

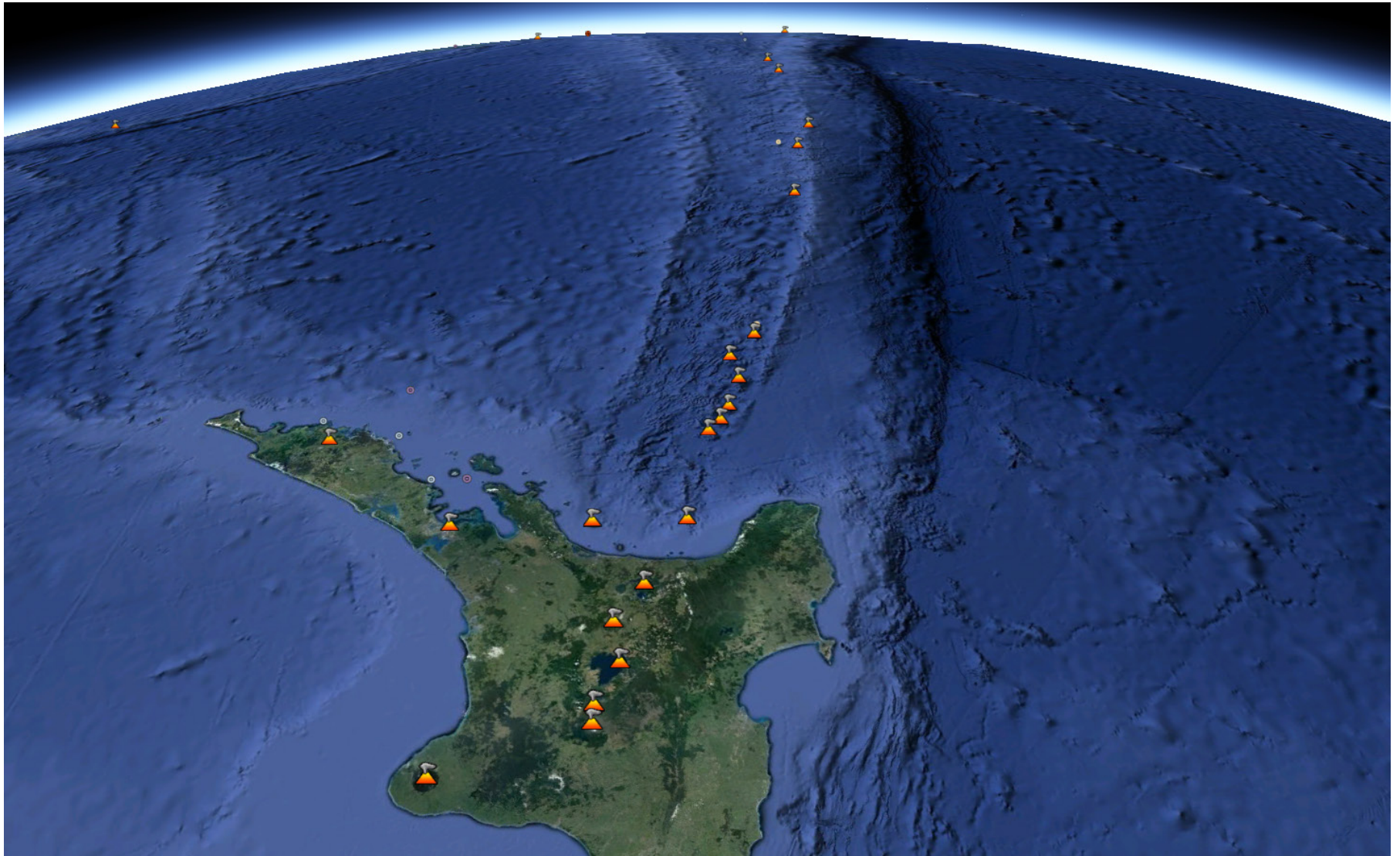
# Arc Volcanism in New Zealand



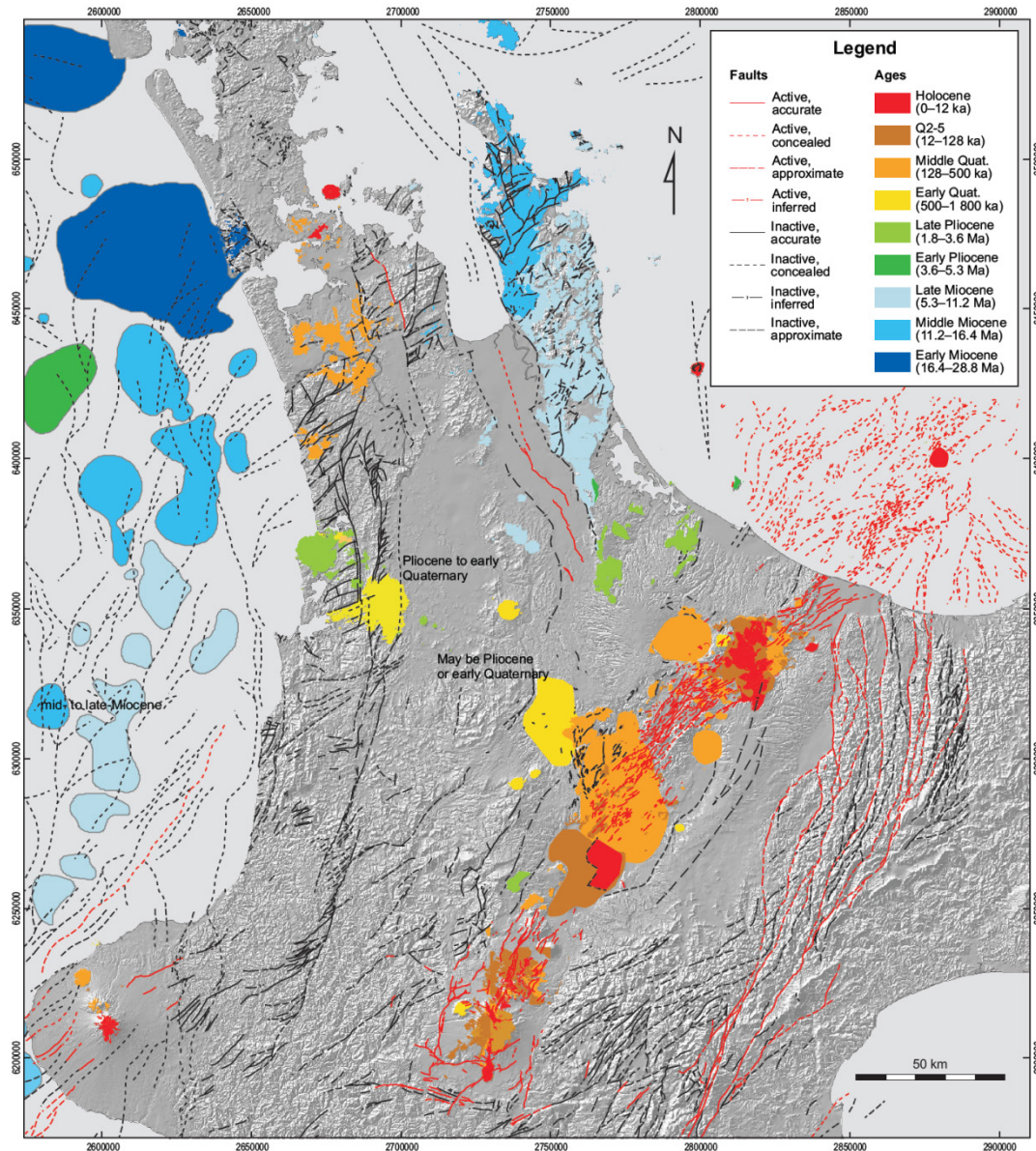
Graham Leonard



# New Zealand subduction zone and volcanic arc



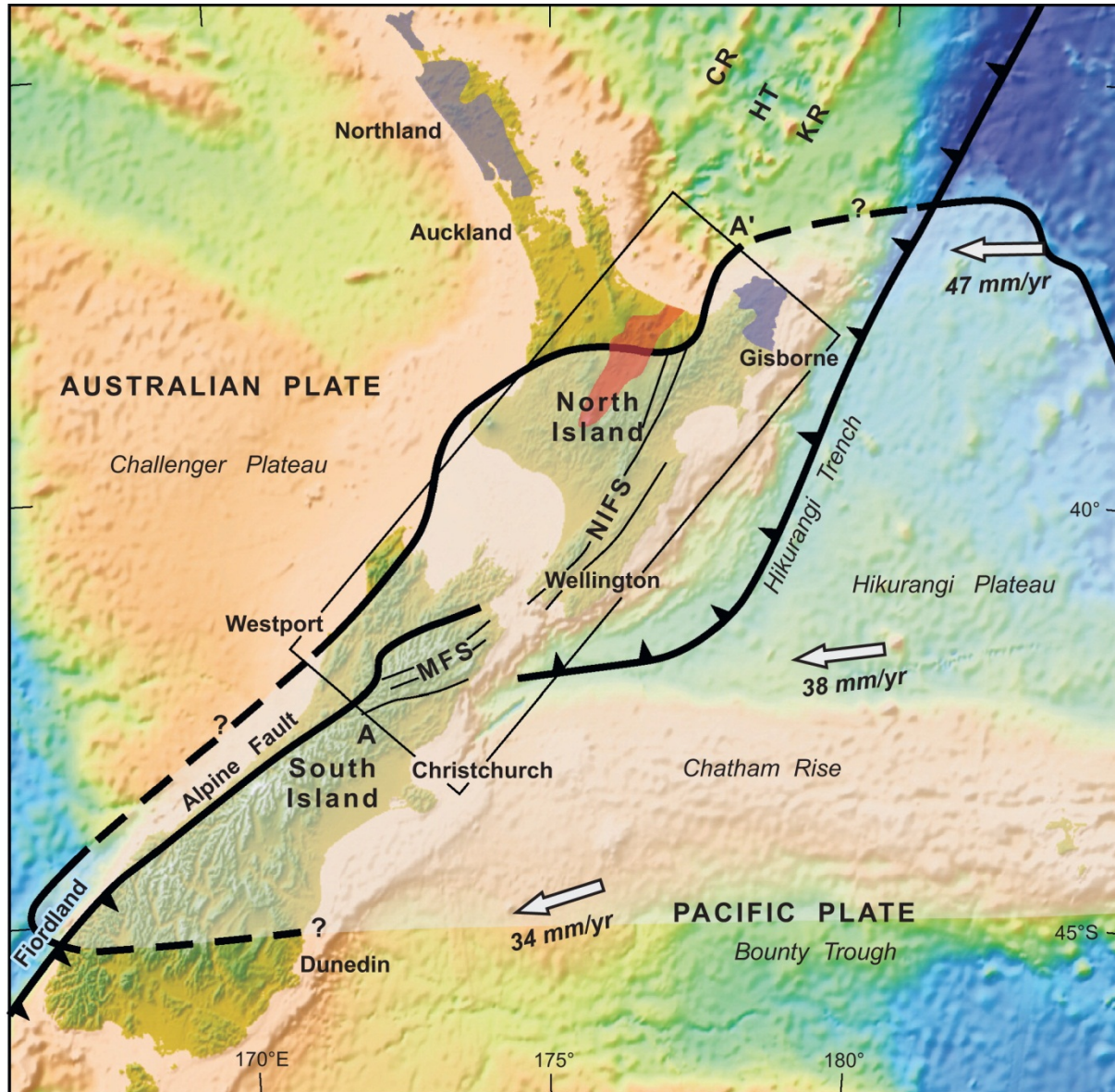
# Ages of volcanism and faulting



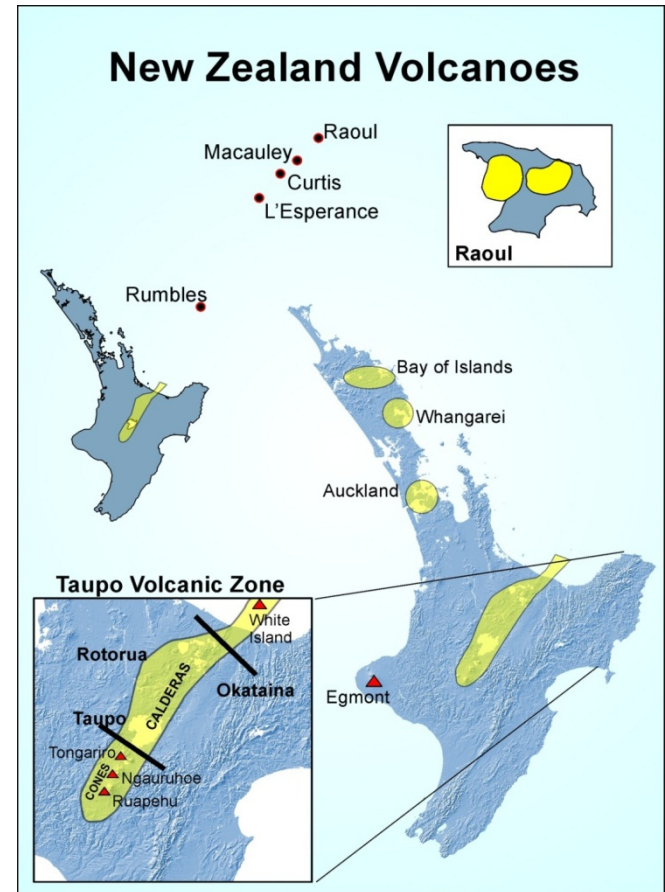
Leonard et al., 2010  
(QMAP Rotorua)

