastern Northland (e.g. Moore 1981).

As well as deep-sea deposited siliceous cherts and muds (argillites), the so-called "eastern" Waipapa sequences include spilitic basalts and alkalaic volcanics, suggesting a within-plate, oceanic paleo-Pacific source for these rocks (Adams & Maas 2004, Hayward 2017). Terrigenous sands and tuffaceous sediments in the "western" greywacke strata reflect input deriving from the coast of Gondwana.

During the subsequent process of accretion at the plate boundary, these Waipapa Terrane rocks have been altered by deep burial metamorphism to prehnite zone, and affected by deformation as evidenced by obvious jointing, folding, faulting and veination (including prehnite, chlorite, quartz and zeolites for example) (Black 1989, Adams & Maas 2004). The nature of the slicing and stacking of thrust-faulted sequences of Waipapa Terrane rocks has been noted elsewhere (see Spörli *et al*. 2022 for a nearby Purerua example).

In November 2023, landowners and the farm manager kindly allowed us access to the coastal section on the northern side of the peninsula, to the west of Te Waihapuku (Rocky) Bay. We scrambled down the steep slope above the site approximately a kilometre east of Moukawa Bay where, in the 1960s Joyce Booth, Chris' mother, had staked a claim for the occurrence of a multicoloured, varigated jasper rock (Fig. 1). The Booth family frequented the coast at this time for weekend outings and fossicking trips. Joyce wished to tumble polish some of the sea tumbled and rounded pebbles for selling in her craft shop, the Hui-Te-Rangiora, in Kerikeri.

Our descent led us into a narrow cove, flanked to the east by a steep headland of massive dark greywacke (Figs 2 & 3).

Fig. 1. Joyce Booth had staked a claim for the occurrence of a multicoloured, varigated jasper rock as shown in this sectioned cobble.

Figs 2 & 3. The narrow cove, flanked to the east by a steep, linear headland of dark greywacke. (Seabourne for scale in Fig. 3)

* *C and A Booth (Kerikeri), S Rust (Hokianga)*

The linear face of this suggested a steeply dipping (>50°) fault zone striking NW, which disappeared inland into an obscured and overgrown hillside to the south.

The west side of this small bay is a rocky exposure of broken formation, largely colourful red and green deformed argillite/mixed melange, containing blocks (5–50 cm) of limestone and other lithics (Figs 4 & 5).

In the small beach are water-worn, tumbled and rounded cobbles of brightly coloured (red-pink-yellowish) jasper and other lithologies, the jasper itself being sourced from larger yellow-pinkish blocks in the channel and immediate vicinity (Figs 6 & 7). Some of the jasper cobbles were ideal hammerstone size (10–20 cm across). Many more jasper blocks were exposed as the tide dropped. Most likely Permian silica-rich argillite or chert from within the original Waipapa Terrane sequence, we wondered if this jasper could represent the "kowhatu whero", a significant, very hard stone with red streaks mentioned by kaumatua Hugh Rihari as occurring on the peninsula. We are aware of only a few Northland archaeological references to the importance of red jasper (e.g. at Pouerua Pā, Pākaraka - Phillips & Green, p. 20 in Sutton 1993), but similar lithology probable hammerstones occur in local collections (Waitangi Museum).

Figs 4 & 5. Red and green deformed argillite/mixed mélange in the cove, containing blocks of pale limestone.

Figs 6 & 7. Colourful jasper sourced from larger yellow-pinkish blocks in the channel and immediate vicinity.

After exploring the jasper site, we continued our exploration around the shore to the west. It became apparent we were traversing an anticline, following the 4+ m thick, predominantly reddish, argillitic melange containing pale pink blocks of limestone/marble, overlying a pale grey argillite.

Then our attention was drawn, as Amaru noticed a spectacular tightly folded block of bedded limestone, some 1.5 m across, weathering out of the mélange (Fig. 8).

