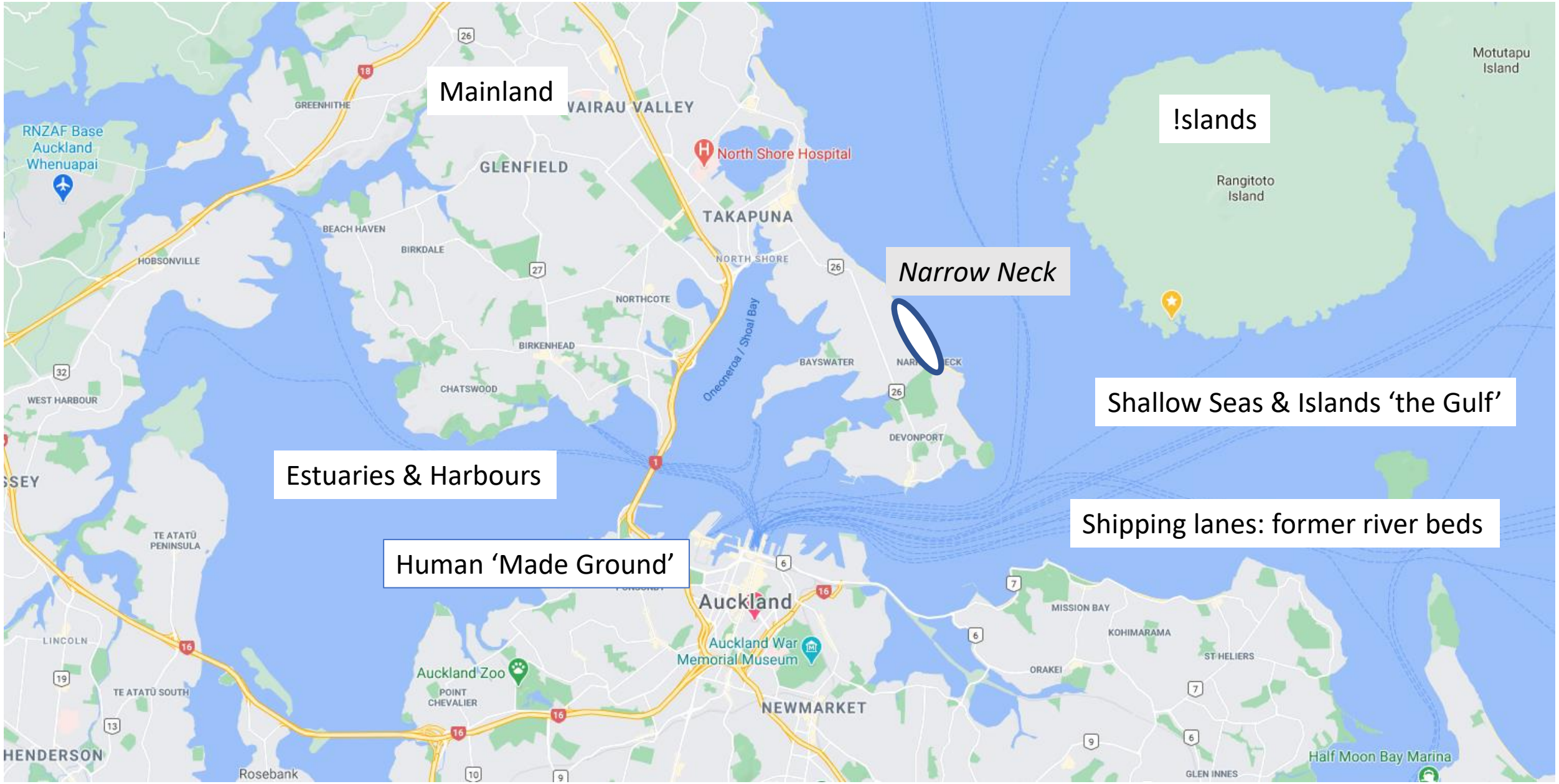
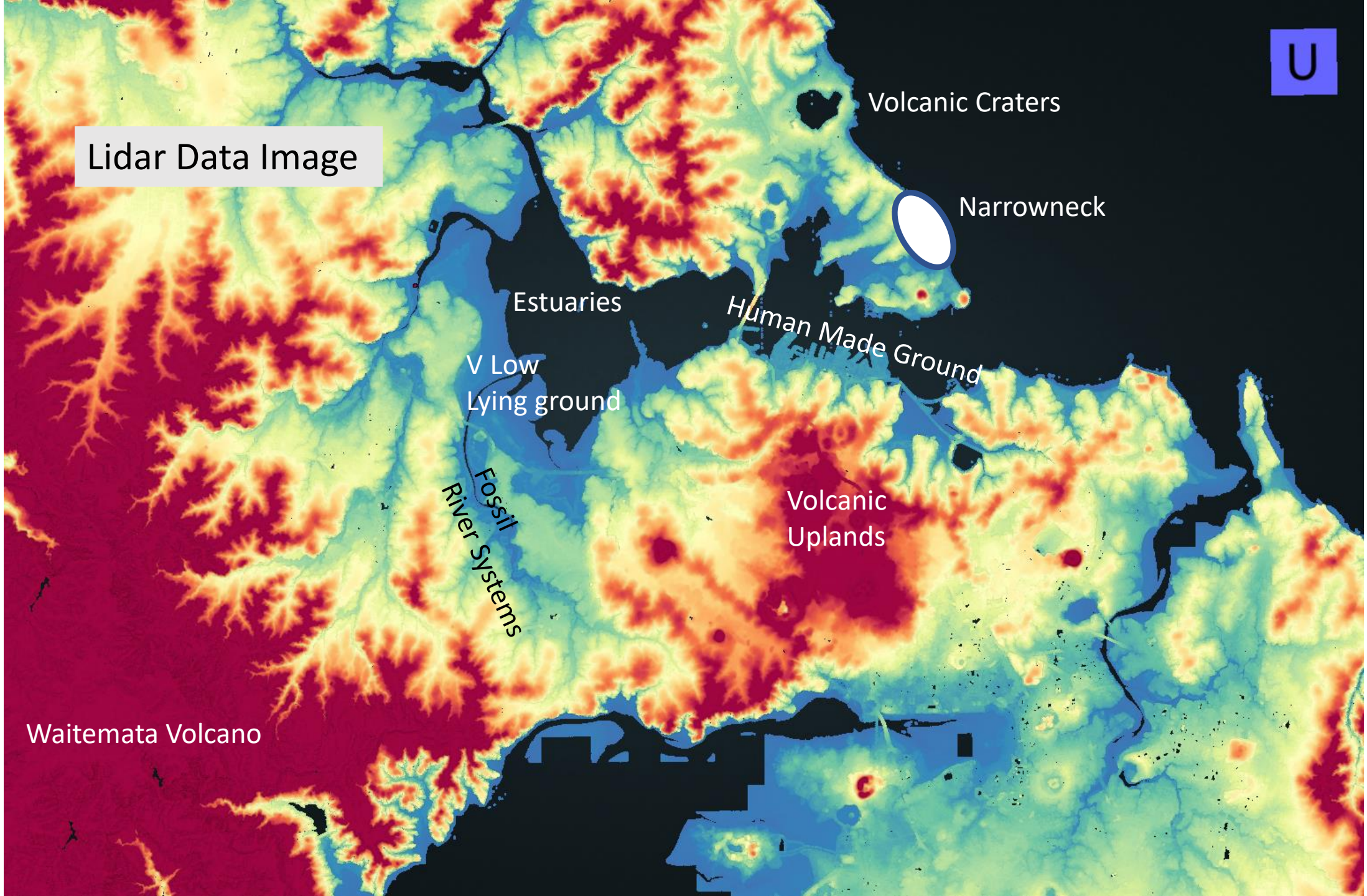
Auckland Coastal Zone Geology & Geomorphology

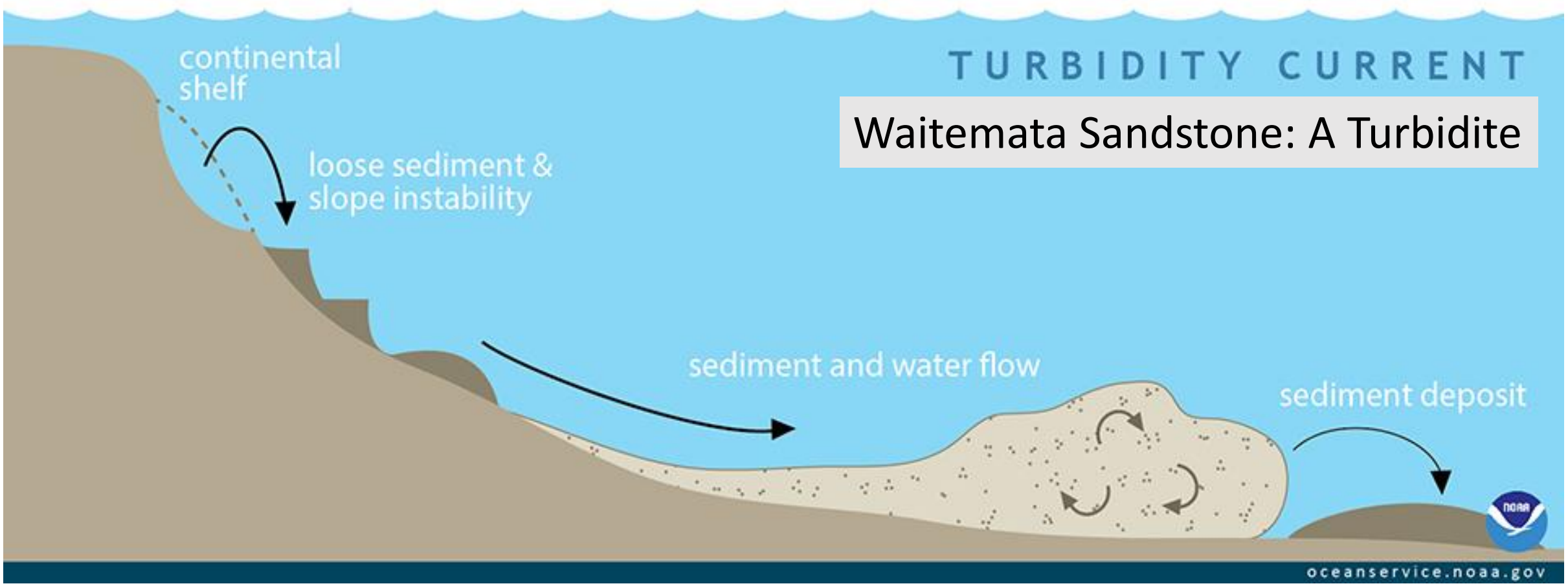
Professor Michael Petterson & Graham Hinchliffe
with Data from Chloe Samaratunga