# Subducting Plateau

M. Reyners. Earth and Planetary Science Letters  
Volume 361, 1 January 2013, Pages 460–468



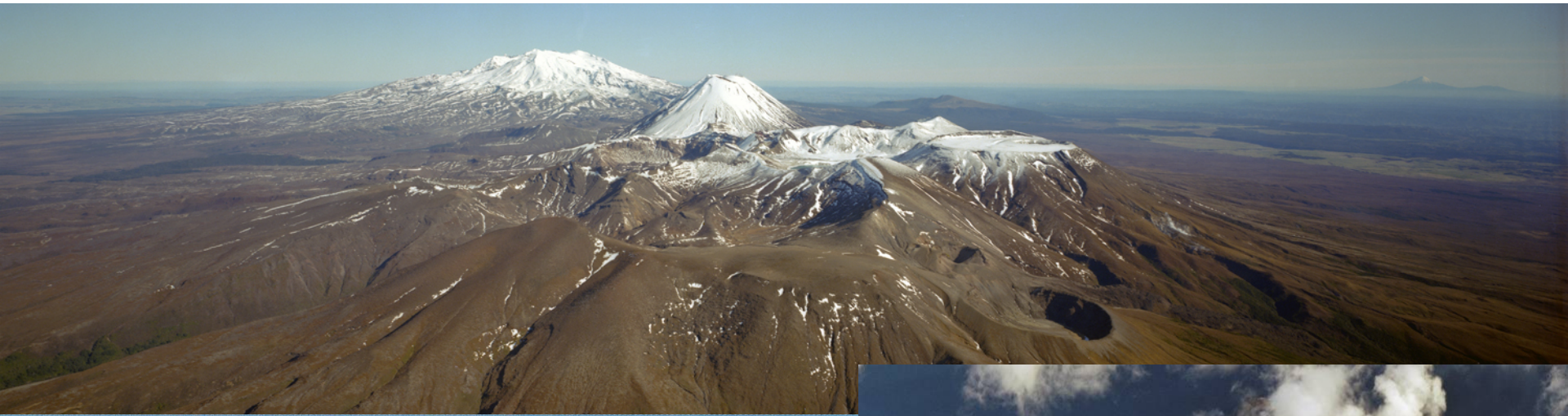
# Active Volcanoes in NZ



# Taupo Volcanic Zone – rhyolite and andesite (and a hint of basalt)



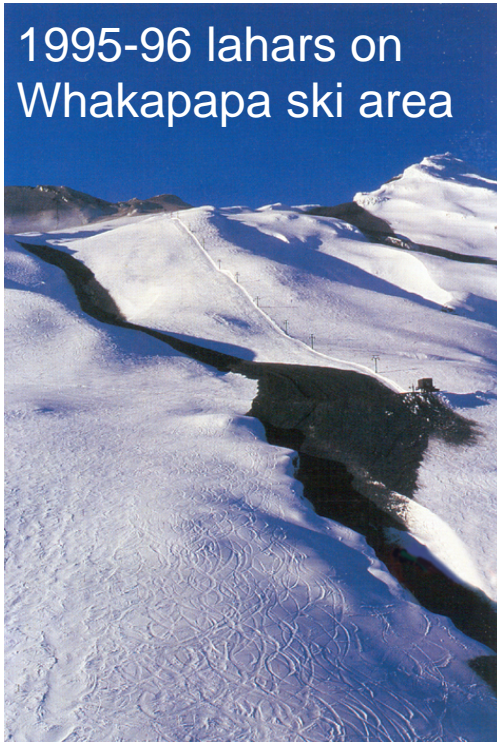
# Cones Volcanoes



# Ruapehu erupted most recently in 1995-96



1995-96 lahars on  
Whakapapa ski area



