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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PURCHAS HILL TUFF PROVIDES INSIGHT INTO TOPOGRAPHY OF TĀMAKI RIVER VALLEY 10,000 YEARS AGO

Bruce W. Hayward

Summary
Inverted topography.

Introduction
In April 2023, twelve Geoclubbers explored part of the intertidal shore platform on the west side of Tāmaki Estuary, Auckland City. This portion of shoreline is seldom visited by members of the general public because it is perceived to be mud flats. In reality, most of the wide intertidal zone between Panmure wharf and Point England (Fig. 1) consists of a flat surface of eroded Early Pleistocene rhyolitic sedimentary rocks overlain by a thin veneer of modern sandy mud (0–2 cm thick) (Fig. 2). When viewed from the coastal walkway/cycleway between Point England and Panmure wharf, there are scattered small areas of harder rock sticking up 10–40 cm above the generally flat shore platform (Fig. 2). It was to examine these upstanding rocks that the Geoclub field trip was scheduled to visit this area.

We noted the presence of three distinct rock units:

Early Pleistocene rhyolitic sedimentary rocks (Tauranga Group)
These consist of mostly massive cream-coloured mudstone or sandy mudstone with occasional horizons containing the in-situ vertical broken-off stumps of small trees (1–3 cm diameter) (Fig. 3). This unit is exposed in many places where there is no mantling modern mud (Fig. 4) and is inferred to directly underlie most of the tidal flats where the thin mud is firm beneath (most uncoloured areas on the maps of figures 4 and 5).

This unit is exposed in low cliffs at Point England and on the opposite side of the estuary at Salvation Pt and St Kentigern cliffs (Fig. 1). At these localities, this sediment is interbedded with lignite units, and near high tide level with primary rhyolitic tephra and ignimbrite deposits. These

Fig. 1. Map of the lower reaches of Tāmaki Estuary, Auckland, showing the location of the study area and the three nearest volcanoes.

Fig. 2. Geoclubbers explore the foreshore adjacent to Dunkirk Reserve, Tāmaki Estuary. They are all standing on the firm ground of eroded Early Pleistocene sedimentary rocks with a thin veneer of Holocene mud. The curved edge of this Pleistocene high ground (beyond the people) is marked by a narrow belt of harder darker tuff that stands out above level of shore platform and indicates the edge of a shallowly incised stream course that has been mantled by the tuff that dips into the channel.

Fig. 3. In-situ stumps of small trees (scrub) sticking up above the level of erosion of the shore platform made of Early Pleistocene sedimentary rocks (beneath mud veneer).

have been geochemically identified as correlative with the Waiuku Tephra (Alloway *et al*. 2004) and have an age range of 1.2–1 myrs (Early Pleistocene). Drillholes 100–200 m west of the study area have intersected up to 17 m of this rhyolitic sediment with at least three distinct horizons of lignite within it (e.g., NZ Geotechnical Database drillhole number 145293). This unit is inferred to be reworked rhyolitic tephra deposited as alluvial or lacustrine sediment in the ancient Tāmaki valley.

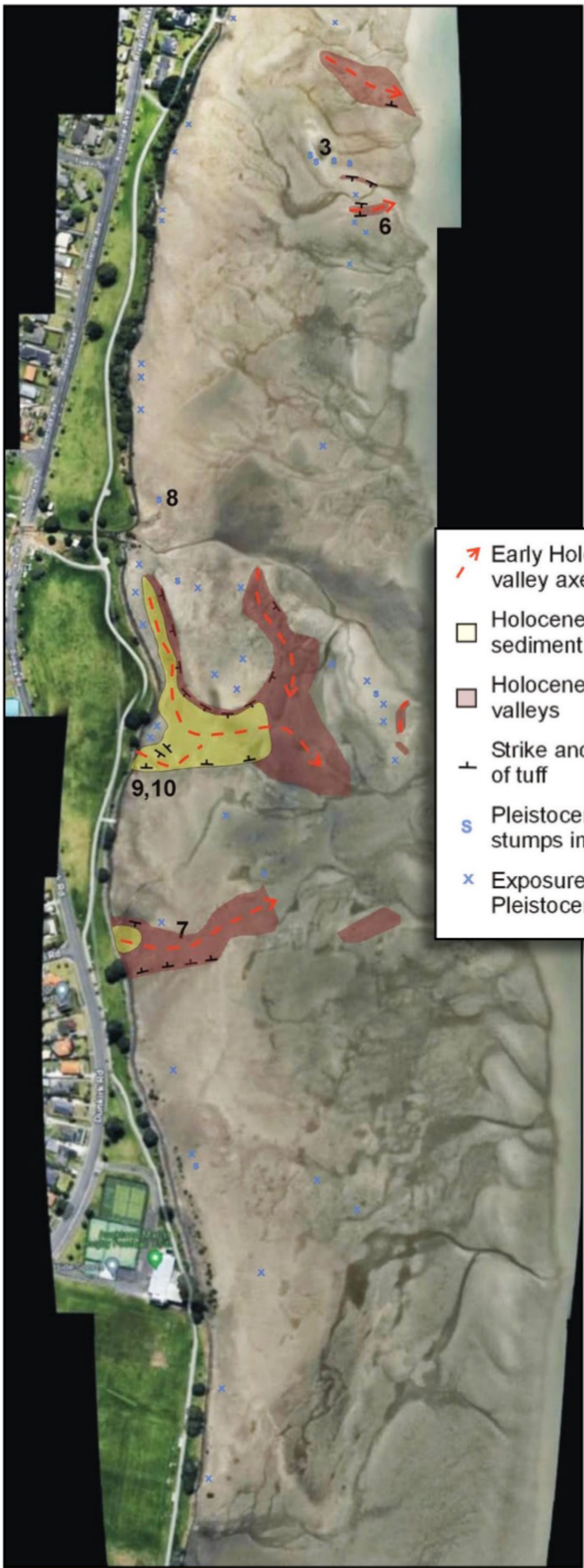

Fig. 4. Mapped extent of tuff and Holocene marine sediment filling paleo-stream courses that have been eroded into the background Early Pleistocene sedimentary rocks (uncoloured). Numbers refer to photographic figures in this article.