Mainland
!slands
Narrow Neck
Shallow Seas & Islands ‘the Gulf’
Estuaries & Harbours
Shipping lanes: former river beds
Human ‘Made Ground’
Motutapu Island
Rangitoto Island
RNZAF Base Auckland Whenuapai
GREENHITHE
VAIRAU VALLEY
North Shore Hospital
GLENFIELD
TAKAPUNA
BEACH HAVEN
BIRKDALE
HOBSONVILLE
NORTH SHORE
NORTHCOTE
BIRKENHEAD
Oneoneroa / Shoal Bay
BAYSWATER
CHATSWOOD
WEST HARBOUR
DEVONPORT
TE ATATŪ PENINSULA
Auckland
Auckland War Memorial Museum
Auckland Zoo
POINT CHEVALIER
NEWMARKET
MISSION BAY
KOHIMARAMA
ST HELIERS
ORAKEI
LINCOLN
TE ATATŪ SOUTH
HENDERSON
Rosebank
GLEN INNES
Half Moon Bay Marina


Lidar Data Image
U
Volcanic Craters
Narrowneck
Estuaries
Human Made Ground
V Low
Lying ground
Fossil
River Systems
Volcanic
Uplands
Waitemata Volcano

Geological Substrate

Waitemata Sandstone
20Ma (Million Yrs Ago): Miocene
Soft conglomerates, sandstones,
Silstones & shales

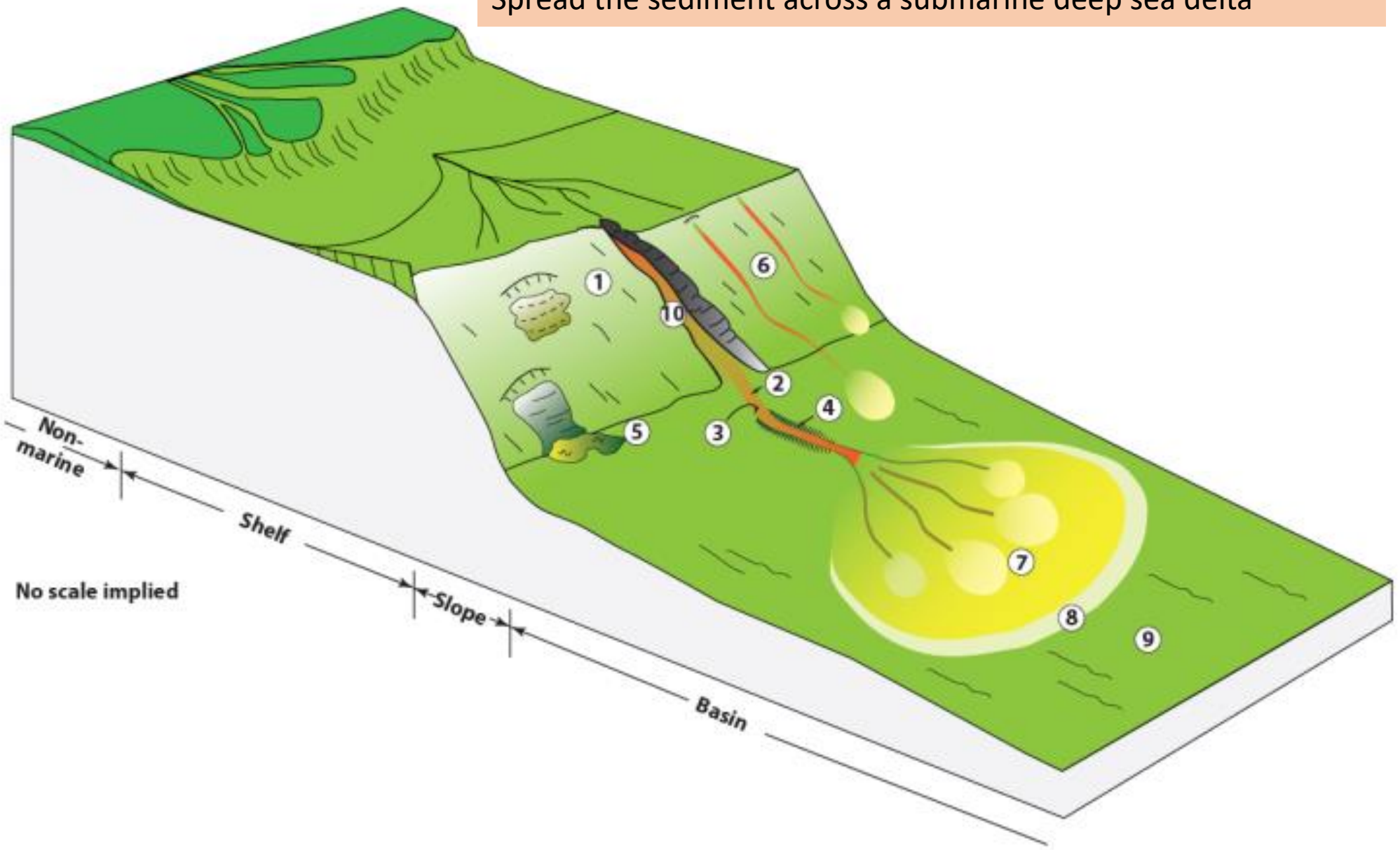


Waitemata Sandstone: A Turbidite

Sediment moves under the force of gravity down the steep continental shelf & travels with fast speeds and across long Distances as a sediment-charged water current until the momentum dies and the sediment is deposited.

Coarser materials are deposited first and finer ones later

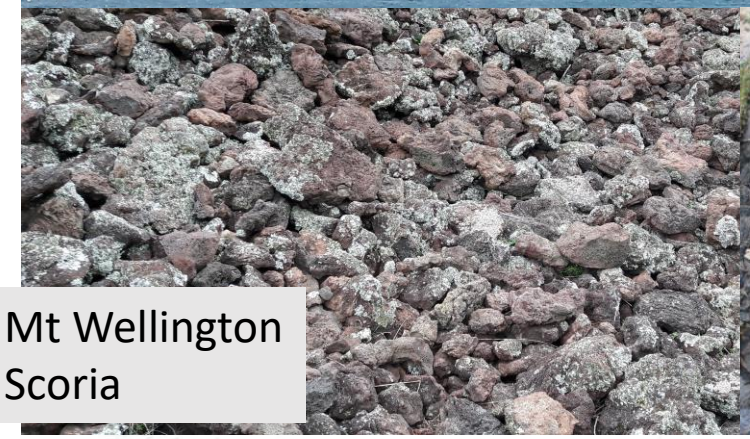
Turbidites form mainly on the continental shelf/slope
& move to deeper water. They are channel-constrained
For part of their journey and then break out of the channel and
Spread the sediment across a submarine deep sea delta



Auckland Volcanics: 250,000yrs to present: Basalts / Scoria / Tuff
Mostly hard resistant rock