Lahar damage in 1975 eruption

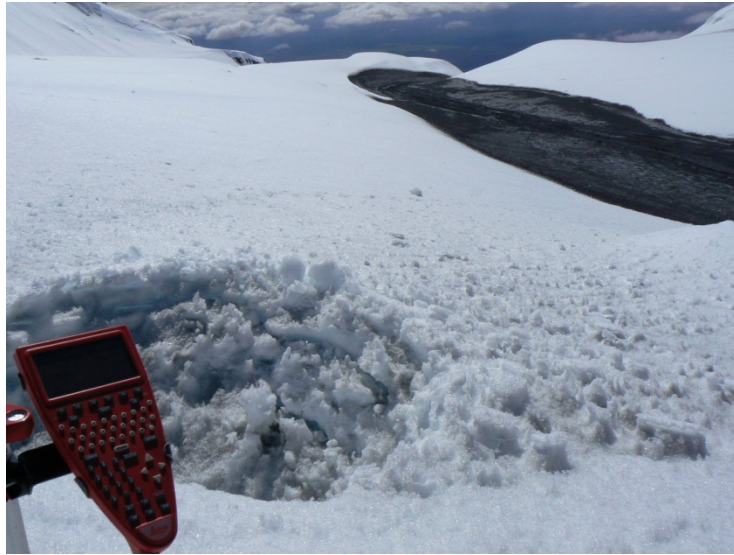


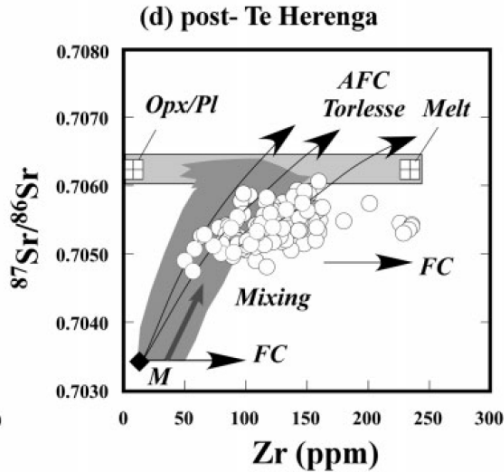
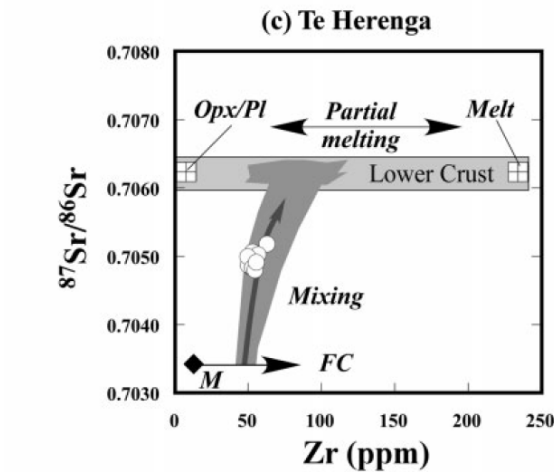
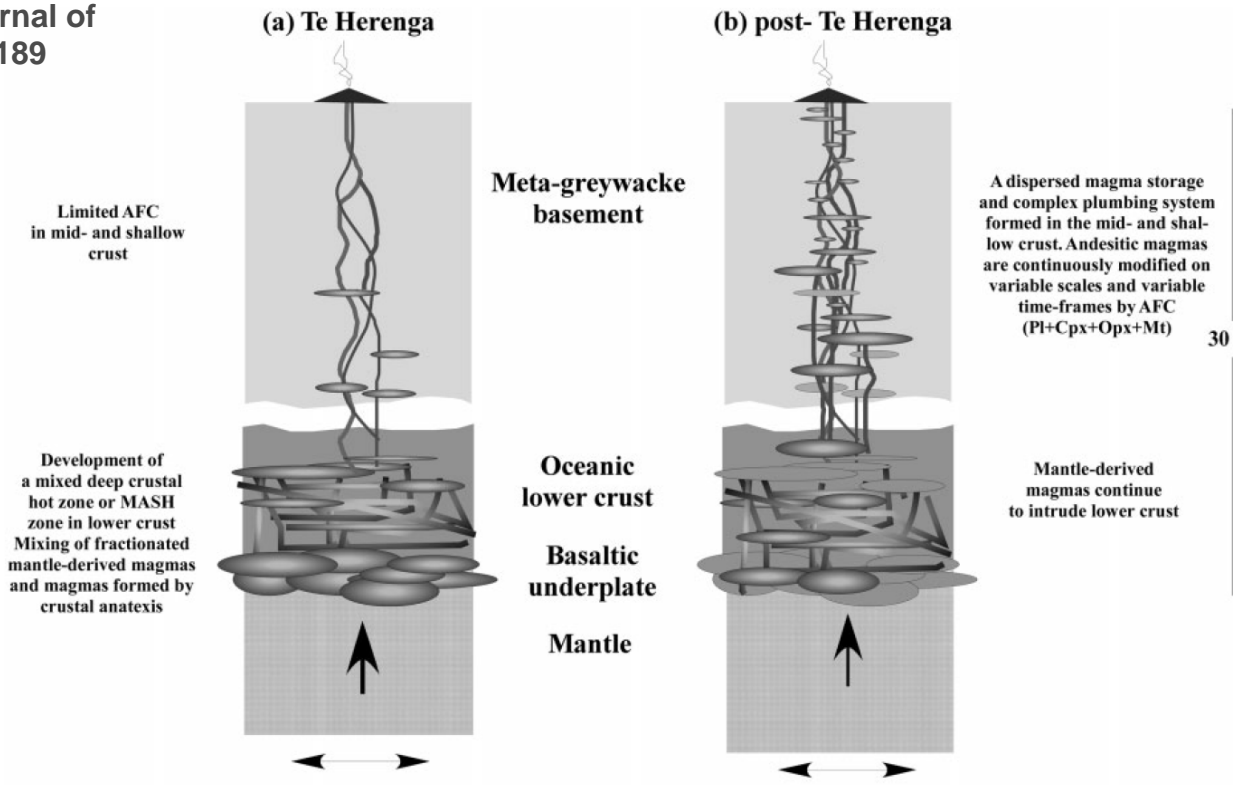


*Ruapehu  
September 2007*



2007



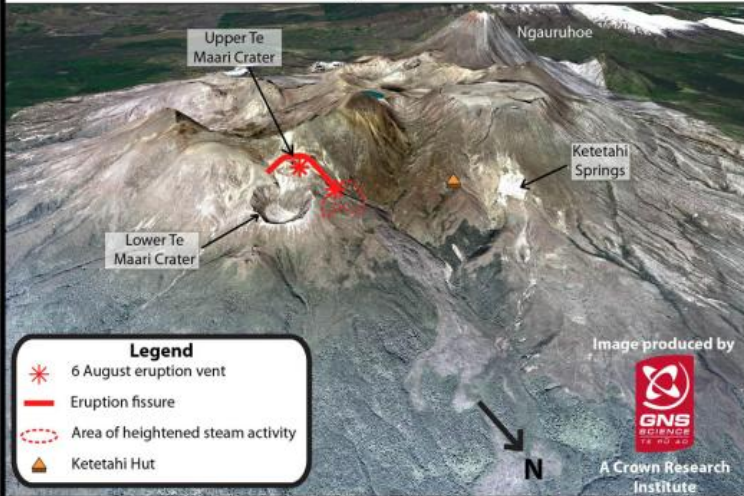


# Ngauruhoe



# Tongariro 2012

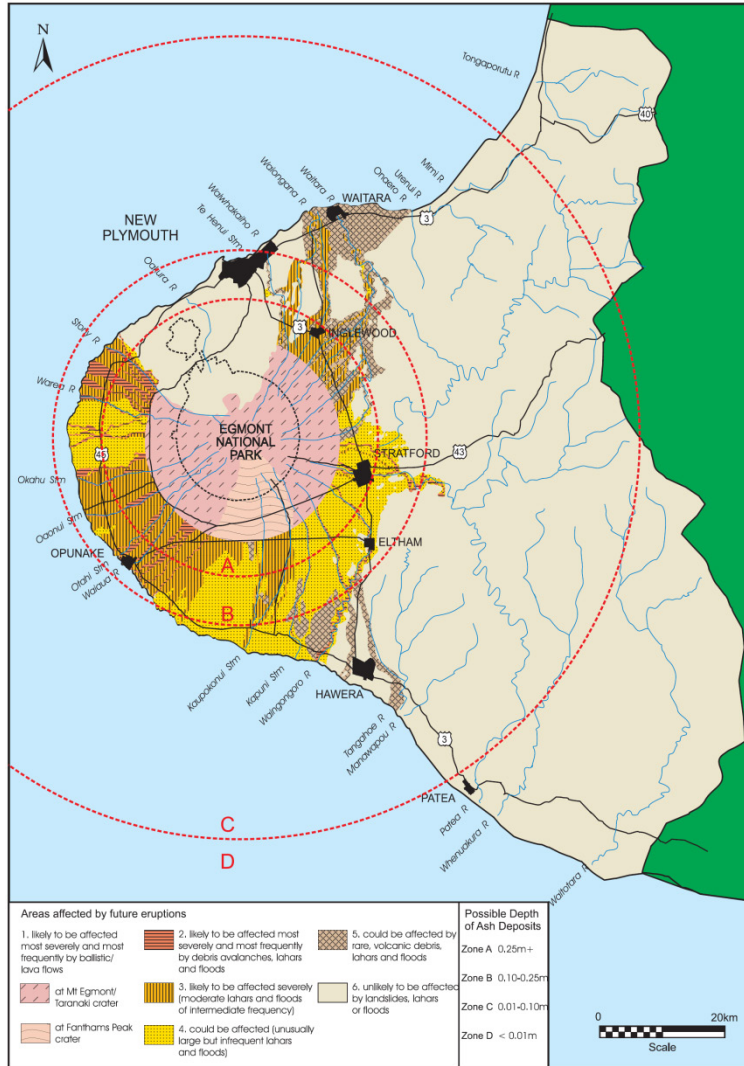
Probable vent locations for Mount Tongariro eruption, 6 August 2012