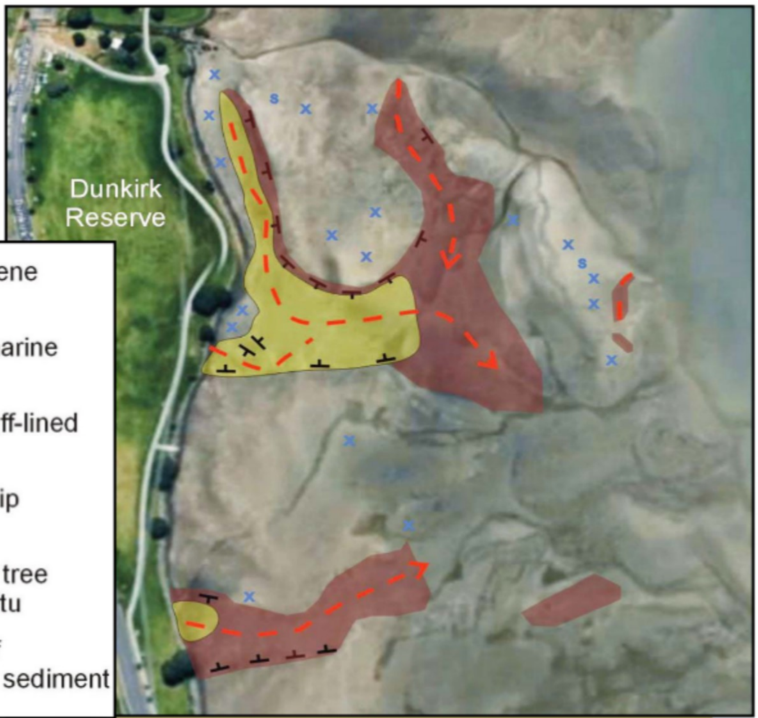

Fig. 5. Blown-up central portion of figure 4 showing the major area of outcrop of tuff and Holocene marine sediment infilling paleo-stream courses adjacent to Dunkirk Reserve, Tāmaki Estuary.

Cemented tuff (Auckland Volcanics)

This unit consists of up to 30 cm of iron-oxide-cemented, cm–dm-bedded, coarse sandy tuff that often stands up above the level of the eroded-off intertidal platform of softer but older rhyolitic sedimentary rock. These rocks may occur as isolated patches but more often as linear outcrops of tuff dipping off the underlying Pleistocene rocks at ~10° (Fig. 2). In places, two lines of tuff dipping in towards each other are present, or there is a continuous linear outcrop in the shape of a narrow syncline (Figs 6, 7).

There is no nearby exposure of this tuff in the cliffs at Point England, nor directly opposite on the other side of the Tāmaki Estuary. The nearest exposures of tuff are in the low cliffs of the Tāmaki, 700–1000 m away to the southwest on either side of the Estuary. In these places the tuff clearly forms the distal part of the tuff ring of 25,000 year old Panmure Basin Volcano (Kermode 1992, Hayward 2019).

The centre of Panmure Basin crater is 1.8 km from the southern end of the study area (3 km from the northern end) (Fig. 1). Two other, even younger volcanoes (both 10,000 years old) - Maungarei/Mt Wellington and Te Tauoma/ Purchas Hill, are 1.5–2 km from all of our study area. Purchas Hill is known to have erupted with an initial phreatomagmatic phase that built a 1 km-diameter tuff ring and might have been the precursor of the dry scoria and lava flow eruptions from Mt Wellington. Thus, the tuff in the study area could have come from either Panmure Basin or Purchas Hill. The consistent thickness of the cemented tuff along the length of the study area might be interpreted as favouring the Purchas Hill source. The fresh, rather than more weathered nature of this unit more strongly suggests it was erupted from younger Purchas Hill.

It is likely that some overlying softer and more weathered tuff has been removed by later marine erosion. Tuff from the Auckland Volcanic Field thickens towards the west (towards Purchas Hill) in this vicinity, from 2.5 m thick (BH145293) 400 m from the shoreline, through 3.5 m thickness (BH145292) 600 m from shore, 4.5 m thickness (BH145466) 800 m from shore, to 10 m+ thick (BH66405)

Fig. 6. In spite of the mud covering, this linear trough (shallow syncline) of tuff fills the eroded core of a paleo-stream course cut into the underlying, softer Pleistocene sedimentary rocks.

Fig. 7. This curved linear syncline of bedded tuff shows the former course of a shallow stream that was lined by airborne volcanic ash inferred to have been erupted from Purchas Hill, 10,000 years ago.

in the Purchas Hill tuff ring itself. This also supports a primarily Purchas Hill source for the tuff in the study area.

No organic matter, derived from vegetation buried by the ash fall, was found preserved beneath or within the tuff, but in several places the underlying rock is weathered to a brown soil. In two places, a single upright tree stump (20–30 cm diameter) in-situ, stands up 30–50 cm above the tuff (Fig. 8) and would appear to be the remains of trees that were growing here when the volcanic ash was deposited.

The tuff that now remains is a miniature example of inverted topography, whereby the tuff was presumably deposited as a thin blanket over the whole area with its bedding mimicking the erosional undulations and stream courses. Holocene marine erosion in the intertidal zone has eroded off up to 2–4 m of this tuff and the underlying Pleistocene sedimentary rock (Fig. 9) creating the present flat-lying shore platform (Fig. 2). Where the tuff mantled the sides and bottom of more deeply incised stream valleys, erosion has not yet removed all the tuff and lines of inward-dipping tuff (on either side of the paleo-stream course) stick out above the level of the eroded off softer Pleistocene (Fig. 9). In places the erosion level has almost reached the bottom of the former stream bed and here a narrow, sinuous syncline of harder tuff remains just above the shore platform surface tracing the route of the former stream bed (Figs 6, 7).