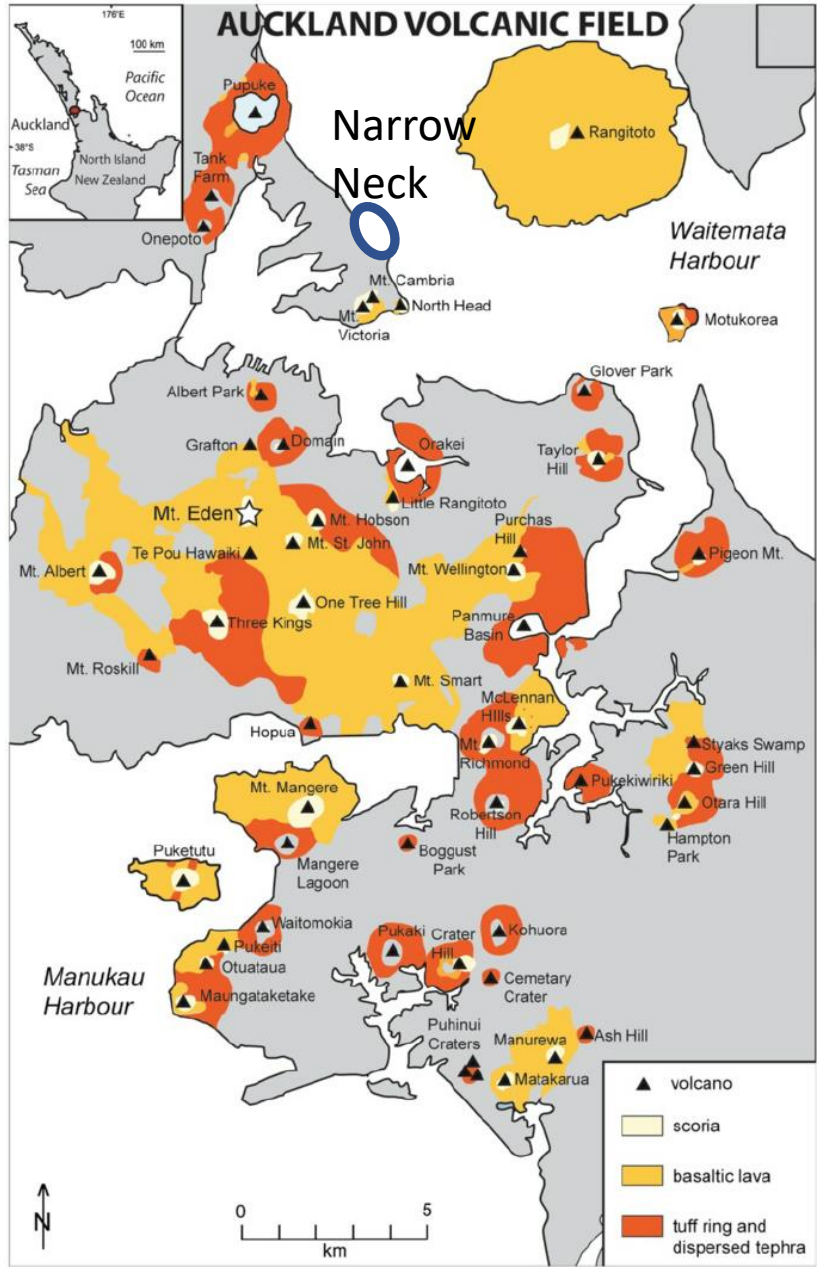
Rangitoto

Mt Wellington Scoria



Pillow basalt

North Head Tuff



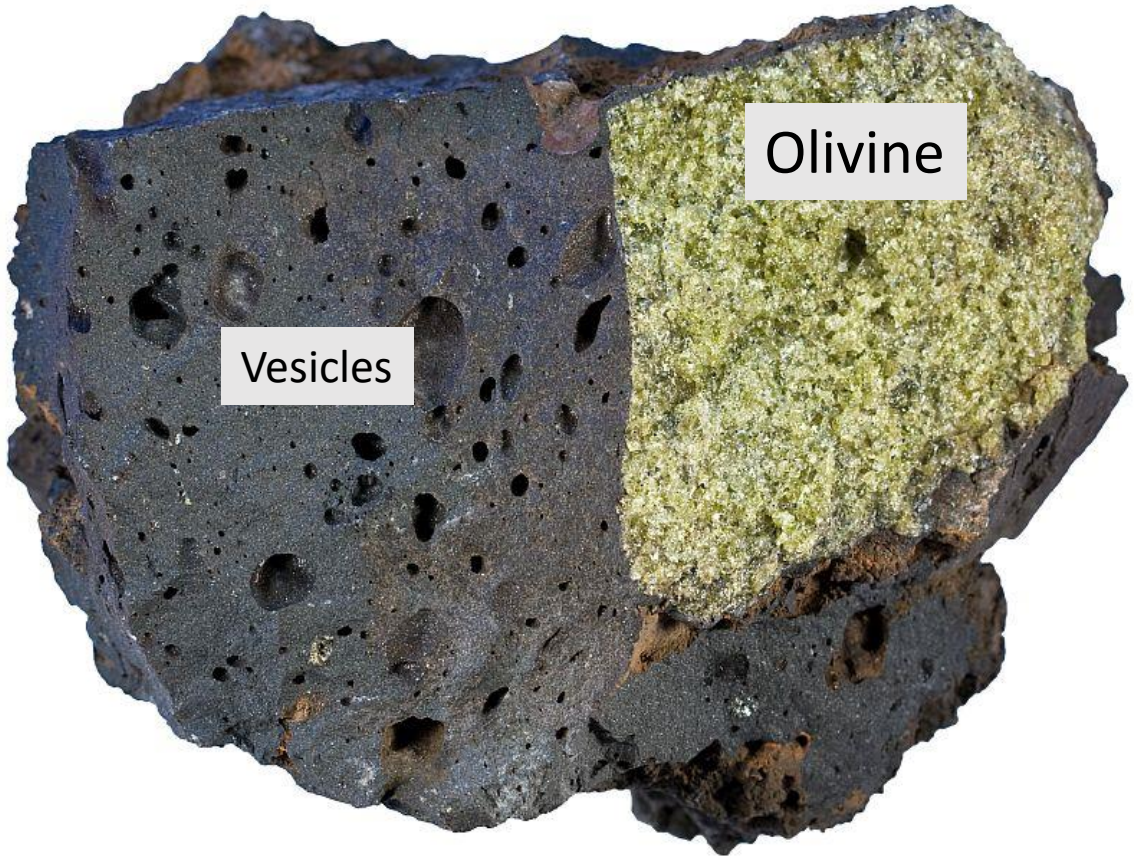
Volcanic Features of Auckland

Rangitoto: Classic shield volcano

Mount Wellington: Young Cone structure

Takapuna
Explosion Crater/
Tuff Ring

Motokorea
Tuff cone

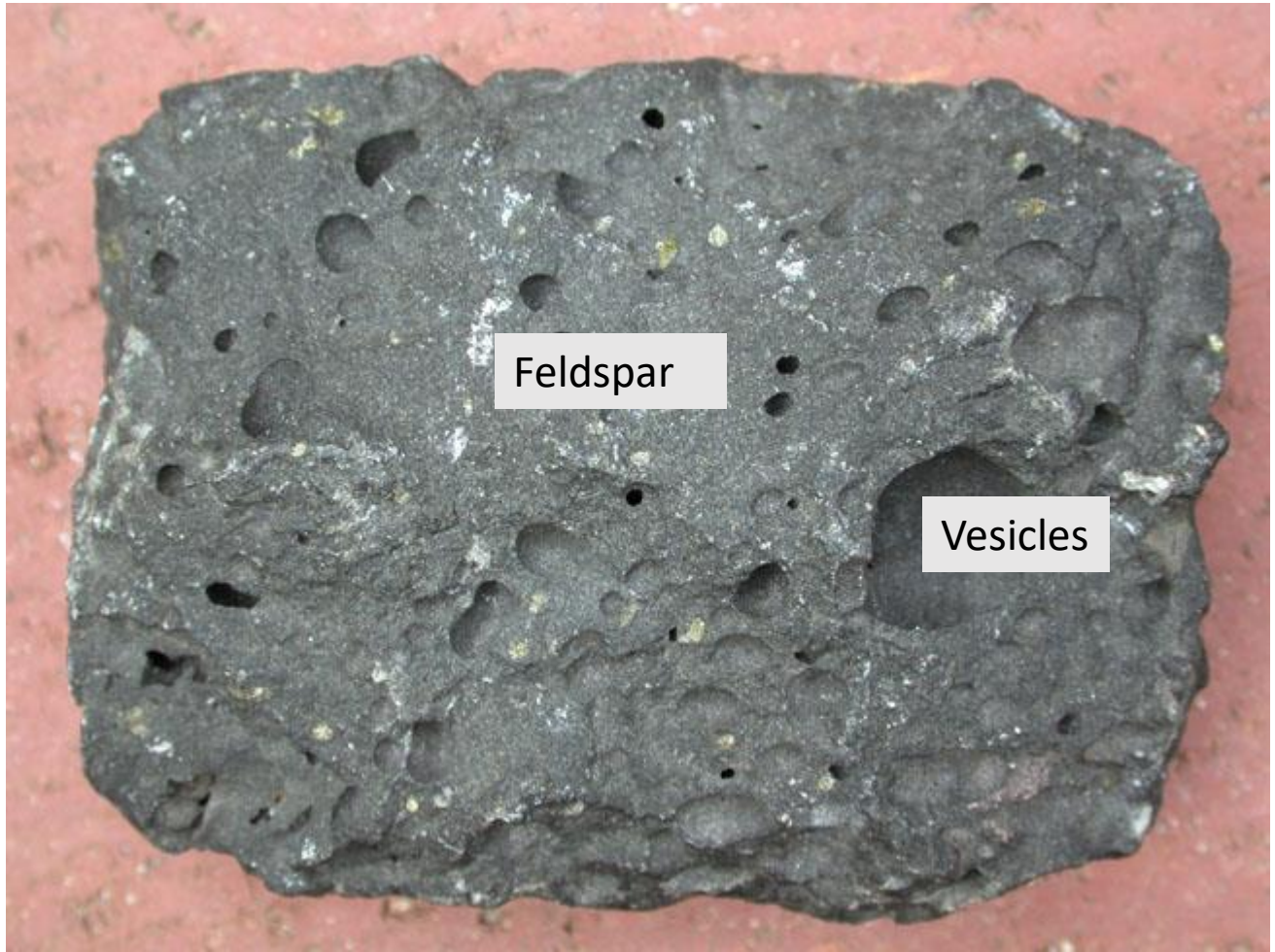


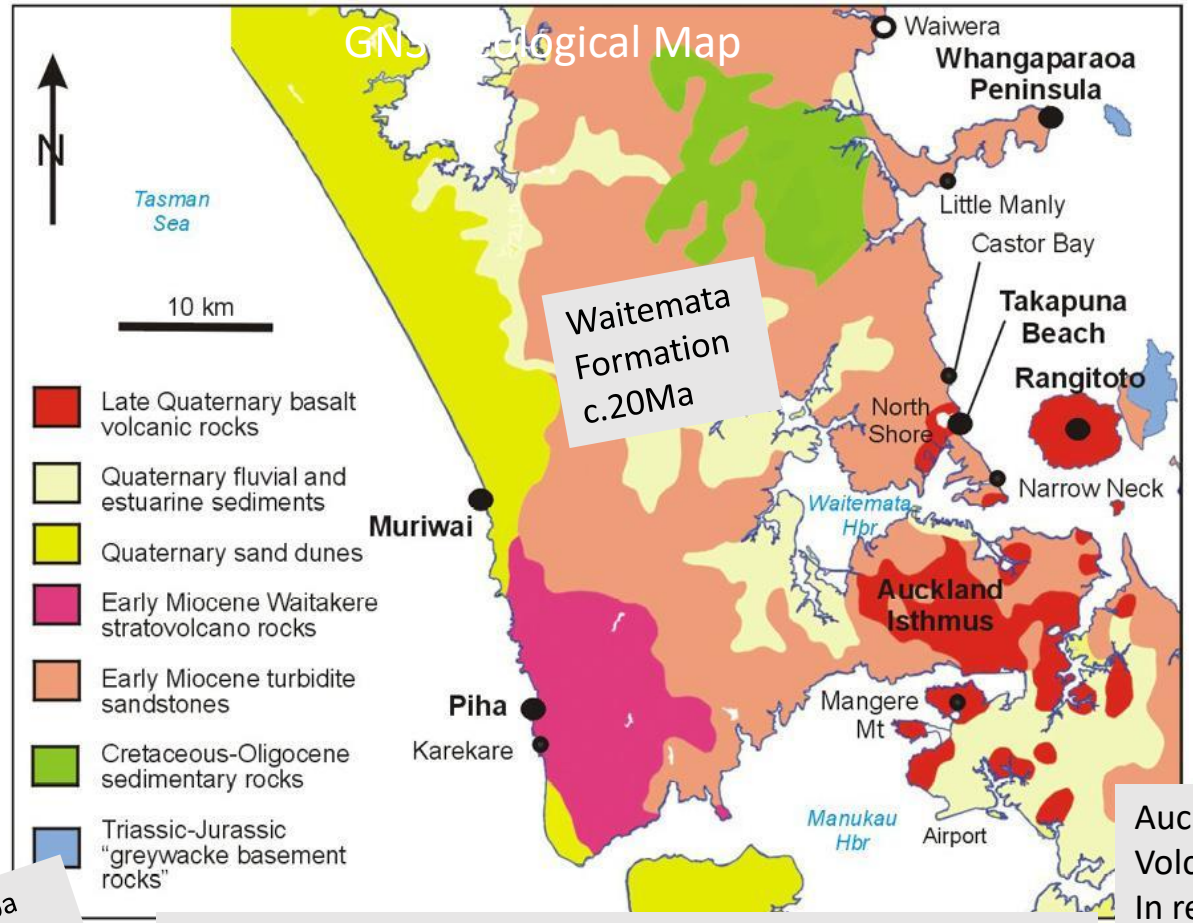
Basalt:

Strongest Rock of Auckland Volcanic Field

Dark Grey, Fine grained,

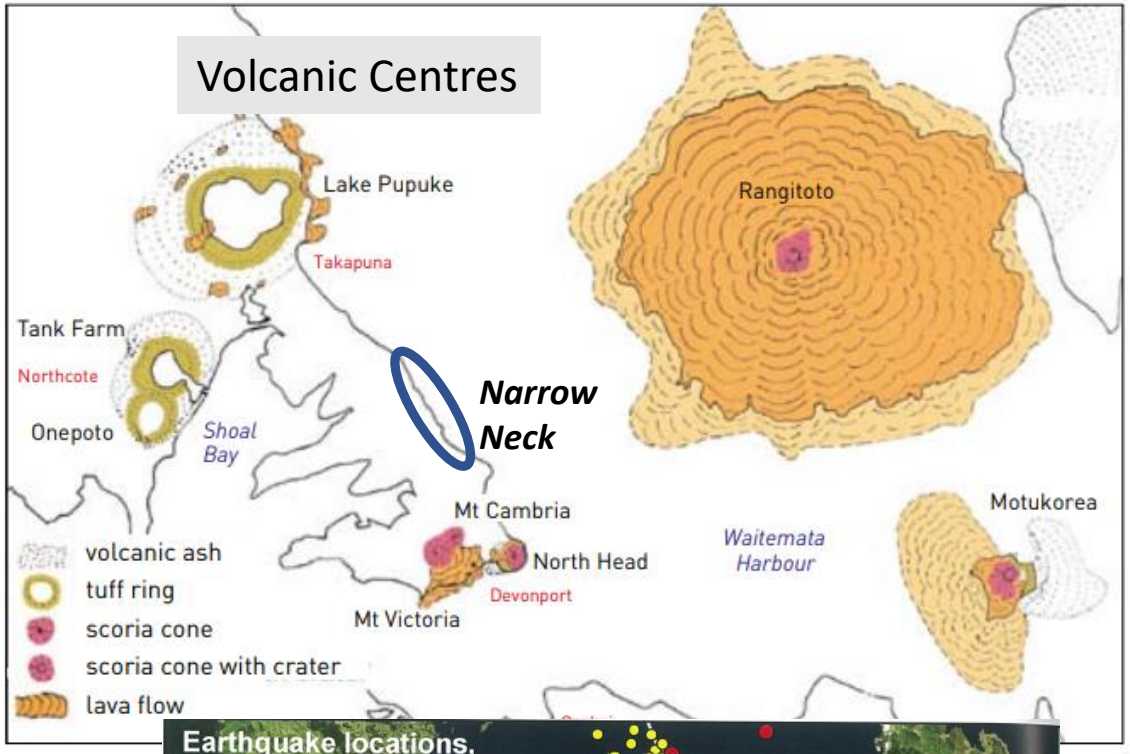
Feldspar + Olivine



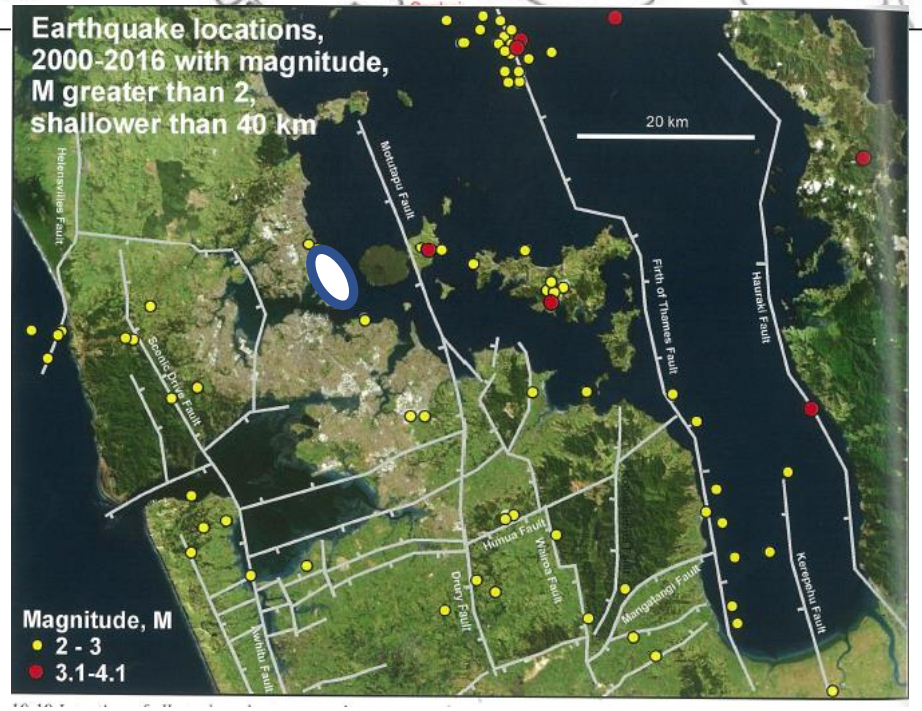


Waitemata Formation c.20Ma

Waipapa Formation 250-100Ma



Auckland Volcanics In red <250ka



Geology & Structure

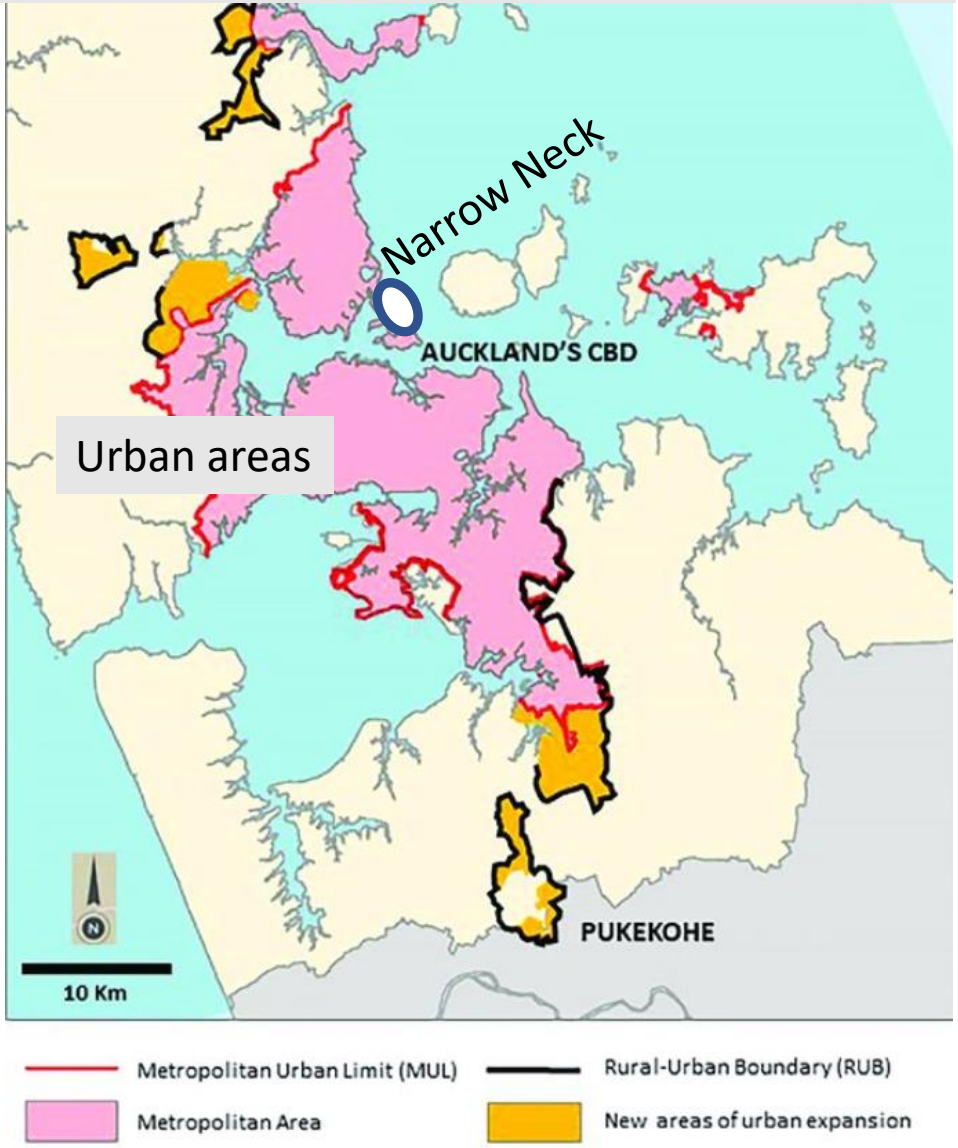
Note the linearity of many Coastlines:

NNW-SSE to N-S & East-West Faults

Strong controls on coastal shapes

Geomorphology of Auckland Coastline

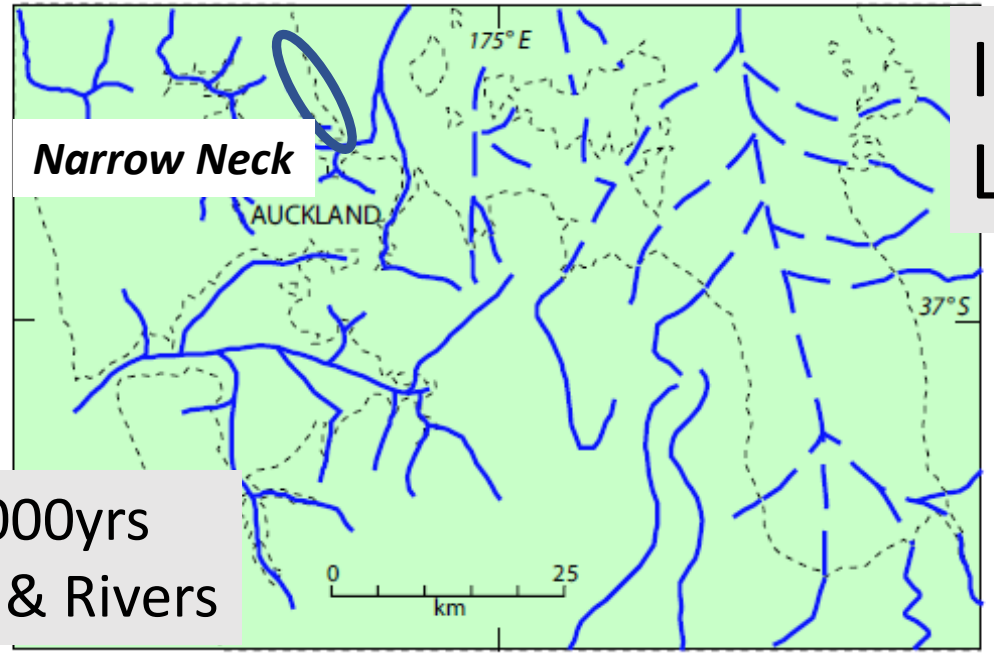
- Low Lying Land & Shallow Seas
- Linear, fault controlled coastlines
- Drowned Coastline: was 120m lower last Ice Age: river systems & valleys…now drowned by sea level rise since 20,000 yrs ago
- Sediment starved: Waikato River flowed into Hauraki pre Taupo Oruanui Eruption (26,500yrs ago)…now flows into Port Waikato
- Urbanised Coastline



Impact of Last Ice Age

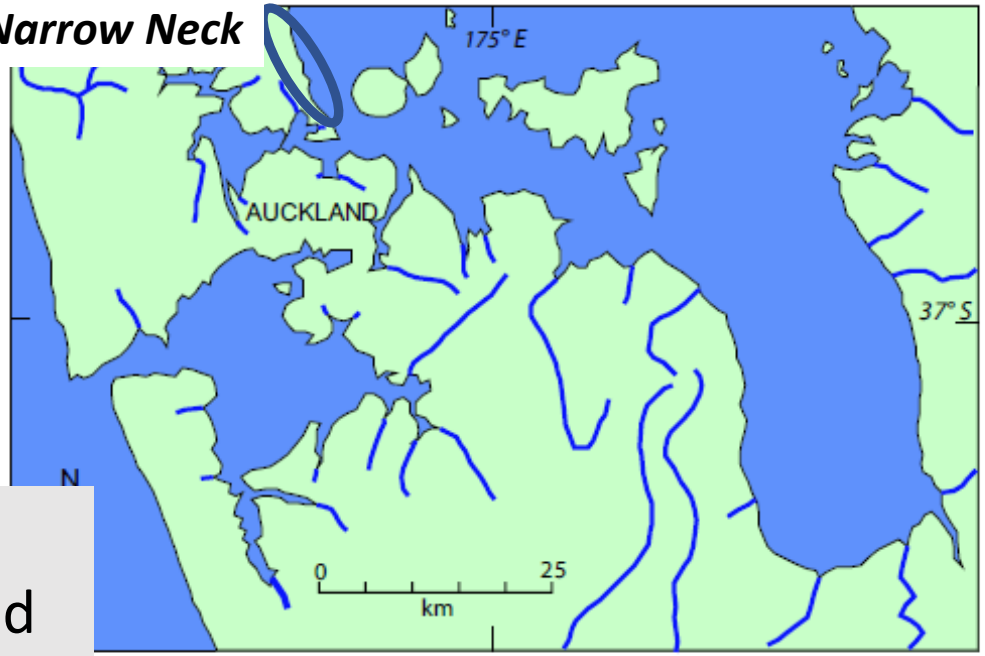
A - low sea-level.

A greatly enlarged land area.