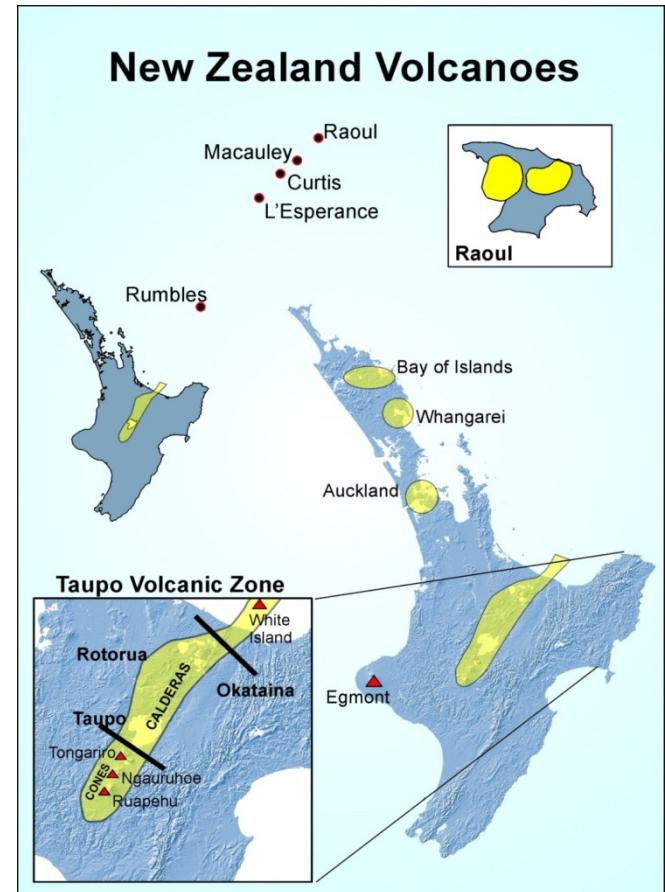
stuff.co.nz



# Taranaki volcano: Debris flow / lahars and nationally-significant lifelines



# Active Volcanoes in NZ

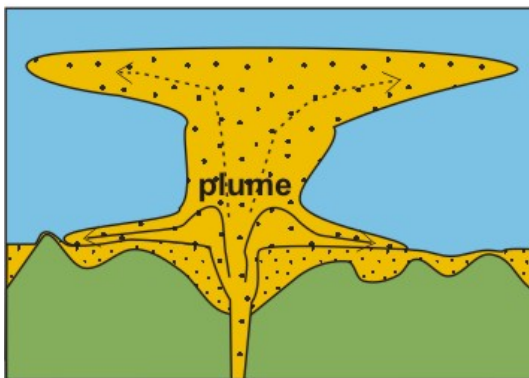
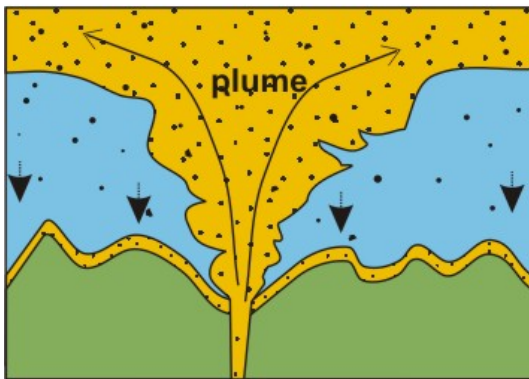
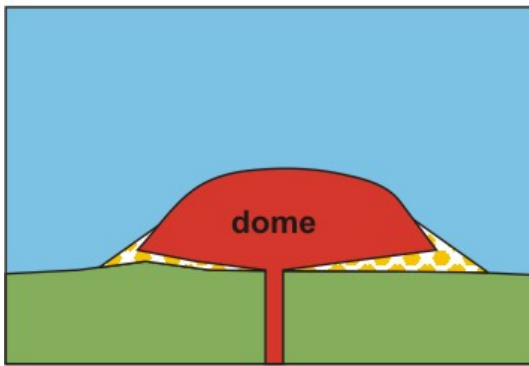


# Taupo Volcanic Zone rhyolite volcanoes





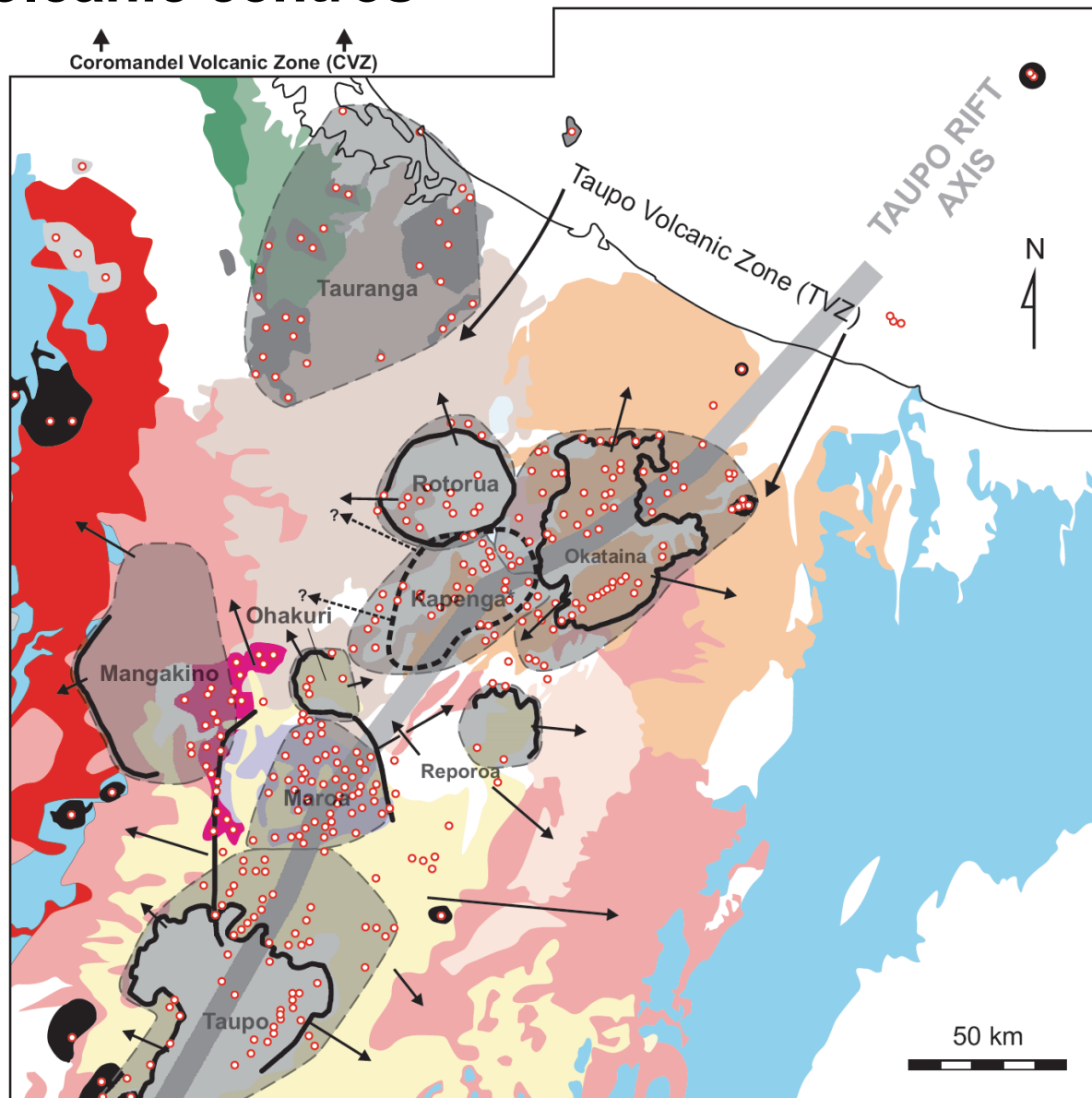
*Side from C.  
Wilson:  
Eruptive styles*