Fig. 8. The partly eroded in-situ stump of a sizeable tree sticks up out of the shore platform and is inferred to have been a forest tree that was partly buried and preserved by volcanic ash erupted from Purchas Hill, 10,000 years ago.

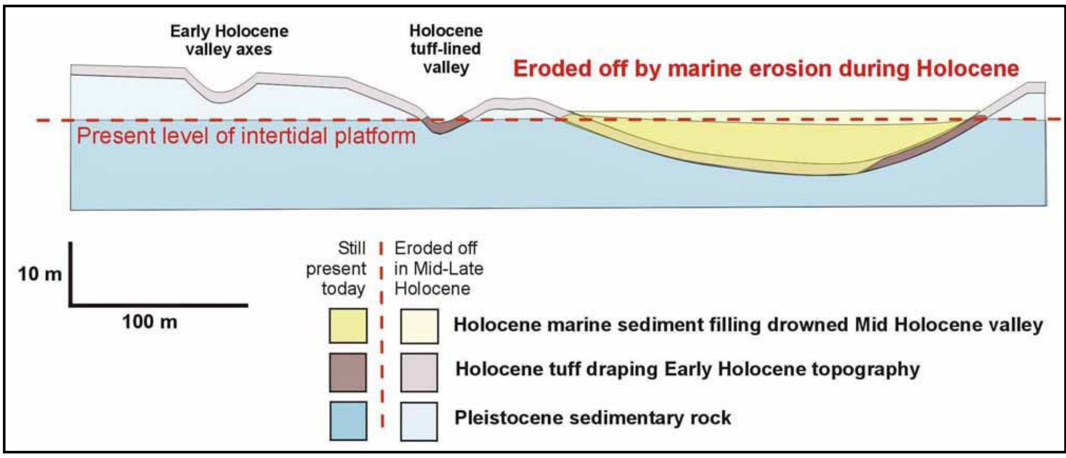

Fig. 9. Cartoon sketched cross-section through part of the study area showing the present configuration of the three rock/sediment units (below the dashed red line) and their distribution above the shore platform prior to their being eroded away after sea level rise in the last 7500 years.

Cemented shelly, woody volcaniclastic sand (Tauranga Group)

This unit consists of iron-oxide-cemented volcaniclastic breccia and sand containing numerous shells of cockle (*Austrovenus stutchburyi*) (Figs 10, 11) and often broken pieces of branch and twig in a sandy matrix. Elsewhere this unit consists of uncemented, shelly, volcaniclastic sand where the shells have dissolved, leaving behind their molds. The dominant volcaniclastic component of this sediment was undoubtedly derived from tidal marine erosion of some of the nearby basaltic tuff.

This rare unit occurs in the upper part of the tidal zone in two places where it fills elongate depressions (stream courses) eroded into the underlying Pleistocene rhyolitic sedimentary rocks (Fig. 5). In some places this unit sits directly on the Pleistocene, whereas elsewhere it overlies the cemented tuff that mantles the eroded side of a small water course cut into the Pleistocene (Fig. 10).

As this unit contains marine shells, it must have been deposited on the edge of the sea sometime after sea level had risen to at least the present level (i.e. 7500 years old or younger). Cockle shells often get concentrated by waves at the high tide level and branches often collect in the upper reaches of intertidal stream channels. This is inferred to be the deposition site of the Holocene marine sediment.

Marine terraces

Adjacent to the intertidal study area there are two contiguous flattish public reserves that preserve parts of extensive coastal marine terraces (Fig. 12). In both Dunkirk and Mt Wellington Memorial reserves there are large sections of relatively flat land that is 2.5–4 m above MSL (mean tide). These two terraces are above high tide level and are at an elevation consistent with their formation during the mid Holocene (6000–2000 years ago) high stand of similar age to the coastal terrace at the same elevation at Bucklands Beach, near the Tāmaki Estuary mouth (Hayward 2023) (Fig. 1). The largest area of Holocene marine sediment, infilling a water-course (intertidal channel), is adjacent to the Dunkirk Reserve Holocene marine terraces. This would not be a coincidence, but suggests

Fig. 10. Holocene shelly volcaniclastic sandy breccia inferred to have accumulated as fill at high tide level in an intertidal stream channel.

Fig. 11. Bedded Holocene shelly volcaniclastic sediment on the side of an infilled stream channel.