>20,000yrs
Land & Rivers

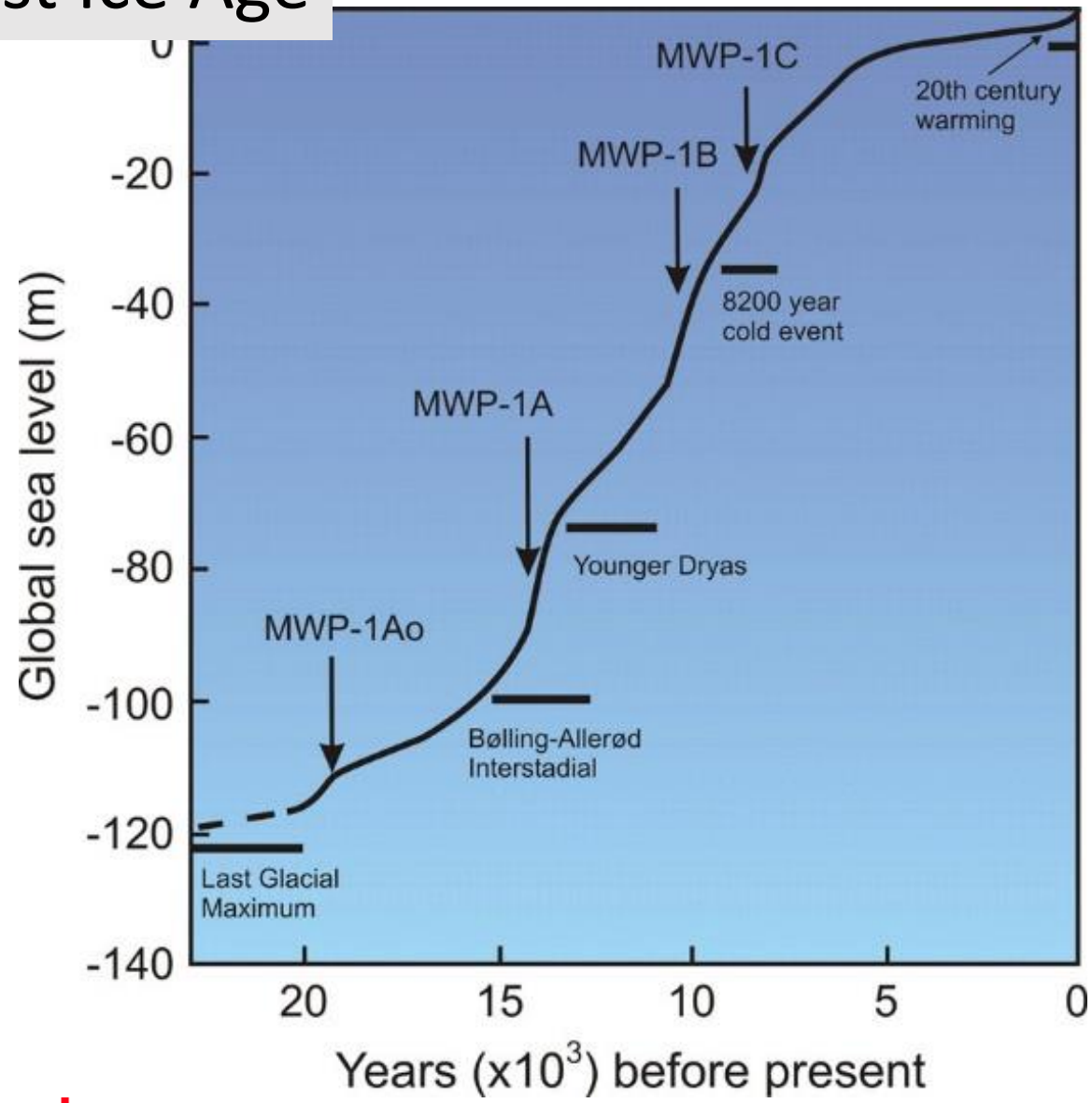
B - high sea-level



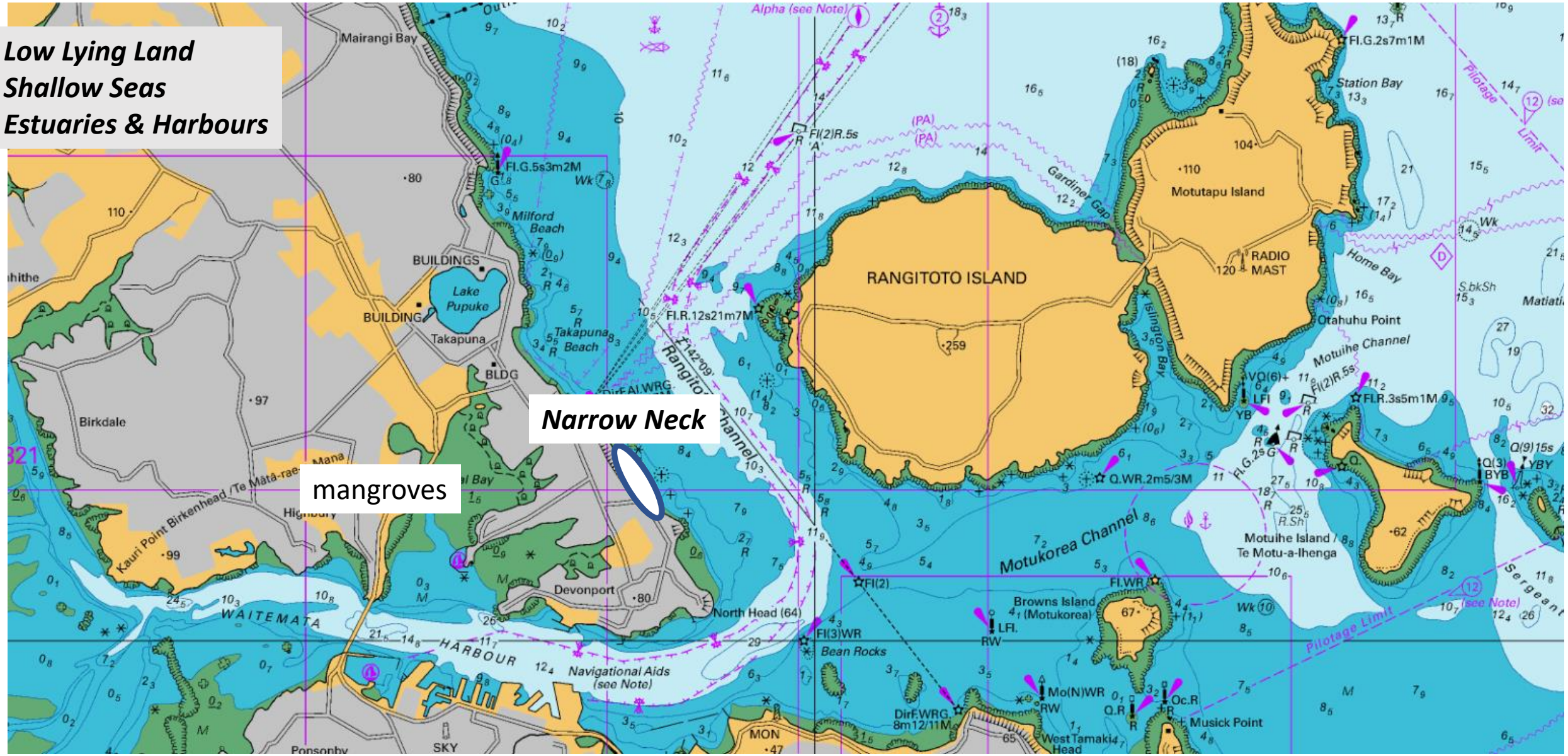
Today:
Submerged
River System

e more consequences of changes of sea-level driven by glaciations.

Sea Level Changes:
120m lower last Ice Age



Bathymetry: Note the shallowness of the sea surrounds: Green = low tide position, dark blue <10m, light blue > 10m
Even the channels are v shallow with maz depths of 29m, 21m, 12m, 16m etc…**Drowned Coastlines : former river valleys**



Taranaki Sea Stacks

4. Spectacular natural arch in gently dipping strata at Whahariki Beach, Northwest Nelson.

GEOSCIENCE SOCIETY OF NEW ZEALAND GUIDEBOOK NUMBER 17

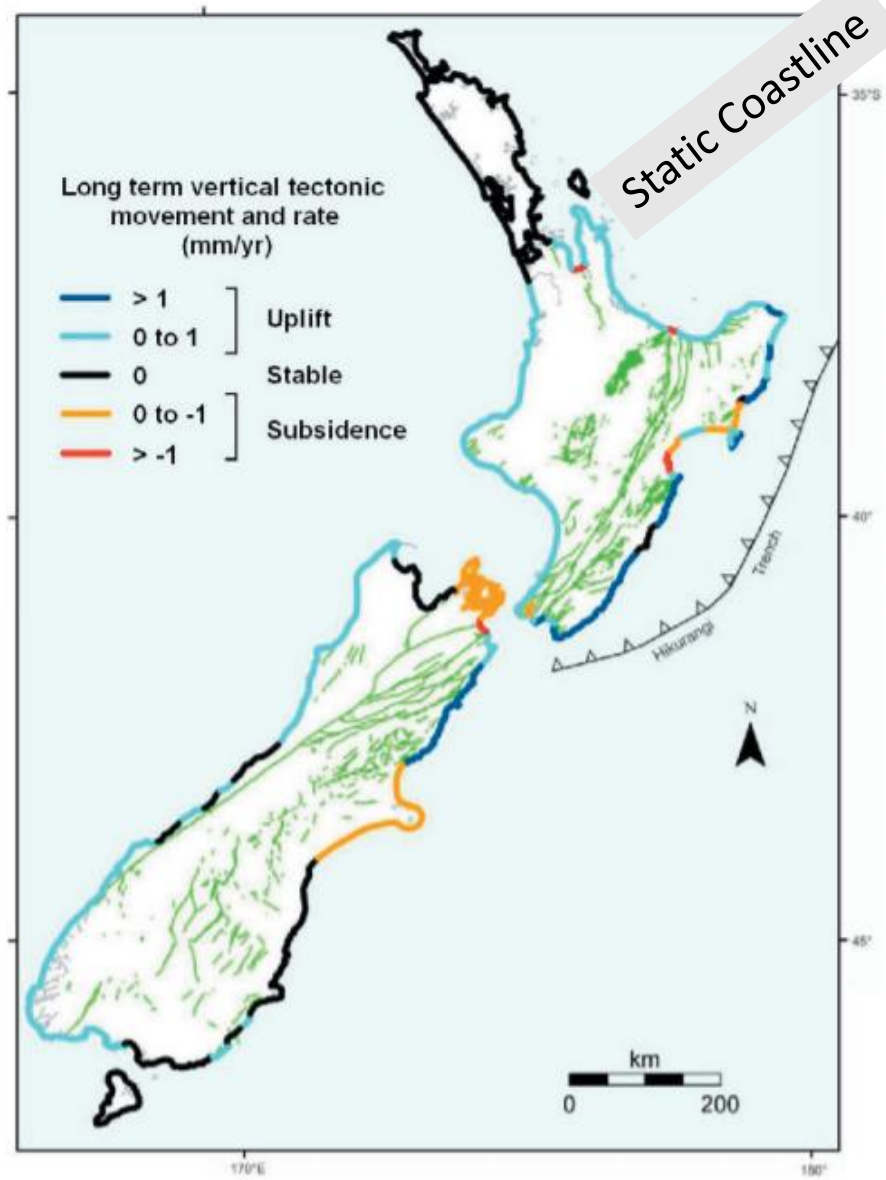
On The Edge

CELEBRATING THE DIVERSITY OF NEW ZEALAND'S COASTAL LANDFORMS

by Jill A. Kenny & Bruce W. Hayward

Examples of NZ Coasts

Geoscience Society of New Zealand



18 (left). Tectonic uplift and subsidence rates around the New Zealand coast
Long-term vertical tectonic movements of the New Zealand coastline, compiled primarily from elevation of 125,000 year old coastal terraces (map courtesy of Nicola Litchfield 2013).
A major factor in determining the character and landforms of a section of coast is whether it is stable, going up, or going down.

From Hayward & Kenny

Classification of Coastline By Tectonics

Uplift & Subsidence in NZ

Present Day

Caused by Tectonics

Measured by satellite & ground GPS

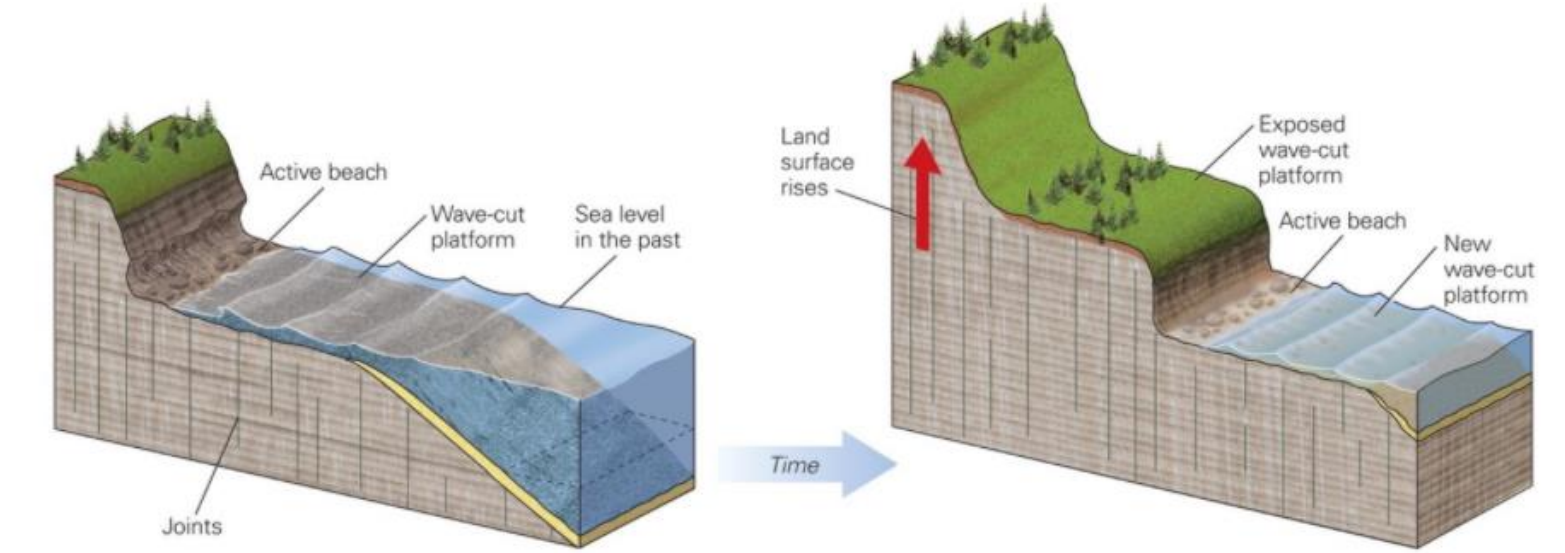
Uplift close to active uplifting faults,
e.g. subduction zones & Alpine Fault