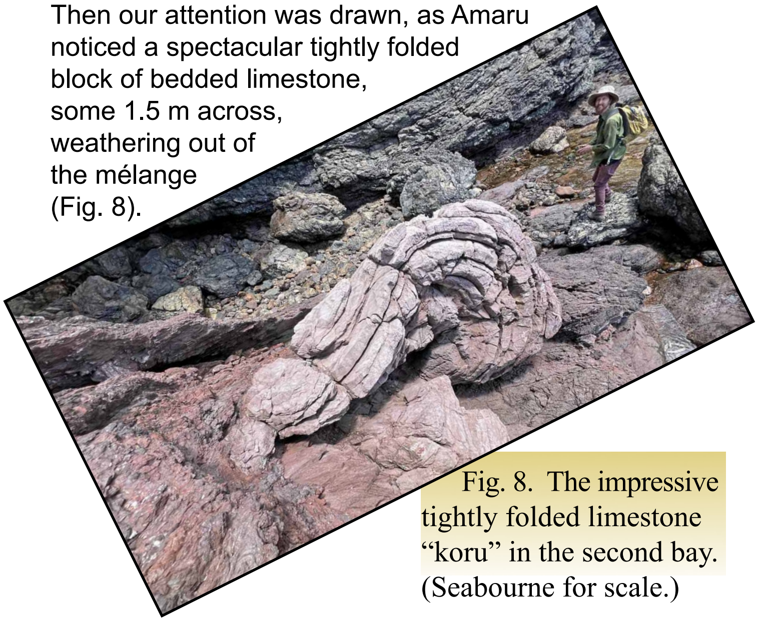


Fig. 8. The impressive tightly folded limestone "koru" in the second bay. (Seabourne for scale.)

We couldn't help but be awestruck by this koru shape feature, formed then captured within the earth over millennia, and now, we had the privilege to witness it boldly presented before us. We speculate that this distinctive koru form has been just as inspirational, or even more so, to people over many generations!

In the second bay, a large pohutakawa tree overhung a step face of dark grey green, chloritic, ?volcanogenic argillite overlying the mélange, which in places was altered and highly sheared, becoming less so up section, and grading into more massive greywacke around the headland further west, towards a sea arch. We did also notice a very minor amount of coloured jasper rocks occurring as loose blocks in the water in this bay.

Hemmed in by the sea and steep cliffs, we then returned by climbing up the face we had come down, noting an additional occurrence of some hard but very weathered siliceous rock outcropping near the top of the slope above the jasper bay.

Walking westwards, the coastal cliffs were much too steep to attempt another descent. Although steeply dipping greywacke rocks were seen, no further highly-coloured outcrops similar to those in jasper bay were noted from above.

Aerial photos of this stretch of coast appear to show other possible faults and structural trends that similarly align NW–SE. This is sub-parallel to the axis of Northland, and consistent with regional accretion of material from the NE (Fig. 9).

In the distance we noted that younger (Late Cenozoic) basalts of the Kaikohe-Bay of Islands Volcanic Field occur as rocky outcrops towards Moukawa Bay. We felt lucky to have spent a day exploring such a beautiful, isolated stretch of coastline with spectacular and interesting geology (Figs 10 & 11).