Viscosity of the magma

- Gas content in the magma
- Eruption rate
- Influence of external water

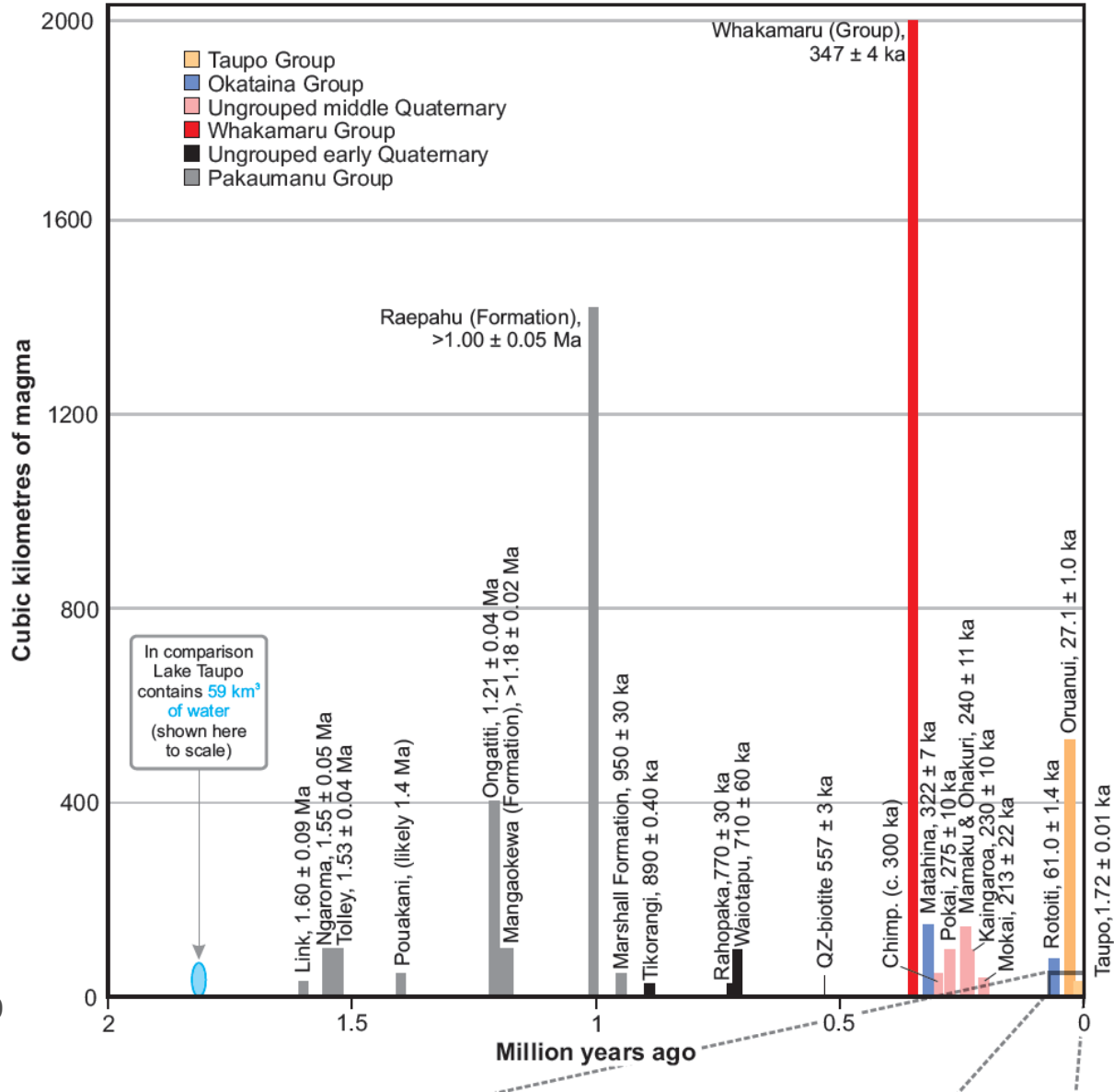
# Rhyolite volcanic centres



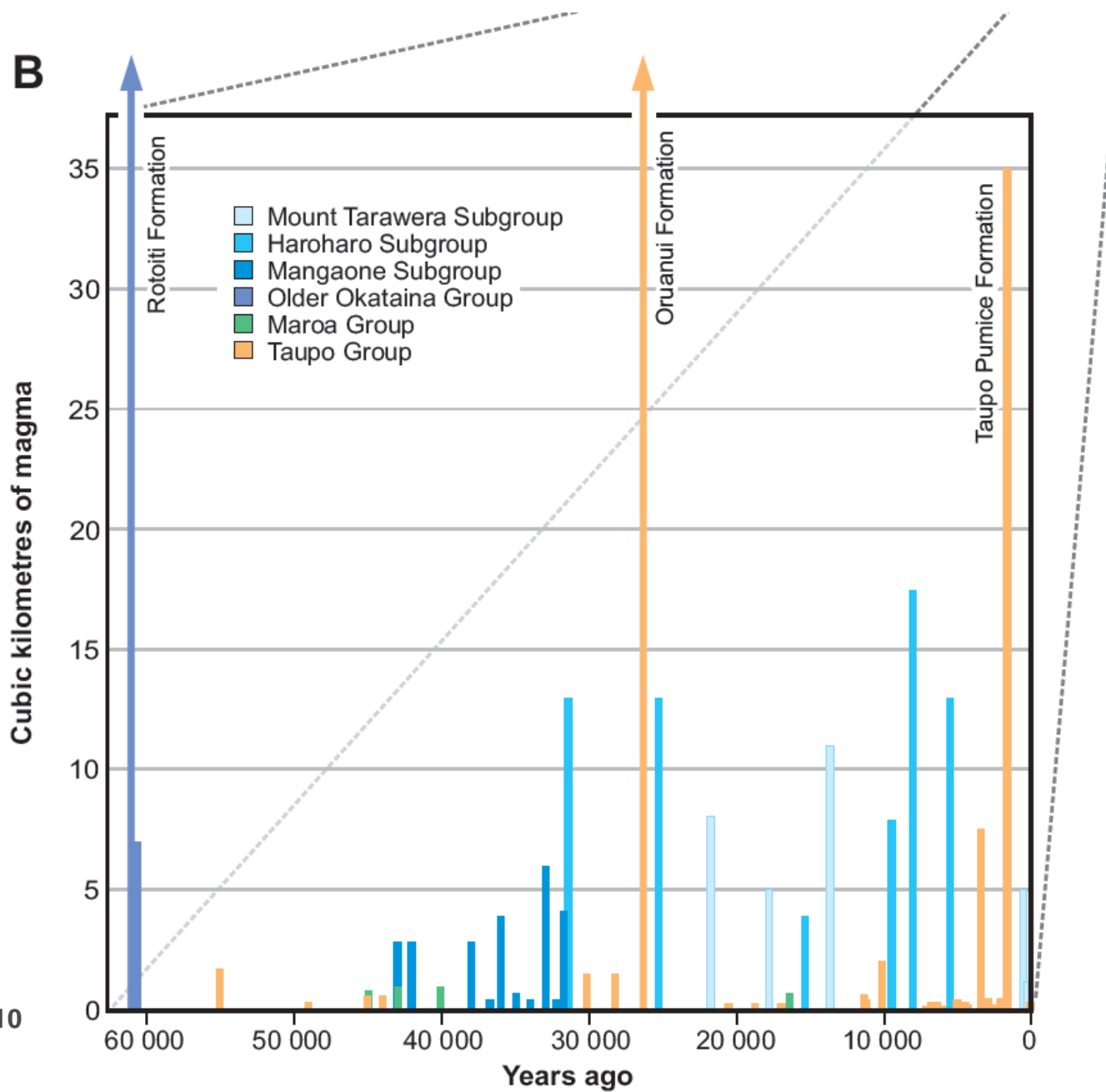
Leonard et al., 2010  
(QMAP Rotorua)