Subsidence because of tectonics &
Accommodation of large amounts of sediment

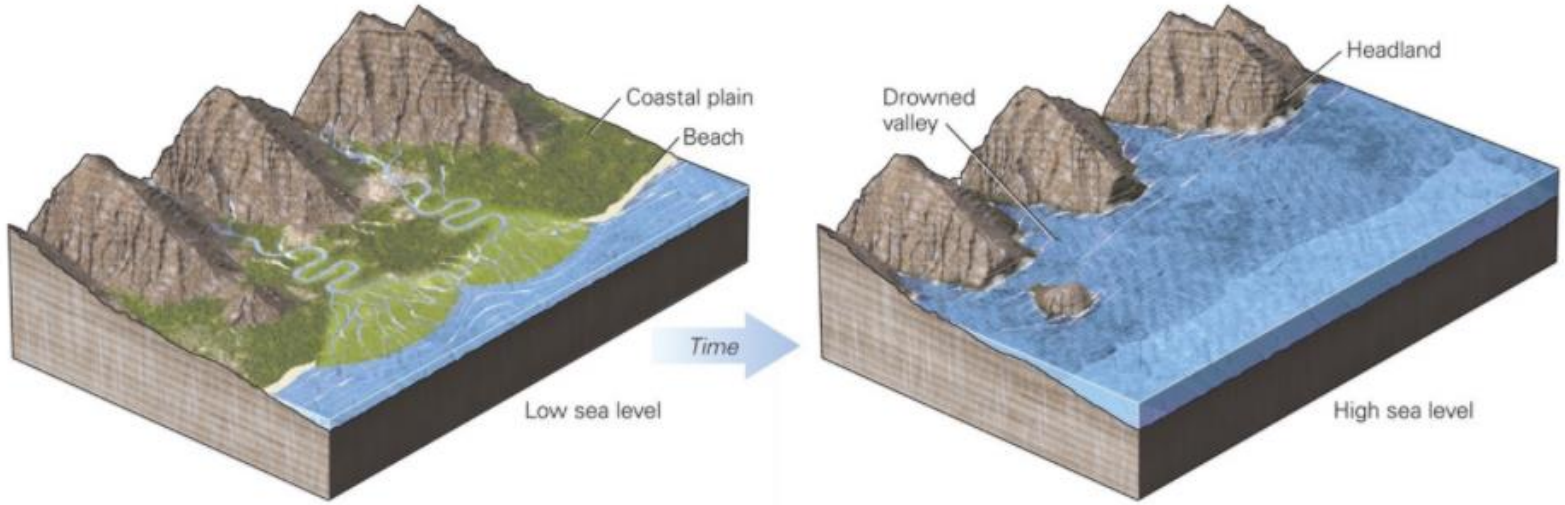
NB

This is the *present day*
We know that things were different in past times

Emergent & Submergent Coastal Features



(a) *Emergent coasts*: Wave erosion produces a wave-cut platform along an emergent coast. As the land rises or relative sea level falls, the platform becomes a terrace, and a new wave-cut platform forms.



(b) *Submergent coasts*: Rivers drain valleys and deposit sediment on a coastal plain. As relative sea level rises, the valleys are flooded and waves erode the headlands.

FIGURE 18.35 Features of emergent coasts (where relative sea level is falling) and submergent coasts (where relative sea level is rising).

Steep Cliffs
Raised Beaches
Wave Cut Platforms
Extensive Coastal Plains

Lower right…drowned/submergent Coastlines (e.g. Auckland, Marlborough, Fiordland)

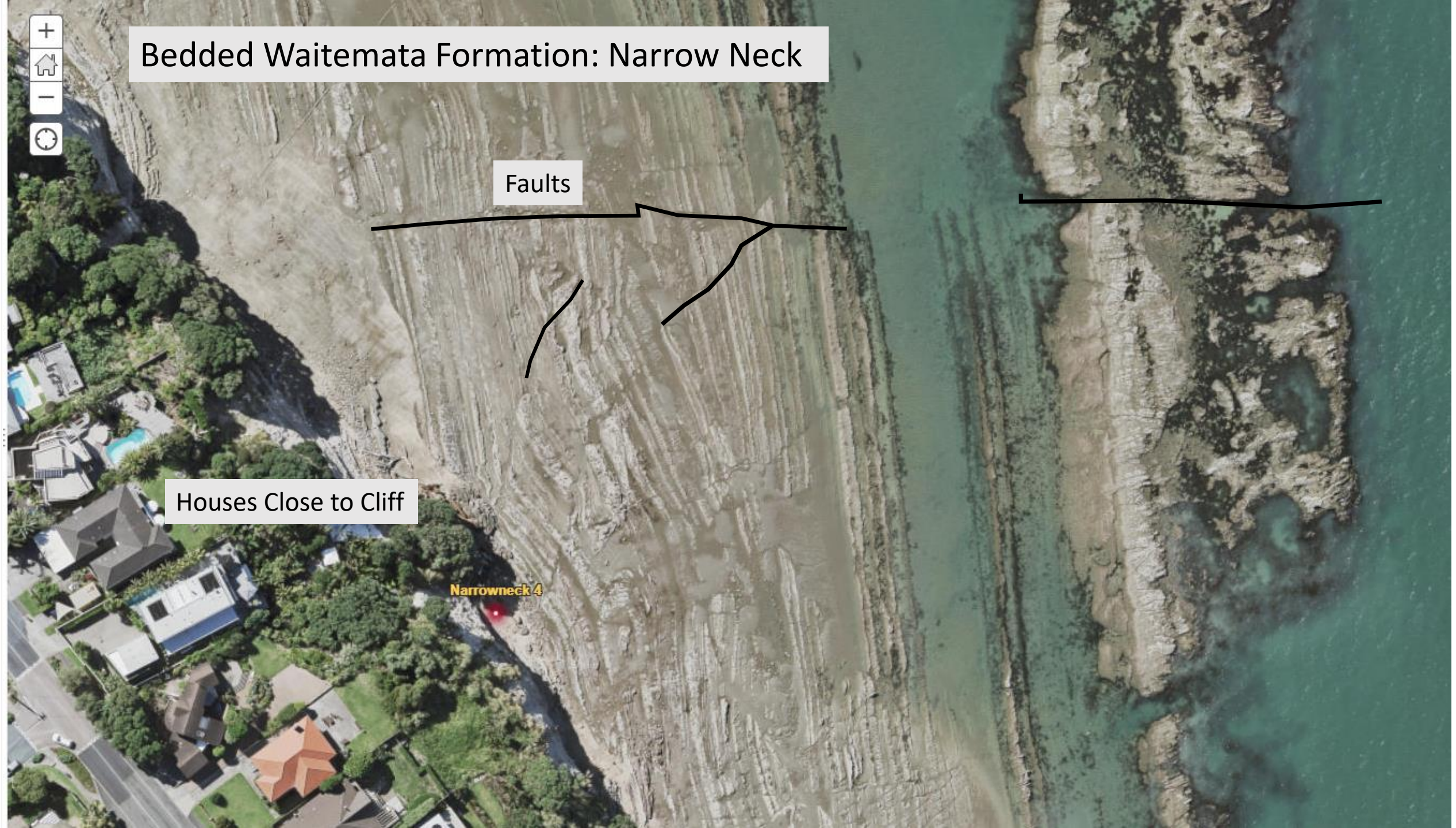
Drowned Coasts

37 (left). Drowned explosion craters
Some of the explosion craters of the Auckland Volcanic Field have been inundated by the sea. Of the 3 explosions craters on Auckland's North Shore, only Tank Farm (centre) remains in a largely pristine state. Onepoto Basin (grassy fields, lower right) has been reclaimed and Pupuke (upper left) is a freshwater lake, not invaded by the adjacent Waitemata Harbour.

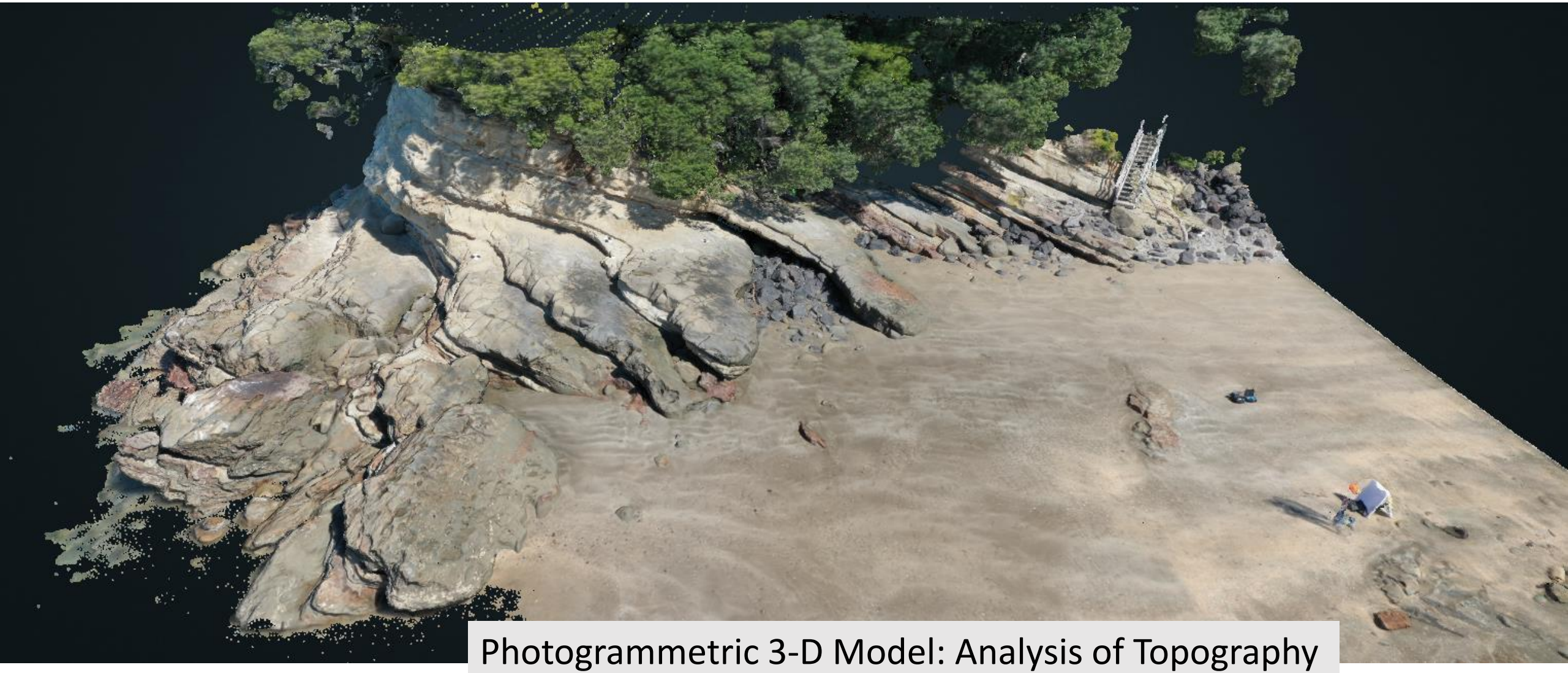
38 (above). Drowned volcanoes
Motukorea (Browns Island), in Auckland's Waitemata Harbour, was erupted onto dry land during the Last Ice Age when sea level was lower. It is now an island at the entrance to Tamaki Estuary (top right of photo) and is being eroded by the sea.