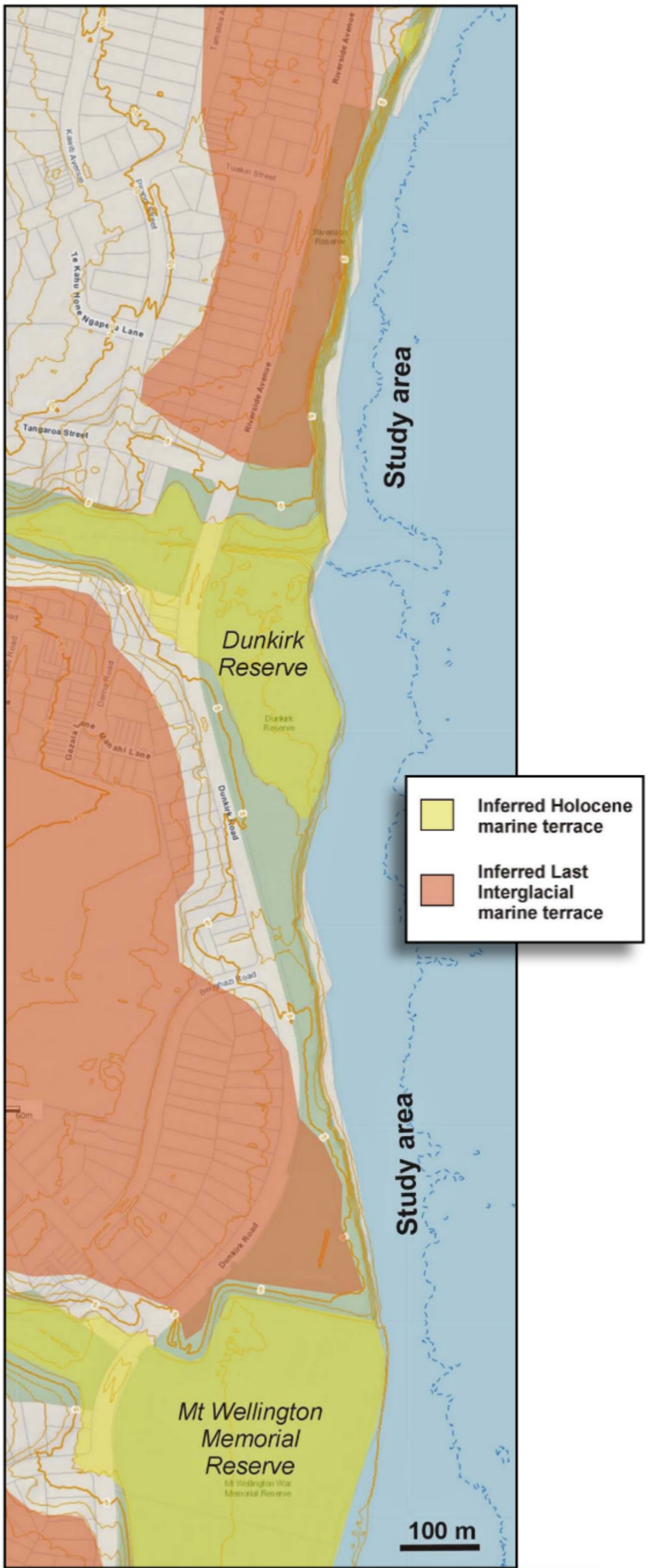

Fig. 12. Contour topographic map (1 m interval) of the coastal strip adjacent to the study area with coastal terraces of inferred mid Holocene (2.5–4 m above MSL) and Last Interglacial (5–9 m above MSL) age. Contours from Auckland City Council GIS.

that this area was the course of a significant stream valley during low sea levels of the Late Pleistocene, eroded into the higher Last Interglacial terrace (next paragraph).

Most of the western side of Tāmaki Estuary is flat lying (5–10 m+ above MSL) and is inferred to have been formed by intertidal erosion of a shore platform when sea level was up to 6 m higher than today during the Last Interglacial Period (~130,000–120,000 years ago). This coastal terrace rises slowly away from the estuary which is probably partly due to an original slope on the intertidal platform and to the thickening of the overlying tuff towards the Purchas Hill explosion crater source.

Interpretation

The Early Pleistocene rhyolitic sedimentary rock is inferred to have been deposited by reworking of rhyolitic tephra and ignimbrite and its accumulation in an ancient Tāmaki River valley as alluvium or lacustrine sediment. The scattered horizons of small tree stumps within the sediment indicate that at times scrub became established on the alluvial flat before being buried and preserved by further sediment deposition. Exactly how much additional Pleistocene alluvial and terrestrial sediment and tephra was deposited on top of what is seen in the foreshore is unknown, but clearly its consolidated state indicates it has been buried by maybe 10+ m of sediment that has subsequently been removed by weathering and erosion.

During the Last Interglacial Period when sea level was up to 6 m higher than today, wide intertidal shore platforms were eroded along the sides of the flooded Tāmaki River valley. Today these are at elevations between 5 and 9 m above MSL, with some addition of elevation as a result of subsequent mantling by 1–3 m of basaltic ash from nearby Auckland volcanoes. Over the next 100,000 years, when sea level was well below present, small streams eroded courses into and across these coastal marine terraces and drained into the main Tāmaki River.

Eruption of nearby Panmure Basin explosion crater, 25,000 years ago, undoubtedly deposited a thin veneer of volcanic ash over the forested study area. Over the next 15,000 years, this ash would have been washed off or incorporated into the forest soil. The closer phreatomagmatic eruption of Tauoma/Purchas Hill, 10,000 years ago, appears to have deposited 0.5–2 m of volcanic ash over the study area. In the following 2500 years some of this ash may have been washed away, some incorporated into the forest soil, but the lower 20–30 cm was cemented by precipitation of iron oxide minerals from passing iron-enriched ground water. The base of the tuff unit followed the contours of the underlying partly eroded Last Interglacial terrace, especially mantling and filling or partly filling the stream courses.

Rising sea level after the peak low of the Last Glacial, reached the present level about 7300 years ago and continued to rise to ~1.5–2 m above present by 5000 years ago, if not earlier (Hayward 2023). For the last 7500 years the sea has been eroding the sides of the drowned Tāmaki River valley (= Estuary) down to a wide flat shore platform (the study area). Initially, when sea level was 1–2 m higher, the new shore platform would have been higher and the shore platform extended inland up the two deepest and widest tributary stream valleys of Dunkirk and Mt Wellington Memorial reserves. Here the Holocene marine terraces were created in part by erosion and in part by infilling of the former tributary valleys with eroded sediment. Some of this Holocene marine sediment that infills the deeper stream courses is exposed in the modern foreshore adjacent to Dunkirk Reserve.

As sea level fell in the last ~2000 years, the intertidal shore platform was lowered in tune with the erosional energy of the tides and small waves. Shallower stream courses, filled and mantled with tuff, at higher elevations cutting across the Last Interglacial terrace, have now been largely eroded away, whereas the level of present-day tidal wave erosion has not yet completely removed the tuff-lined deeper stream courses (Fig. 9).

Thus, today the intertidal shore platform in the study area preserves evidence (in the form of lineaments of cemented tuff) of the location, depth and filling of the deeper stream courses that were in existence 10,000 years ago. These streams fed into the main Tāmaki River at the time. The study area is a wonderful miniature example of inverted topography, where the harder tuff that was deposited in the stream beds now sticks out above the level of the former low stream banks on either side.