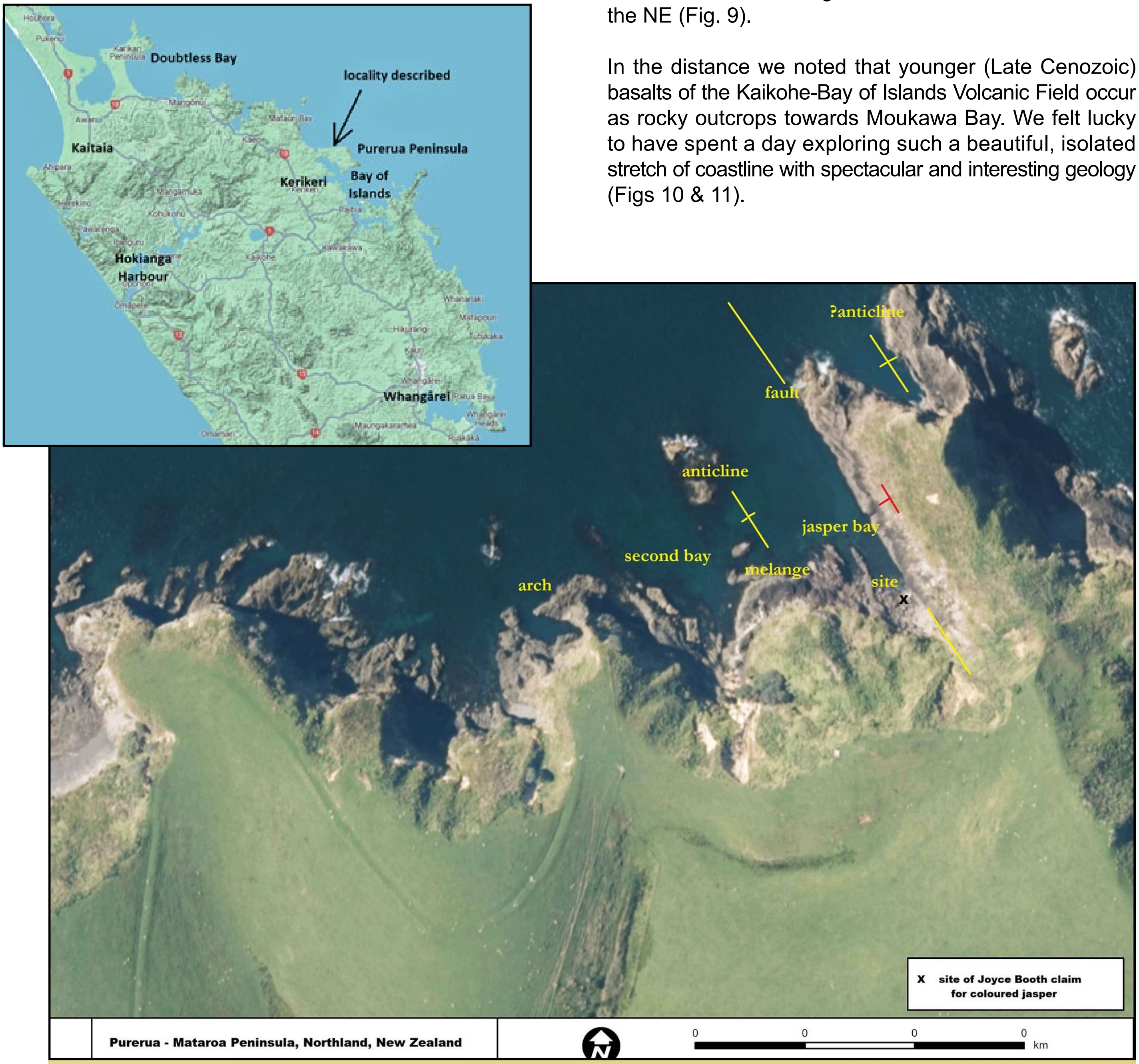


Fig. 9. Annotated aerial photo of coast, with inset of the locality in eastern Northland.

Figs 10 & 11. Amaru and Chris Booth enjoying the spectacular peninsula scenery, with sea arches to the east (upper) and west (lower).

Acknowledgements

We thank kaumatua Hugh Rihari (Ngati Torehine, Te Hikutu), for sharing his deep knowledge of the local history, and Bernhard Spörli for his input on geological interpretations. Thanks also to the landowners and farm manager for access.