A

# Eruption tempo

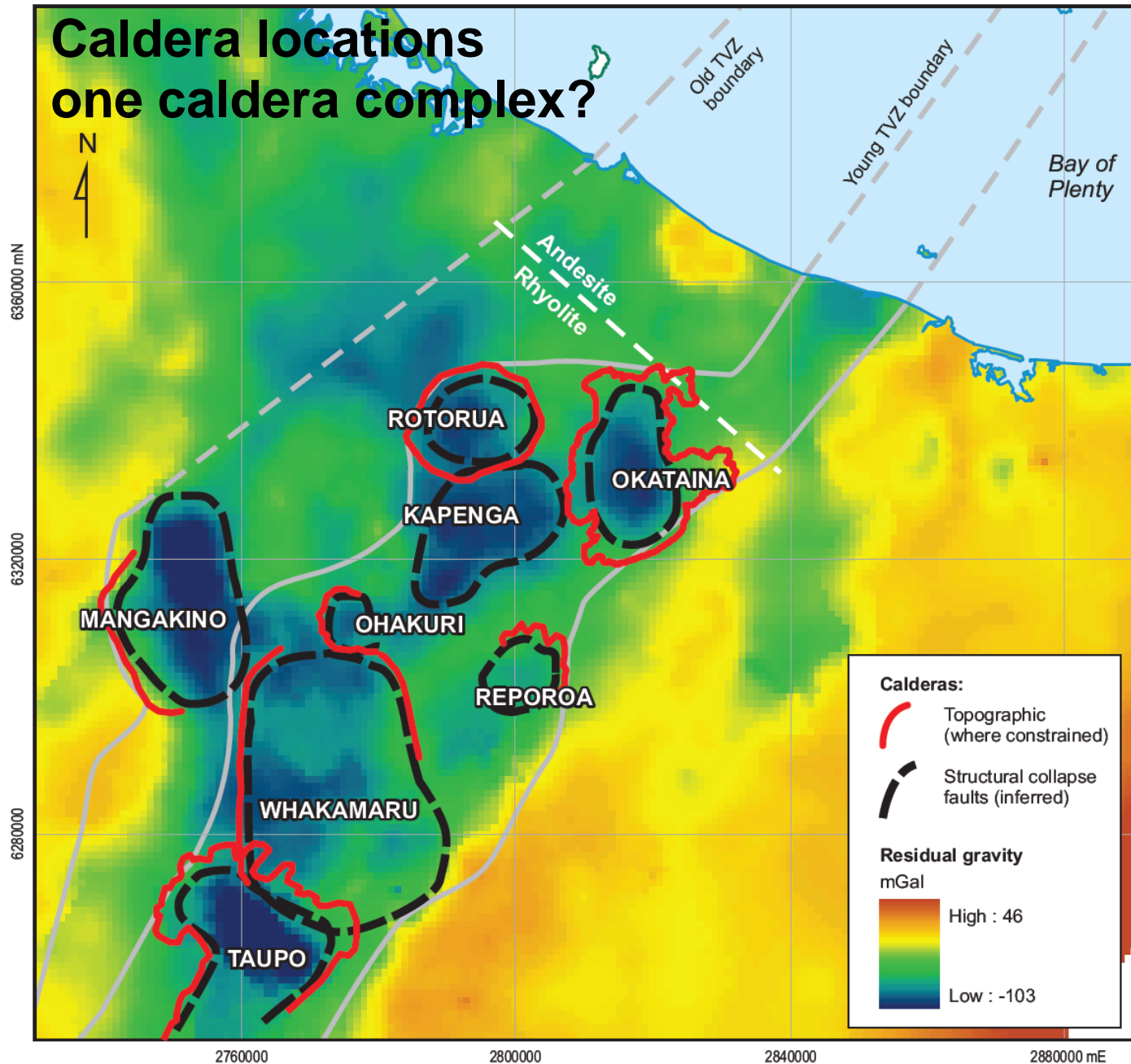


Leonard et al., 2010  
(QMAP Rotorua)

**B**

Leonard et al., 2010  
(QMAP Rotorua)

# Caldera locations one caldera complex?

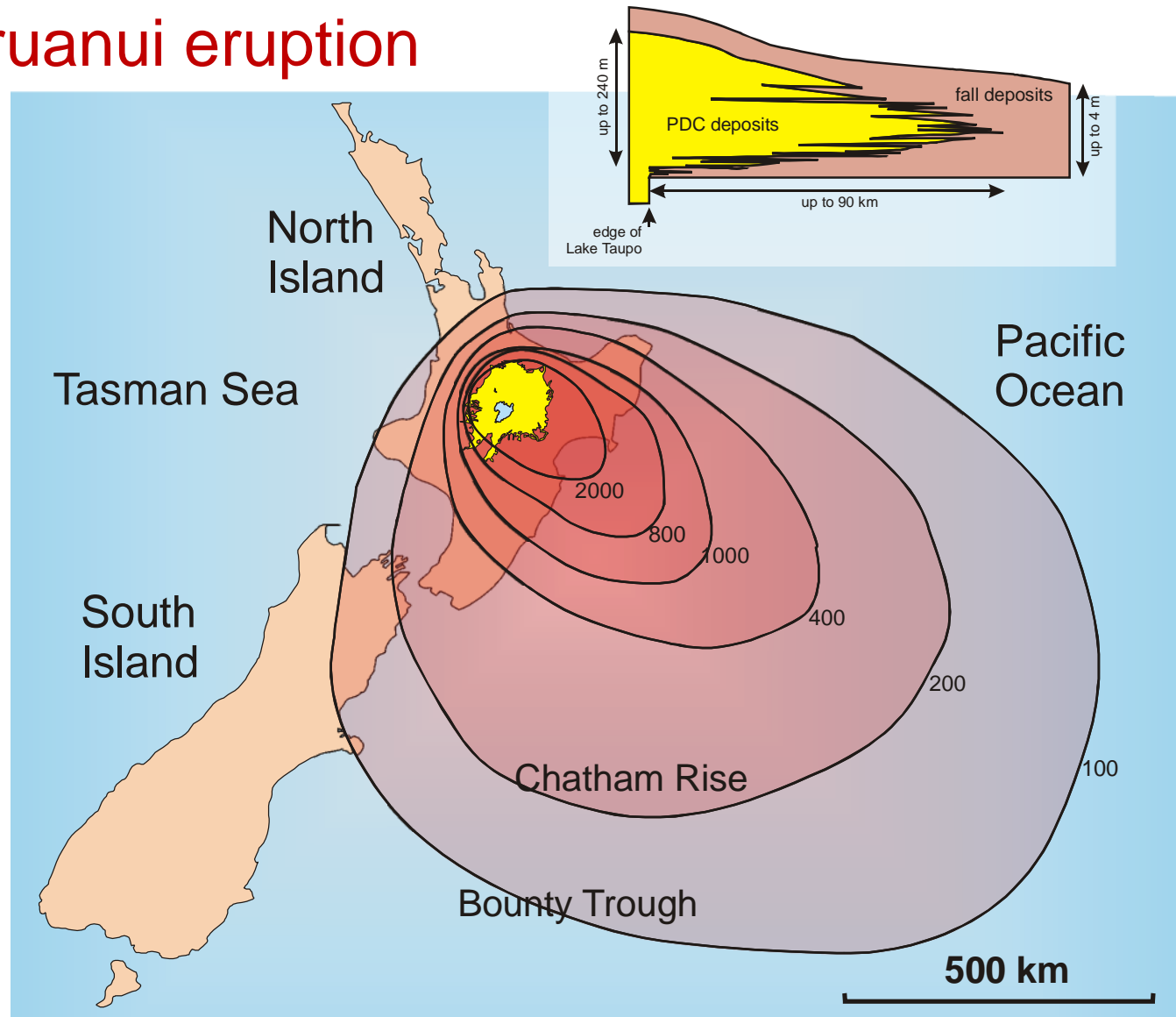


Leonard et al., 2010  
(QMAP Rotorua)

# Dispersal of pyroclastic fall and flow deposits from the 26,500 year ago Oruanui eruption

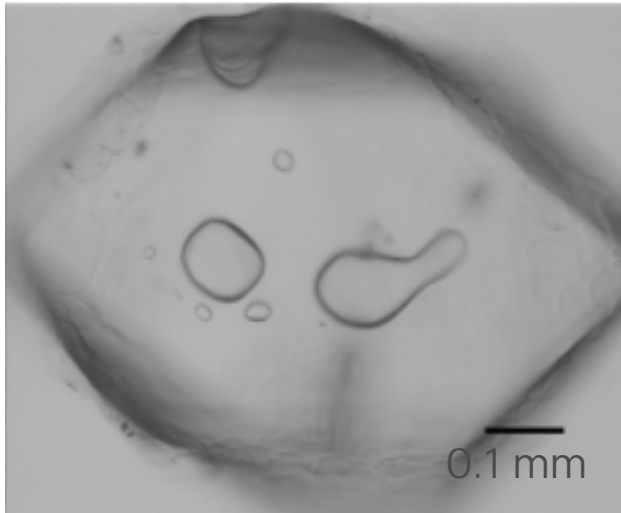
**>500 km<sup>3</sup> dense rock equivalent of magma**

**C. Wilson**

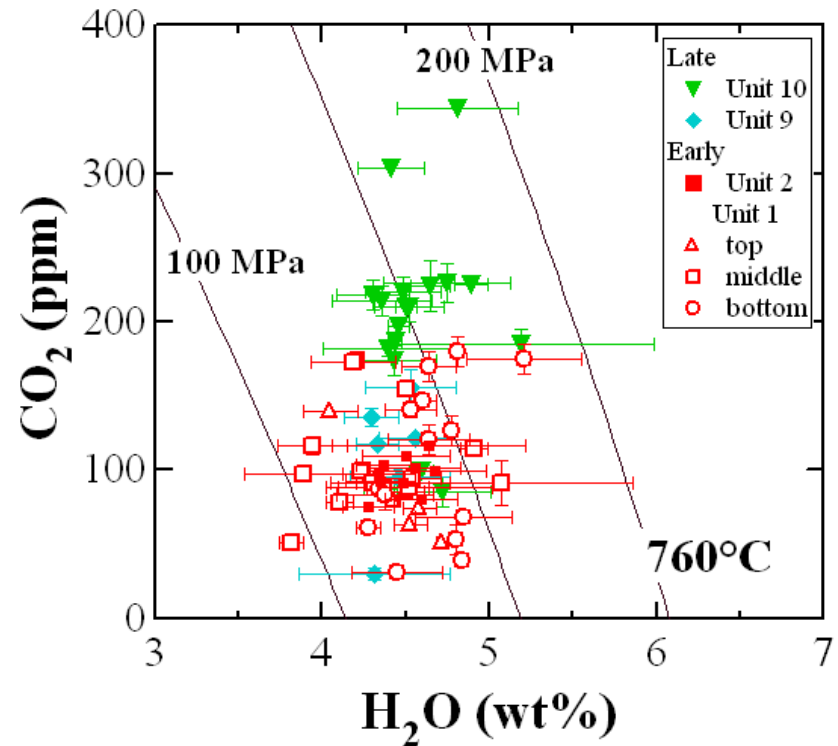


# Slide from C. Wilson: Crystal histories

## Quartz (particularly the melt inclusions)



The compositions of the melt inclusions tell us that the Oruanui magma body accumulated between 4 to 8 km below the Earth's surface