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ORBICULAR GRANITE IN THE WANGAPEKA VALLEY, NORTHWEST NELSON

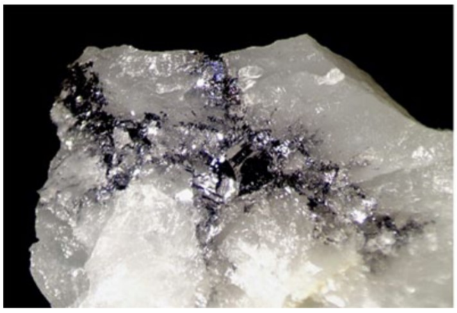
Tim Saunderson

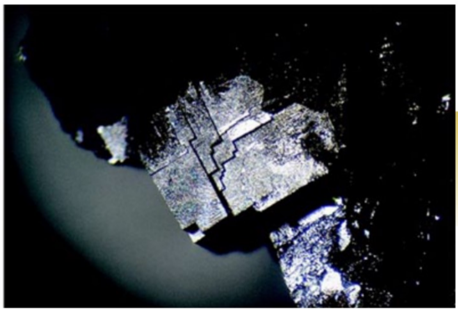
The article on orbicular granite in Geocene 35 by Glenys Stace reminded me of a trip down to the South Island I did last year. I photographed the orbicular granite boulder in Murchison in April 2023 (before it was moved to its present location). It seems the boulder was bigger then and looking at Glenys's photos compared to mine, it looks like the top part must have cracked off during the move.

Murchison orbicular granite boulder and closeups showing details of orbicules, before it was moved.

Note the somewhat compressed orb in lower right photo; it seems this is not uncommon in orbicular granites and might be caused by settling under gravity, squashing the orbs while they are still soft and semi-molten. The dark bands are probably biotite mica and maybe magnetite crystals as well.

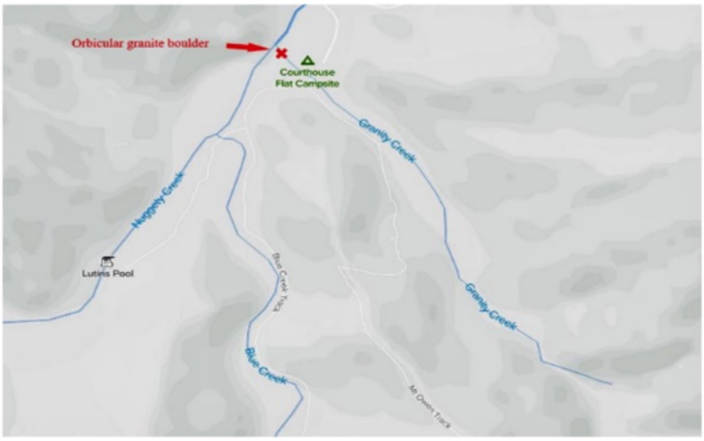
In November 2013 I went on a field trip with the Nelson rock and mineral club to the Colossus Mine in the Wangapeka Valley. The road up the Wangapeka Valley ends at Courthouse Flat and it is about a 15-minute walk to the colossus mine but on the way, there are several streams to cross. One of these is called Granity Creek and it has a very large boulder of orbicular granite which I photographed during this field trip. There is quite a lot of lichen on the surface that partly obscures the orbicules – it is tempting to take a wire brush and give it a good clean up! There is a lot of granite in the area, some of which is cut by quartz veins. The Colossus mine was set up about 1917 to work galena (lead sulphide) in the quartz veins and a small crushing battery was bought in but never set up. It seems the ore was simply not available in sufficient quantity and the whole venture was uneconomic. Gold and silver were found in the area as well and they also proved to be uneconomic.





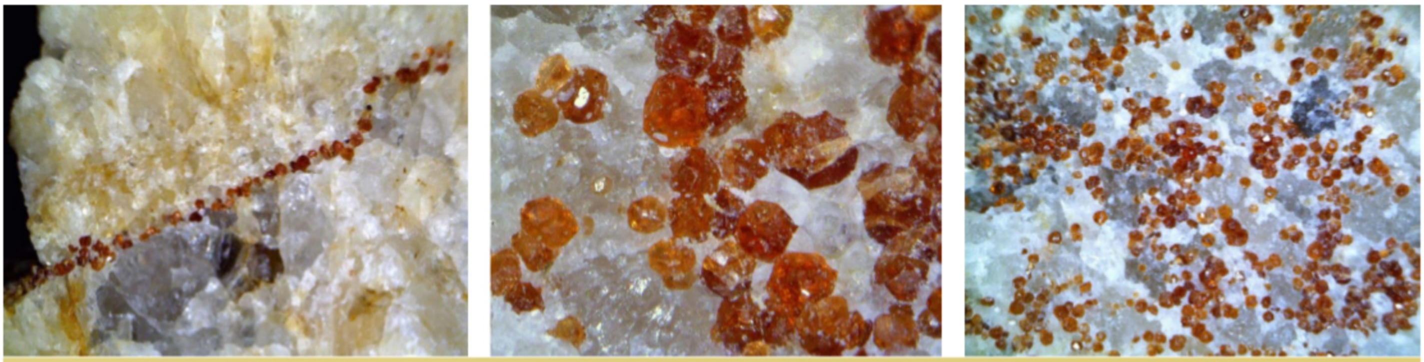
Galena in quartz from the Colossus Mine.

The orbicular boulder in Granity Creek is very close to where the creek joins Nuggety Creek, which becomes the Rolling River.



Orbicular granite boulder about 1.8 meters across, Wangapeka Valley.