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FOSSIL LEAVES FROM THE YOUNGER IHUMĀTAO FOSSIL FOREST, MĀNGERE, AUCKLAND

Bruce W. Hayward

One of Geoclub's favourite places to visit is the Ihumātao fossil forest site at the end of Renton Road, Māngere (Figs 1 & 2). The older, undated fossil forest, mainly composed of in-situ kauri tree stumps and fallen logs preserved in peat, is exposed in the intertidal foreshore and lower parts of the low cliffs. Growing out of the top of the peat, and buried by volcanic tuff erupted from close-by Maungataketake Volcano, are the remains of a second, younger and more diverse forest (e.g. Hayward & Hayward 1995, Hayward *et al*. 2011). The age of this younger forest is the same as that of Maungataketake Volcano, whose early phreatomagmatic eruptions killed the forest and buried it in tuff (e.g. Hayward & Hayward 1995, Agustín-Flores *et al*. 2014). The currently accepted date for the Maungataketake eruption is 88.9±2.4 ka, determined by Ar/Ar dating of basalt lava (Leonard *et al*. 2017). Two optically-stimulated luminescence dates of 177±23 ka and 140±14 ka from the lower part of the tuff sequence have been reported by Marra *et al*. (2006). Two radiocarbon dates of >55 ka were also obtained by Marra *et al*. (2006) on kauri tree stumps of the older forest.

The initial phreatomagmatic eruptions from Maungataketake Volcano were a series of turbulent, wet base surges that entered a living forest, knocking over many trees, and stripping them of branches and leaves (e.g., Brand *et al*. 2014, Agustín-Flores *et al*. 2014). The broken stumps, fallen branches and leaves are preserved as fossils in the lower layers of the tuff ring, which at this level is mostly composed of lithic tuff derived from the near surface layers of soft Pliocene and Pleistocene sediments as the volcano excavated its vent (Agustín-Flores *et al*. 2014).

Moving east along about 1 km of the cliff exposures eroded through the forests and tuff (Fig. 2), the character of the tuff changes from coarser and thicker (up to 8 m) proximal deposits to finer and thinner (~1 m) more distal deposits. Thus, in the west the fossil wood and carbonised leaves are buried by 5–8 m thickness of tuff and are well-preserved, probably because they would have been constantly water-saturated beneath the water table since soon after the eruption. Moving east away from the volcano, fossil leaves are no longer preserved and most of the wooden stumps and branches occur as moulds where the wood has rotted away because it has likely been above the water table for various periods since burial.

The first records of fossil leaves from the younger forest preserved in the lower 0.3 m of tuff were made by Hayward & Hayward (1995), found in the base of the cliffs about 100 m west of the Renton Road steps, Ihumātao (Fig. 1) (NZ Fossil Record site R11/f187). Recorded were abundant rimu, hinau and miro with less common kauri, tānekaha and the monocotyledon *Dianella*. Marra *et al*. (2006, figure 6) published a photo of rimu leaves from this locality without further discussion. Photographs of fossil leaves of rimu, tānekaha and kauri from this locality were published in Hayward *et al*. (2011, p. 21) and of rimu by Hayward (2019).

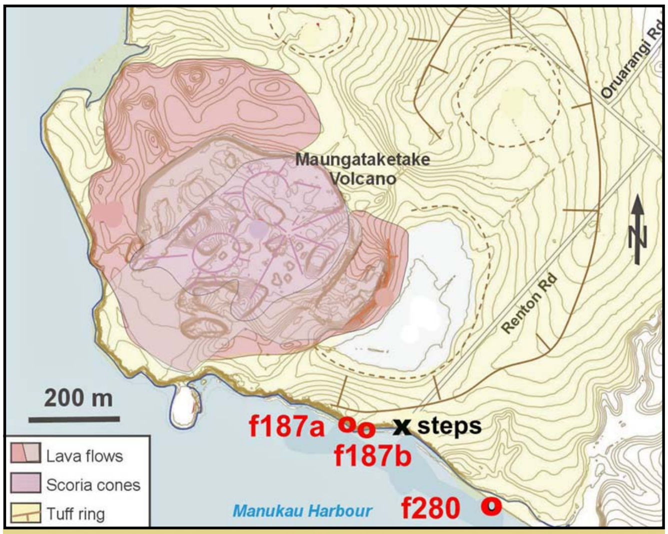

Fig. 1. Map of Maungataketake Volcano, located 1 km northeast of Auckland Airport, showing NZ Fossil Record numbers (R11/f) for localities where fossil leaves are recorded.