39. Drowned ridge crests
Cape Jackson forms the northern extremity of a long, sinuous drowned ridge line jutting into Cook Strait between Queen Charlotte Sound and Port Gore, Marlborough Sounds. Other drowned ridges are visible in the distance, including spindle-shaped Long Island in mid-channel (right side of photo) and the large V-shaped Arapawa Island beyond.

40. Inundated forests
Drowned forests have a strange melancholy appearance. Here at Rangihaeata, Golden Bay, we see trunks and roots of forest trees that grew here 8000 years ago and were killed by rising sea level at the end of the Last Ice Age. They have been buried and preserved in wet sediment and only recently exhumed by sea erosion (photo Egon Eberle, 2009).

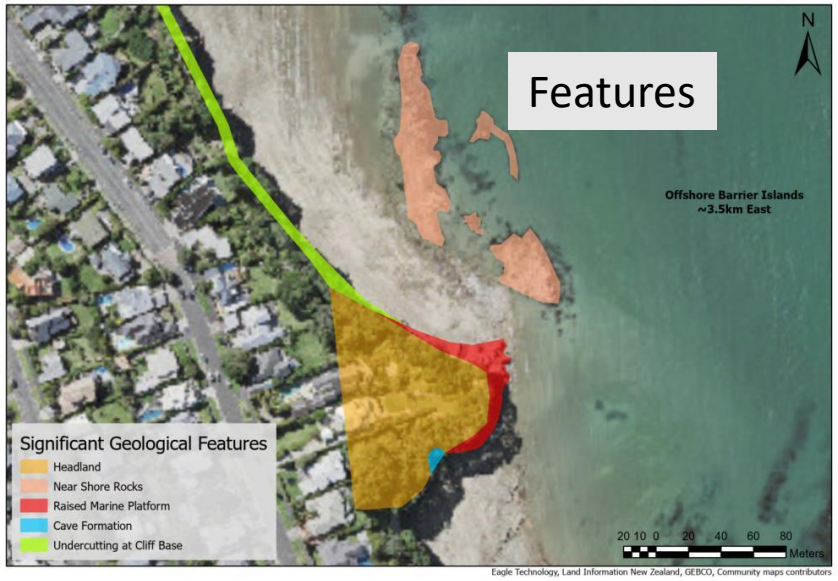

Bedded Waitemata Formation: Narrow Neck
Faults
Houses Close to Cliff
Narrowneck 4

Coastal Protection from Erosion:
Large ‘Armour’ Basalt Boulders at the Foot of the Cliff & Seawall

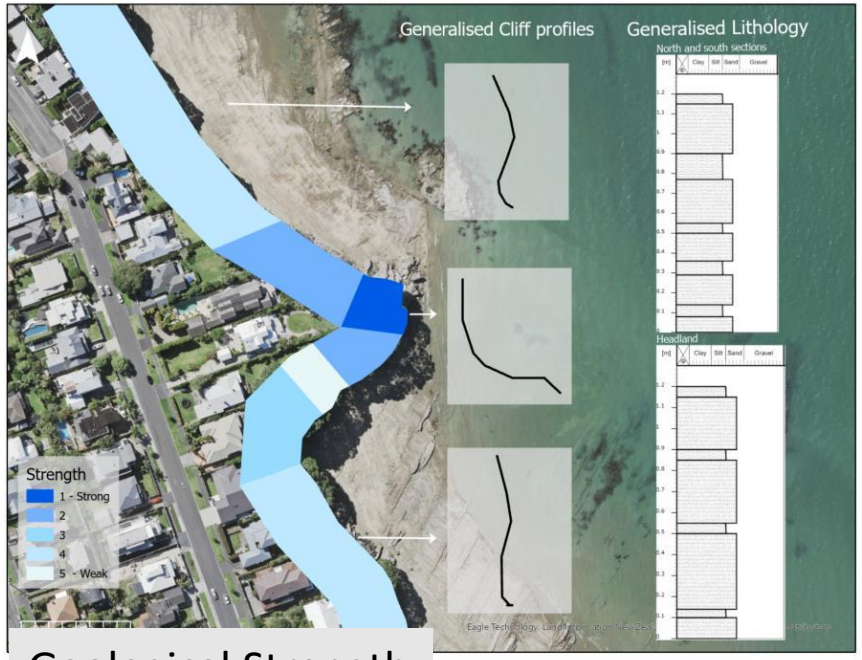


Photogrammetric 3-D Model: Analysis of Topography
Bedded Sandstone and Cliff Erosion

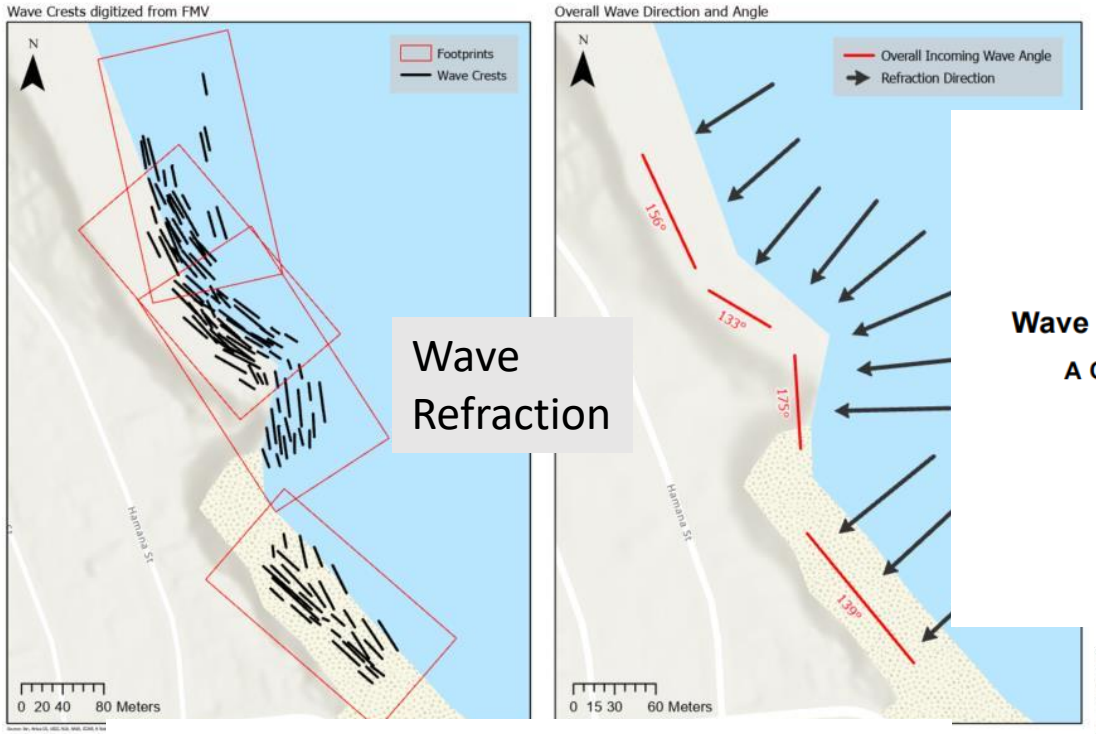
Significant Geological Features at Narrowneck Auckland NZ



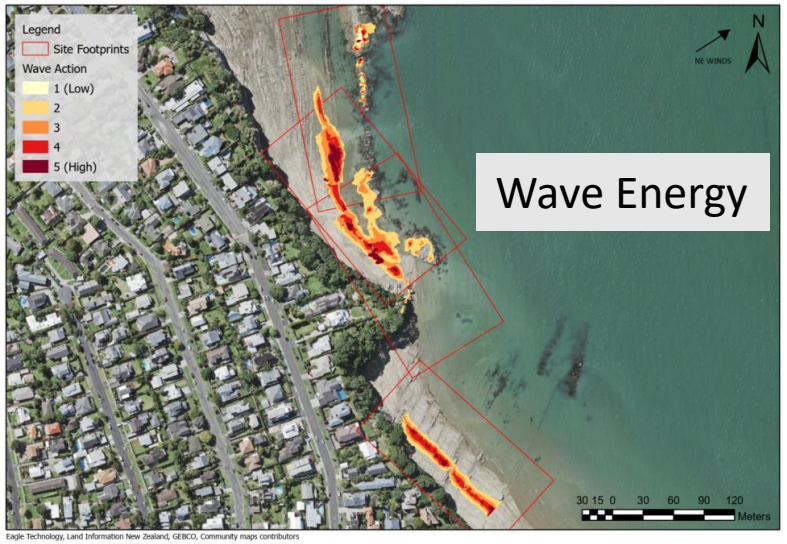
Generalised Geological Stability at Narrowneck



Wave Refraction at Narrowneck NZ



Wave energy distribution at Narrowneck Auckland NZ



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Wave Energy Dynamics And Coastal Erosion

A Case Study On Narrow Neck Bay, Auckland

2022

Auckland University of Technology

School of Science