The geology of the area is diverse and varied. I have collected several pieces of granite from the Dart River in the Wangapeka valley and they have tiny orange garnets embedded in them – often on fracture surfaces in the rock. Some of the limestone in the valley is black in colour and I believe this is due to the presence of graphite. The Nelson Museum has a fine example of rare fossil trilobites collected in the Wangapeka area; they are small but relatively intact. Unfortunately, I didn't have a camera with me at the time, so I didn't get a photo.



Very small garnets in granite from the Dart River, Wangapeka Valley.

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POSTSCRIPT TO GEOCENE 35 ORBICULAR GRANITE ARTICLE

Glenys Stace

When in Nelson, following our adventures in Murchison, we visited Mike Johnstone. He showed us a slice of an orbicule bigger than any I have ever seen. It was so unusual that I thought it was worth publishing the picture.

Mike says:
"*The sample was for many years lying in the back of a garage so I gave it a home. Perhaps west Nelson is the best one can do*."

I wish the location could be found because this specimen is truly spectacular.

Fig. 1. Mike Johnstone's large orbicular granite specimen.

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LATE PLIOCENE FOSSIL SEAGRASS OCCURRENCES FROM AUCKLAND, NEW ZEALAND

Bruce W. Hayward & Ian J. Geary

Fossil seagrass is internationally rare (e.g. Reich *et al*. 2015) and up until 2015 no pre-Holocene fossil seagrass record had been published from New Zealand. Conran *et al*. (2015) recorded *Ruppia*-like seagrass fruit from the Early–Middle Miocene Manuherikia Group paleo-lake in central Otago. Potamogetonaceae pollen is recorded in New Zealand from Early Miocene onwards (Mildenhall 1980). Both these records are of freshwater lacustrine taxa that are classified in with the seagrasses. Today there is a single species of seagrass living intertidally and in the sheltered shallows around New Zealand - the endemic subspecies *Zostera muelleri* subsp. *novazelandica* (Stetch.) S.W.L. Jacobs.

In 2016, the authors discovered rich fossil deposits of abundant, thinly-carbonised blades of grass in two localities on the southeast shores of the Manukau Harbour, Auckland (Figs 1, 2). We were confident that this was fossil seagrass because of its association with casts of intertidal or shallow-marine molluscs. Samples were sent to fossil seagrass expert John Conran in Adelaide, Australia, who confirmed our initial identification. Photographs of this fossil seagrass have already been published by Hayward (2017, fig. 10.28), Hayward & Geary (2017) and Larkum *et al*. (2018). Larkum *et al*. (2018, fig. 1.1e), in the figure caption to their photograph of the seagrass from Weymouth, tentatively identified it as "*Enhalus*-like revolute-margined seagrass leaves".

In this note we provide details of where these occur, the associated macrofauna and age determinations.

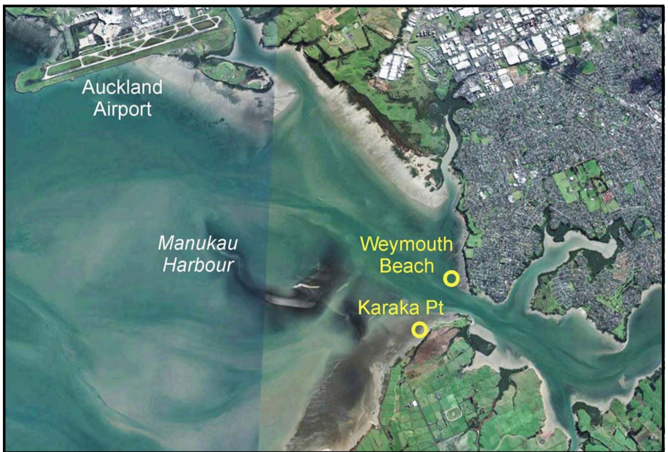

Fig. 1. Location of the two fossil seagrass deposits (yellow circles) on the southeast shore of the Manukau Harbour, Auckland.

Fig. 2. Aerial view over the mouth of the Drury Arm of Manukau Harbour, showing the two locations of fossil seagrass at Weymouth (W) and Karaka Pt (K).

Weymouth locality

The fossil seagrass blades at Weymouth occur in a 5–10 cm thick band of grey fine sandstone (Fig. 3) located 5–20 cm below the surface over a relatively large area (~50 x 20 m) between mid and low tide levels, off the south end of Weymouth Beach, Manurewa, Auckland (Fig. 4). The band (no bedding planes) is flat-lying, as is the eroded shore platform above, which is usually covered with a thin layer of wet modern mud. The thin seagrass-bearing sequence occurs 40–60 cm stratigraphic distance above the onlapping contact over an irregular eroded surface of

Fig. 3. Fossil seagrass blades in fine sandstone, Weymouth. Photo width 15 cm.

Fig. 4. The fossil seagrass at Weymouth occurs 5–10 cm beneath the mud-covered shore platform. Heaps of soft rock indicate where the seagrass has been found by digging.

Fig. 5. Fossil large-leaved southern beech leaf (*Nothofagus brassi*-group) co-occurring with seagrass at Weymouth. Photo width 10 cm.

Fig. 6. Mold of horn shell (top left) co-occurring with seagrass blades from Weymouth.
Width of photo 8 cm.

Fig. 7. Outlined extent of the fossil seagrass offshore from the south end of Weymouth Beach.

relatively hard early Miocene sandstone and mudstone (Waitematā Group). In this locality the fossil-bearing unit seems to have been deposited in a shallow paleo-embayment. What lies beneath the seagrass-bearing sandstone here is unknown (not exposed), although sections nearby to the north (e.g., Moore & McKelvey 1971, Geary 2022) indicate the possibility that non-marine or brackish estuarine fossil leaf- and fruit-bearing lignite and sandstone could be present. Apparently interfingering or overlying the seagrass unit just to the north are mollusc-rich shell beds (as molds and casts) and a 2 m-thick sandstone (Geary 2022).