Fig. 2. Oblique aerial photo of low cliffs and foreshore on the Manukau Harbour where the two fossil forests and tuff from Maungataketake Volcano (quarried top right), are seen.

All these previous records of fossil leaves were the result of limited searching largely in one part of the tuff section and could very well not be representative of the total local forest dominance or diversity at the time of the eruption. In 2025, one of the authors (BWH) spent several hours methodically searching for leaf fossils along the full exposed length of the tuff sequence at the end of Rentons Road. With only one exception, no fossil leaves were found in the distal portion of the deposit southeast of the steps. This is presumed to be due to the lack of suitable preservational conditions, possibly a result of having been exposed to air when groundwater levels fell below the base of the tuff rather than due to an original lack of leaves. The one exception was a kauri branchlet with leaves still attached that was preserved by iron-oxide deposition around it (Fig. 3) and exposed on the surface of the tuff at the far eastern end of the cliffs (R11/f280, Fig. 1).

Fig. 3. Branchlet of a kauri preserved by rusty iron oxide growth around it in the distal tuff erupted from Maungataketake Volcano (R11/f280).
Width of photo 30 cm.

Fig. 4. Cliff section with tuff overlying black peat where fossil leaves were obtained (R11/f187a).
Width of photo 4 m.

Fig. 5. Fossil rimu leaves, Ihumatao younger forest (R11/f187a). Width of photo 25 cm.

To the west of the steps, there were two localities on either side of a small promontory, that contained reasonably common fossil leaves (Fig. 1). The first (R11/f187a) (Fig. 4), the more proximal of these sites, contained dominantly rimu leaves (Fig. 5) but also occasional miro (Fig. 6). At the second locality (R11/f187b) (Fig. 7), just 20 m away, rimu leaves were also found along with common hinau (Fig. 8) and black maire (Fig. 9). Also found at this site were occasional kauri (Fig. 10) and tānekaha (Fig. 11) leaves.

Fig. 6. Fossil miro and rimu leaves, Ihumatao younger forest (R11/f187a).
Width of photo 5 cm.

Fig. 7. Cliff section with tuff overlying black peat where fossil leaves were obtained (R11/f187b).
Width of photo 12 m.

Fig. 8. Fossil black maire leaves, Ihumātao younger forest (R11/f187b).
Width of photo 8 cm.

Fig. 9. Fossil hinau leaf, Ihumātao younger forest (R11/f187b). Width of photo 10 cm.

Fig. 10. Fossil kauri leaf, Ihumātao younger forest (R11/f187b). Width of photo 5 cm.

Fig. 11. Fossil tānekaha leaves, Ihumātao younger forest (R11/f187b). Width of photo 8 cm.

Discussion

Seven species (Table 1) of identifiable leaf have been found in the basal layers of the Maungataketake tuff ring. The distribution of these leaves is not uniform but clustered, with leaves of one species dominating in one area, but of different species dominating nearby. This seems to indicate that leaves were stripped from the trees by the initial wet ash sticking to them, possibly prior to the strong base surge blasts responsible for blowing over or snapping off the trees themselves. The concentration of leaves of different kinds in different areas would then be a result of the original patchiness of the forest.

Table 1. List of fossil leaves from the younger forest, killed and buried in tuff by the eruption of Maungataketake Volcano.

R11/f187, *Dianella*, flax lily, rare (not found in 2025)	
R11/f187a, 100 m west of Renton Road steps	
	Dacrydium cupressinum, rimu, dominant
	Prumnopitys ferrugínea, miro, uncommon
R11/f187b, 80 m west of Renton Rd steps	
	Elaeocarpus dentatus, hinau, common
	Nestegis cunninghamii, black maire, common
	Dacrydium cupressinum, rimu, common
	Agathis australis, kauri, rare
	Phyyllocladis trichomanoides, tānekaha, rare
R11/f280, 200 m south of Renton Rd steps	
	Agathis australis, kauri branchlet, rare

Acknowledgments

I thank Ewen Cameron and Rhys Gardner for identifying or checking my identifications of many of the leaves.