Amounts of water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>) tell us about the pressure at which the inclusion was trapped, hence depths below the surface

(From: Liu et al., Contrib Mineral Petrol 151, 71, 2006)

# Calderas

D. Townsend



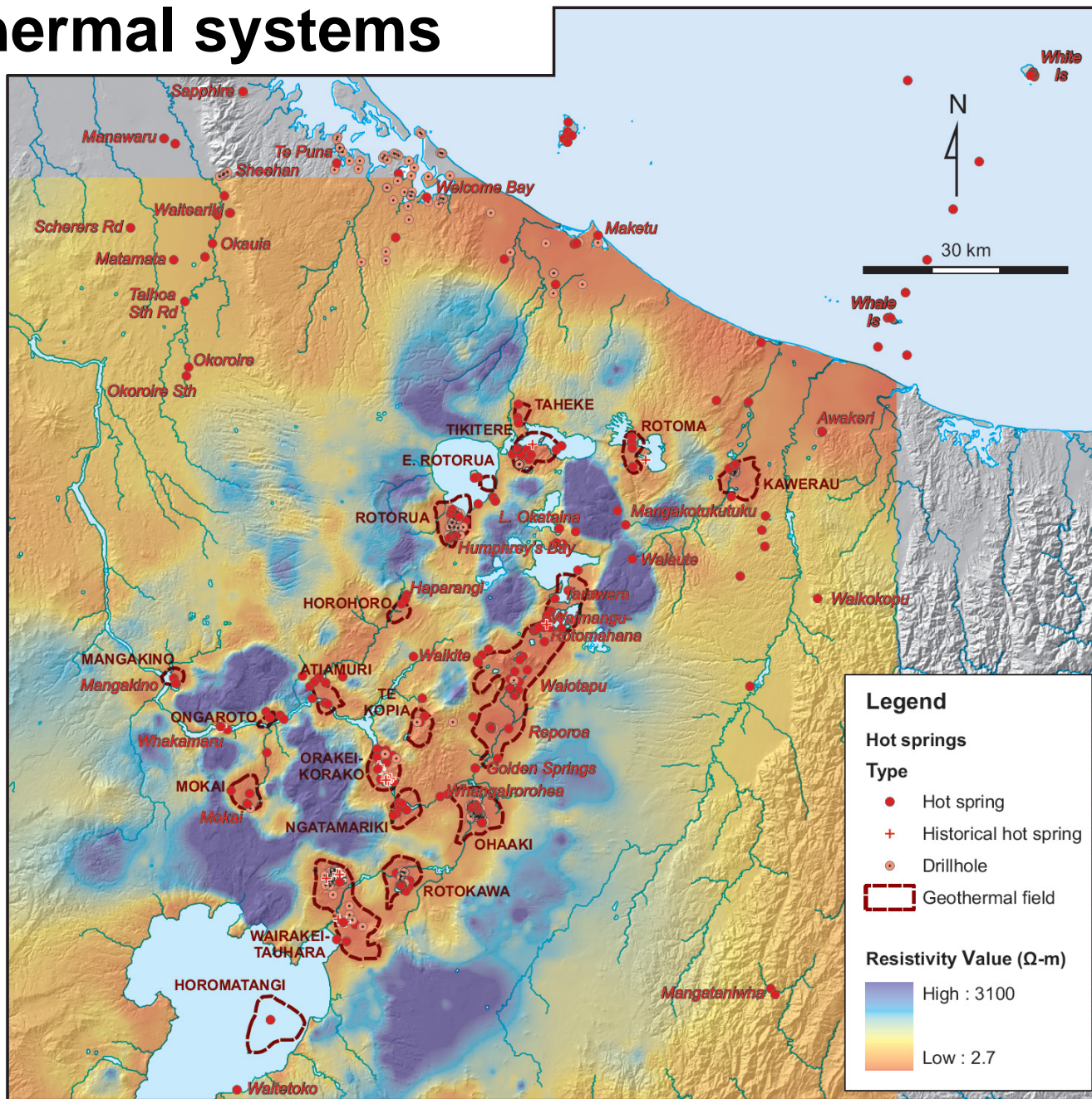


# Rhyolite lava domes

D. Townsend



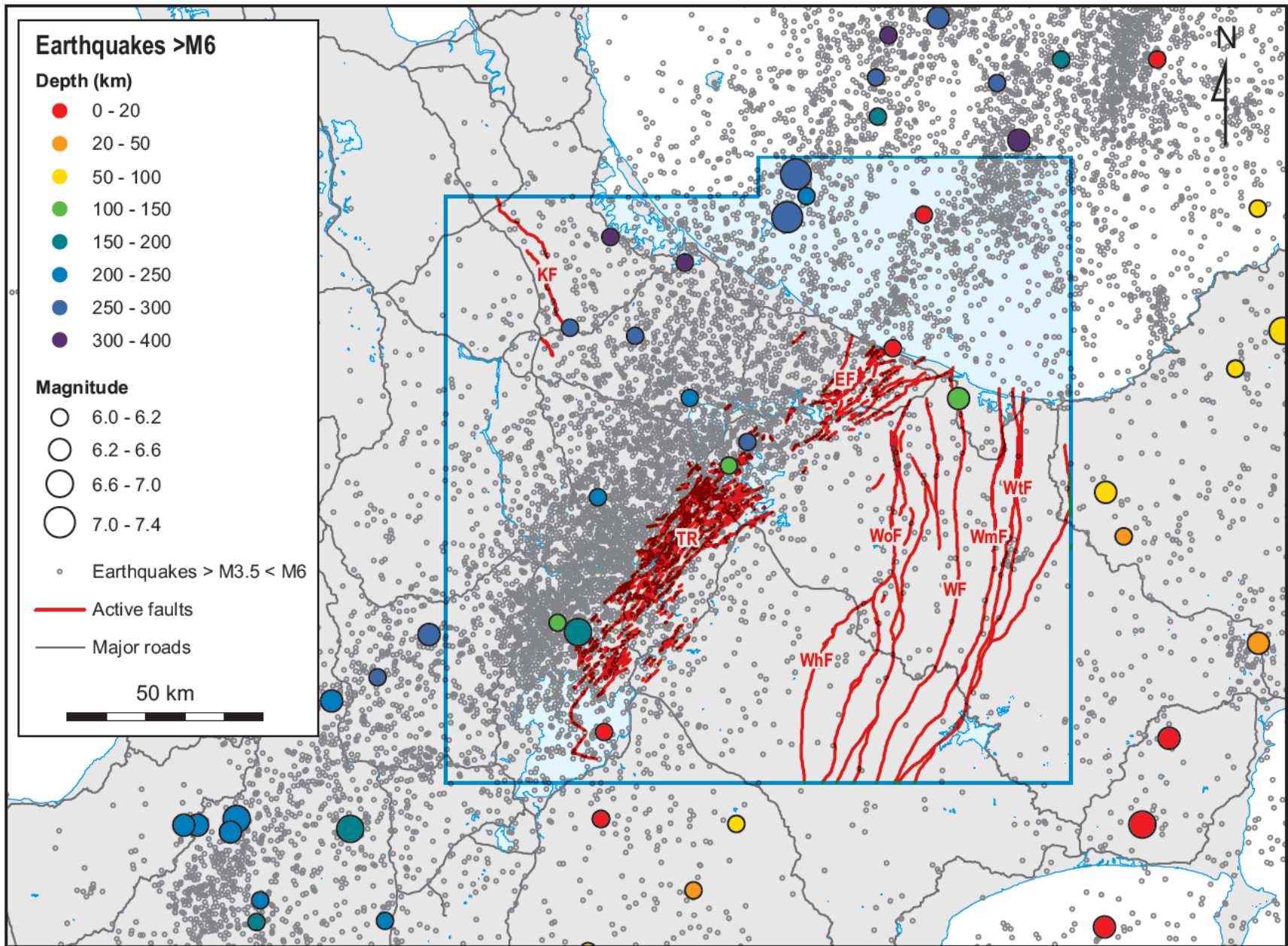
# Geothermal systems



# Taupo Rift

D. Townsend