In addition to the fossil seagrass, this unit contains rare leaves of the extinct, large-leaved southern beech of *brassi*-group *Nothofagus* (Fig. 5) and scattered molds of a low diversity, apparently in-situ mollusc fauna that includes double-valved wedge shells (*Macomona*, *Barytellina*), cockle (*Austrovenus*) and horn shell gastropods (*Zeacumantus*) (Fig. 6) and extinct *Taxonia tesserata* and *Pyrazus ebeninus*.

This seagrass fossil site occurs between 37° 02’ 56.67” S, 174° 51’ 20.26” E and 37° 02’ 58.03” S, 174° 51’ 18.63” E and has been registered with the NZ Fossil Record File (FRF) number R12/f82 and lies 200 m northwest of the end of Roys Road (Fig. 7).

Karaka Point locality

Fossil seagrass also occurs in an unbedded fine sandstone beneath a low-lying shore platform at about mid tide level near Karaka Point. The bed covers a much smaller area (~10 x 10 m) than at Weymouth. The seagrass fossils are in a 5–10 cm thick band just beneath the surface and co-occurs with occasional fossil molds of wedge shells, cockles and horn shells (Fig. 8). The relationship of this unit with the units around it is not exposed, but it is probably similar to Weymouth with shellbeds above and a fossil fruit and wood-rich sandstone possibly below.

This seagrass fossil site is located about 1300 m southwest of the tip of Karaka Point and 400 m northeast of the

Fig. 8. Fossil seagrass blades together with molds of a wedge shell (upper left) and a cockle (top right) from Karaka Point. Width of photo 12 cm.

extended end of Urquhart Road (Figs 9, 10). It occurs at 37°03'35.3"S 174°50'49.4"E and has been registered with the NZ Fossil Record File (FRF) number R12/f87.

Paleoenvironment

The mollusc fauna associated with the seagrass is the same at both localities and is typical of an intertidal (or shallow subtidal), estuarine environment. The seagrass is only represented by fossil grass blades with no rhizomes recognised. This suggests that the seagrass fossils are not a fossil in-situ seagrass meadow, but probably a storm-eroded concentration that may have accumulated intertidally and been rapidly buried by sand.

Late Pliocene age determination

Rich shell beds (as casts and molds) interfinger with and appear to overlie the two seagrass deposits. All the mollusc species so far identified in them are also present in the diverse faunas previously recorded from the Otahuhu Brewery well (Marwick 1948) and Māngere wastewater tunnel shafts (Hayward *et al*. 2023). Both these have accepted ages of Late Pliocene (Waipipian stage, Wp; 3.7–3.0 myrs old). Among the taxa present at Weymouth and Karaka Point that have overlapping age ranges (from Spencer *et al*. 2009) that also indicate a Waipipian age are *Barytellina crassidens* Wp–H, *Bassina katherinae*

Fig. 9. Aerial view southwest along the coastline south of Karaka Point showing the location of the fossil seagrass deposit (K).

Fig, 10. Outline area of extent of fossil seagrass deposit southwest of Karaka Point.

Wp–Wm, *Dosinia powelli* Wp, *Eumarcia kaawaensis* Wo–Wp, *Macomona williamsi* Wp–R, *Musculus impactus* Wp–R, *Pyrazus ebeninus* Wp–Wc, *Spisula couttsi* Wp, and *Taxonia tesserata* Wp.

The fossil plant bearing sedimentary rocks at the north end of Weymouth Beach were dated using palynology by Dallas Mildenhall in Moore & McKelvey (1971) (FRF: R11/f9619). He identified 19 microfossil plant taxa and considered the sediment was likely of Waipipian to Mangapanian age (3.7–2.4 Ma), based on the overlap of three locally-extinct *Nothofagus* subgenus *Brassospora* species and *Eugenia* sp.

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AUCKLAND VOLCANOES FROM MAUNGAWHAU / MT EDEN, 1849

Bruce W. Hayward

I recently came across a panoramic painting from Maungawhau/Mt Eden in five parts by Willaim Fox (1812–1893). It depicts the landscape from Shoal Bay on the North Shore around to the east as far as Maungakiekie/One Tree Hill (Fig. 1). Here I present two parts (Figs 2–3) blown-up more, showing the local volcanoes early in the history of European colonisation of Auckland.

For comparative purposes I also show a panoramic photo montage from Mt Eden covering the same section of landscape (Fig. 4). Three of the photos were taken by the Burton Brothers in 1884 and the Rangitoto-North Shore one by Josiah Martin a few years later. Again, I present two parts (Figs 5–6) blown-up more, showing the same local volcanoes as in the 1849 painting.

Fig. 1. *'Auckland 1849 Showing Extinct Volcanoes'*, by William Fox (1812-1893) depicting Auckland seen from the eastern side of Maungawhau/Mount Eden. Sketchbook bequeathed to Dr T.M. Hocken by Sir William Fox in 1893; Dr T.M. Hocken's Collection (Wikimedia Commons).

Fig. 2. Part of William Fox's (1849) painting from Mt Eden showing the Devonport volcanoes of Takarunga/Mt Victoria and Maungauika/North Head with Rangitoto behind. Motukorea/Browns Island is also visible off the end of Musick Point.

Fig. 3. Part of William Fox's (1849) painting from Mt Eden showing the volcanoes to the east (from left to right) of Ōhinerau/Mt Hobson, Maungarei/Mt Wellington (beyond), Te Kōpuke/Mt St John (with central crater), Rarotonga/Mt Smart and Maungakiekie/One Tree Hill. The hill directly beyond Te Kōpuke is the sandstone ridge of Matukuroa/Hamlins Hill.