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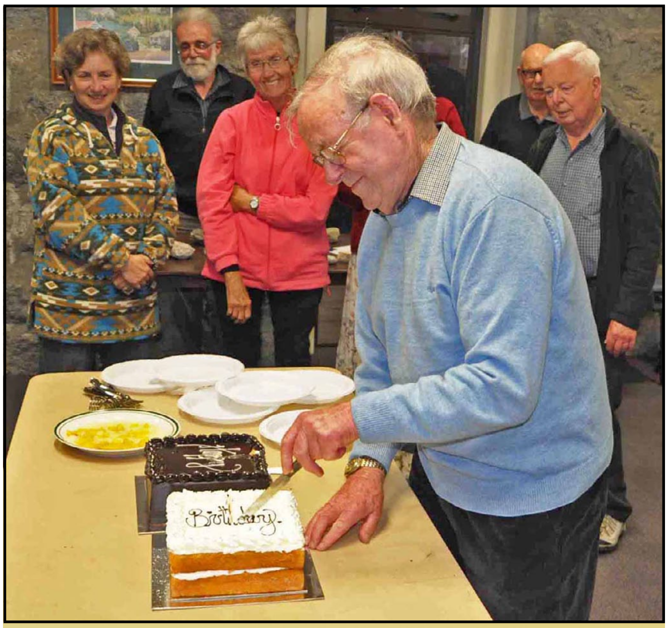
REMEMBERING MORE FORMER GEOCLUBBERS

Bruce W. Hayward



Foundation member Colin Christie cutting the club's 20th birthday cake in 2012. He retired from the club a few years ago due to his advancing age. In the background are (left to right): Jill Kenny, George Wingate, Margaret Morley, Warren Spence and Malcolm Simpson.

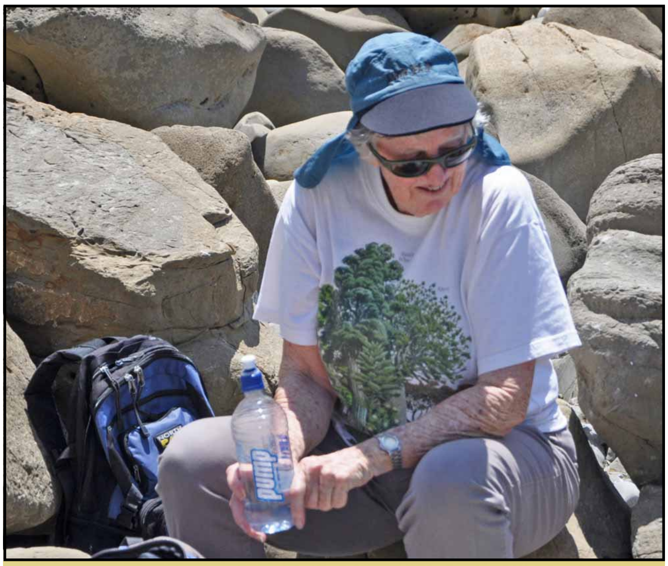
Colin Christie (left) lunches with (from left to right), Margaret Morley, Rhiannon and Peter Daymond-King at Ohakuri Dam, 2009.

Former members rest on the beach on the south Hokianga coast, 1997. From left: Murray and Jaqui Jones (Whangarei), Margaret Morley, Nancy Smith, Lola Gregory (Foundation Member), Hilda and Horst Hoppe.

Former Geoclubber Nancy Smith (1994-2012), Onekaka, NW Nelson, 2007.

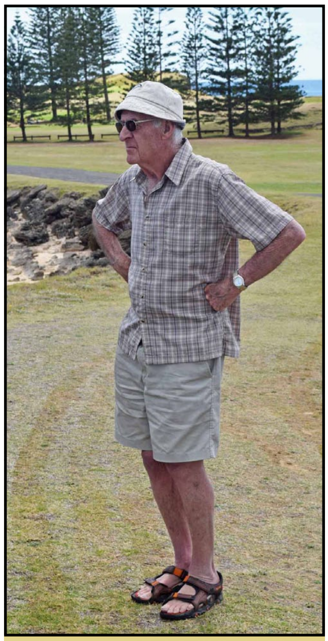
Whangarei cattle farmer Jean Hawken leads a group of Geoclubbers comprising (left to right) Julie Daymond-King, Margaret Morley, Peter Daymond-King, Hugh Grenfell and Helen Holzer, Atiu Creek Regional Park, 2008.

Former Geoclub member Pam Battey (blue coat) with Kathy Prickett at Tokatea Hill, Coromandel, 1996.



Jean Hawken, former Geoclub member (2007-2019) from Whangarei came on many of our longer and northern trips. Here she takes a water stop at Mangawhai Heads, 2012.

Former Geoclub member (1996-2013) Tom Turnwald, Tank Farm, Northcote, 2000.



Bill Jamieson (Geoclubber 2008-2020) came on many field trips, including to Norfolk Island (here) in 2015.

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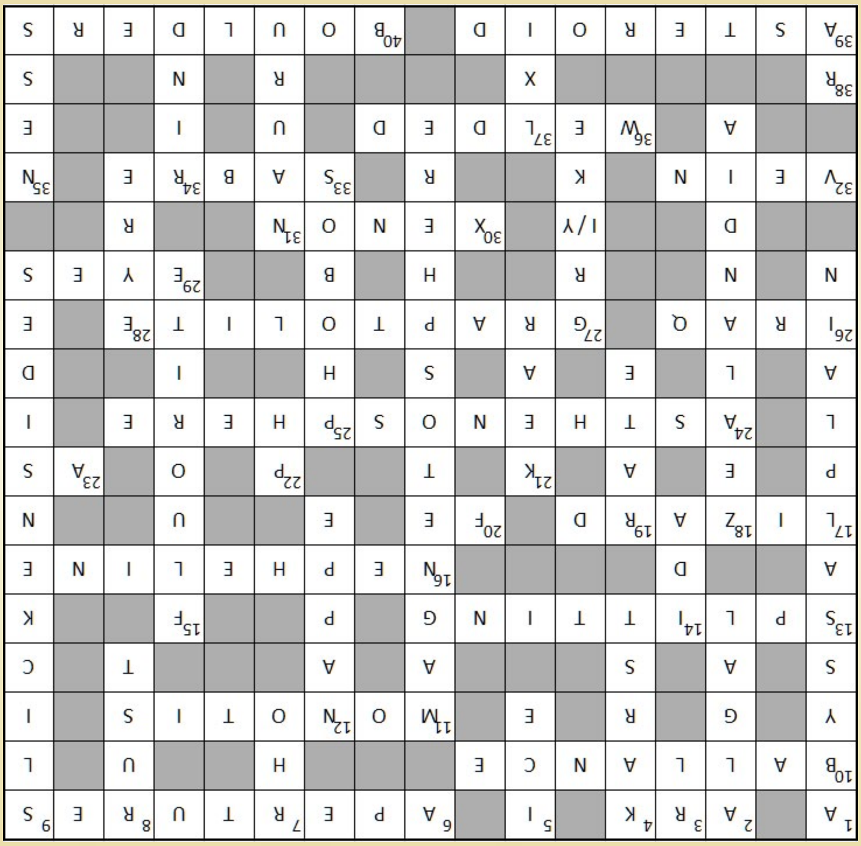
GEOLOGICAL CROSSWORD ANSWERS



ACROSS
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24 Asthenosphere
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27 Graptolite
29 Eyes
30 Xenon
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36 Welded
39 Asteroid
40 Boulders

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2 Algal
3 RL
4 Karst
5 Ice
7 Rho
8 Rust
9 Slickensides
11 Magnetosphere
12 Nappe
14 Ida
15 Fluorite
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