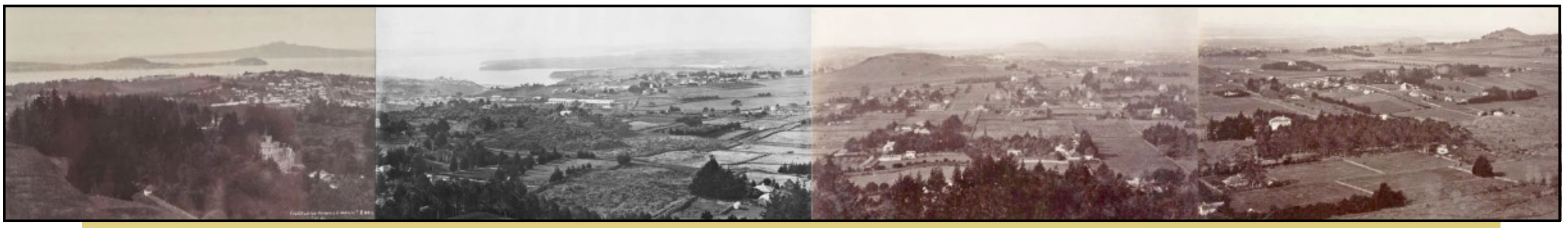

Fig. 4. Photo montage from Maungawhau/Mt Eden taken by the Burton Brothers in 1884 (three photos on right) and by Josiah Martin a few years later.

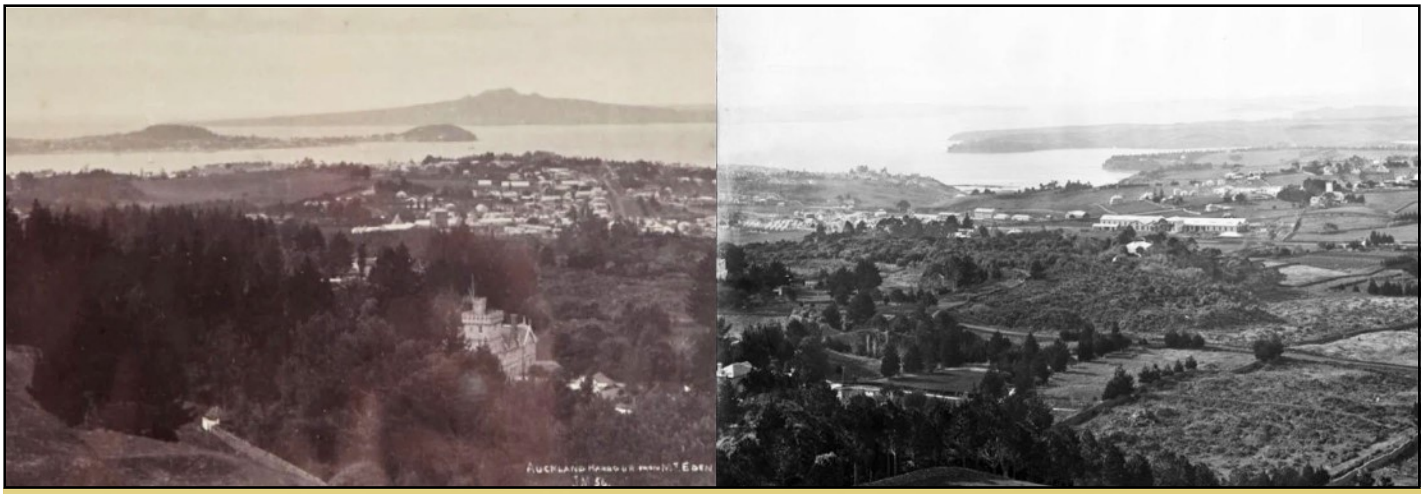

Fig. 5. 1880s photo montage from Mt Eden showing the same landscape and volcanoes as figure 3.

Fig. 6. 1884 photo montage from Mt Eden showing the same landscape and volcanoes as figure 4. Te Kōpuke is in the very centre (photo join) and additionally Rarotonga/Mt Smart is visible to the left of Maungakiekie/One Tree Hill.

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REMEMBERING MORE FOUNDATION MEMBERS OF GEOLOGY CLUB

Bruce W. Hayward

Trevor and Anita Clarke, foundation members and keen fossil collectors, participated in many Geoclub activities, 1993–2008. Photo at Geoclub Xmas BBQ at Long Bay, 2000.

Lola Gregory (right) with Keith and Colleen Eyre at Long Bay in 2000.

Trevor Clarke (left) and Les Kermode on Kawau Island, 1993.

Geoclub foundation members Merv and Maureen Burke at Paturau Beach, Northwest Nelson, 2007. Merv was a keen Geoclubber until he had to stop for health reasons, but Maureen continues up till the present as an active member of the Geoclub committee.

Merv Burke at Onekaka, Northwest Nelson, 2007.

Geoclub foundation members Merv and Maureen Burke at Whitford, 2007, with Helen Holzer (right).

Foundation member Lola Gregory was an enthusiastic Geoclub member, 1993–2007. Photo on the west coast of Northland, south of Hokianga in 1997.

Malcolm Dickens at Onekaka, Northwest Nelson, 2007.

Malcolm and Jan Dickens at Crater Hill lava caves, 2004. They were foundation members of Geoclub and regular attendees on field trips and at evening meetings until Malcolm's death in the late 2010s.

Malcolm and Jan Dickens with Theresa Kermode (centre) at Geoclub's 20th birthday party in 2012.

Fred Haeuter, and his wife Glenda, lunching beneath blackberry on the side of the road at Waiotapu in 2005. They were both Foundation members of Geoclub and attended many field trips and evening events together until Fred's death in the mid-2000s. Glenda has continued as one of the dedicated regular Geoclub members up till the present.

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HYPERLINK INSTRUCTIONS

Hyperlinks have been added to the contents page numbers column (coloured blue) to simplify finding each article. To activate a hyperlink, click on the coloured page number and you will be sent to the article beginning on that page.

At the end of each article there is another coloured hyperlink, which will take you back to the contents page.

If you wish to return to the previous page you were reading, and you have Windows operating system and standard Adobe Reader, just right click and chose 'previous view' on the drop-down menu, or you can use a shortcut Alt + left arrow. For Macintosh or Ubuntu operating systems, contact the Editor for instructions.

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