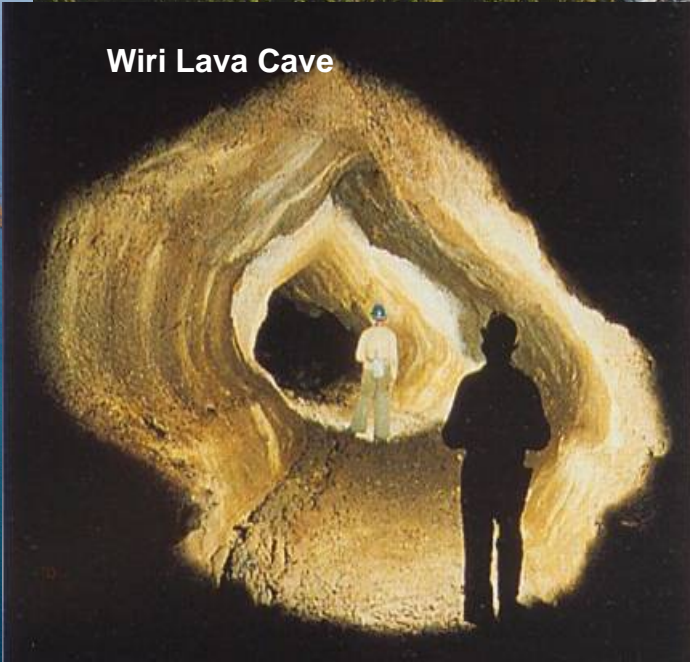




# Auckland Volcanic Field



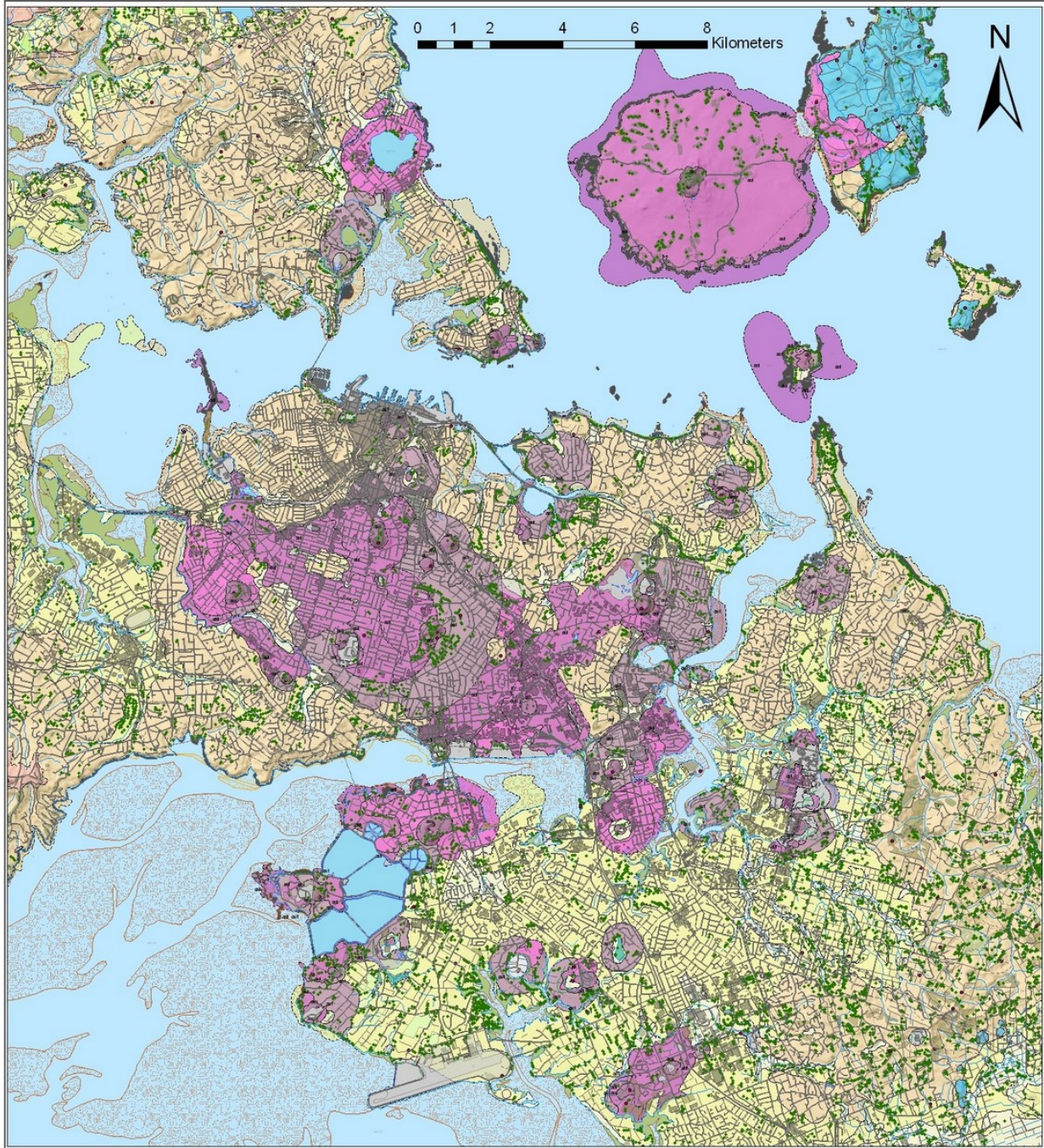
Motukorea (Brown's) Island



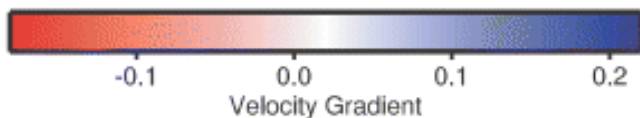
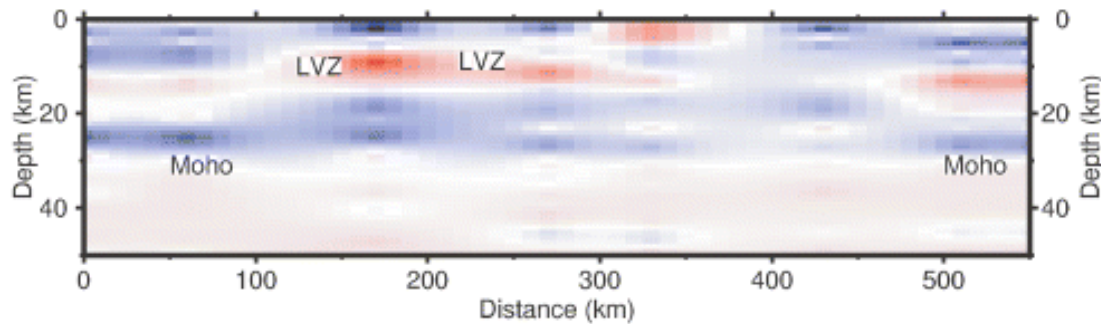
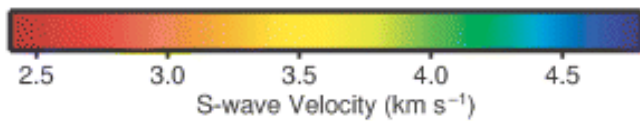
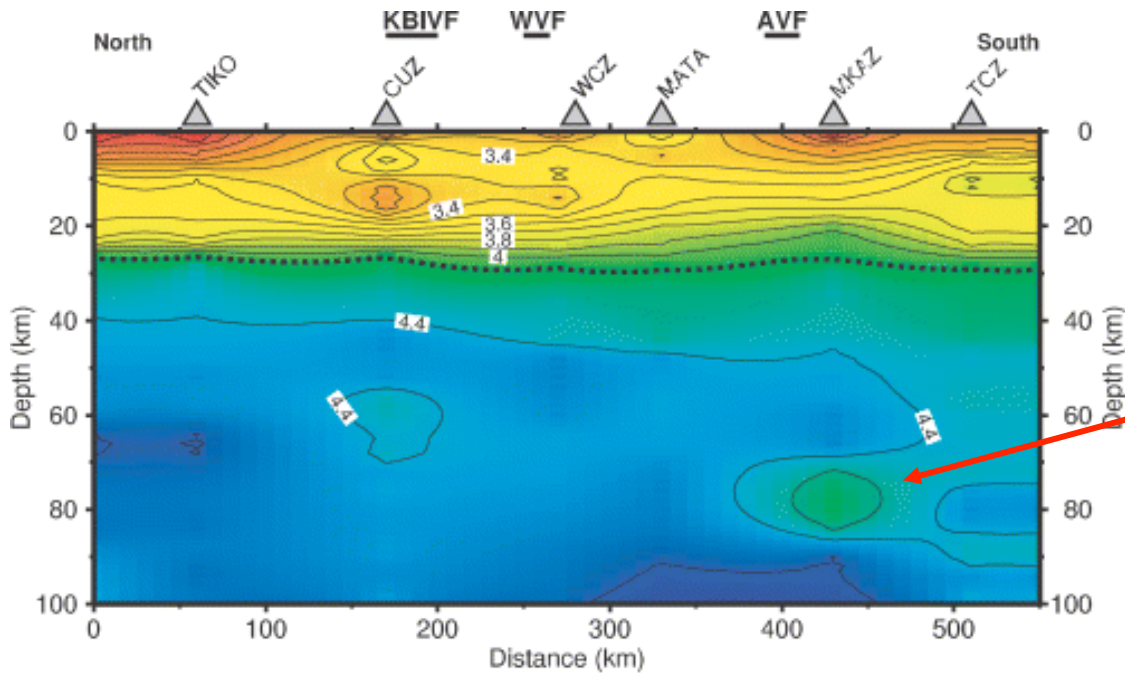
Wiri Lava Cave



Hochstetter (1859)



Kermode, 1992 and LINZ cultural data



The magma is there....

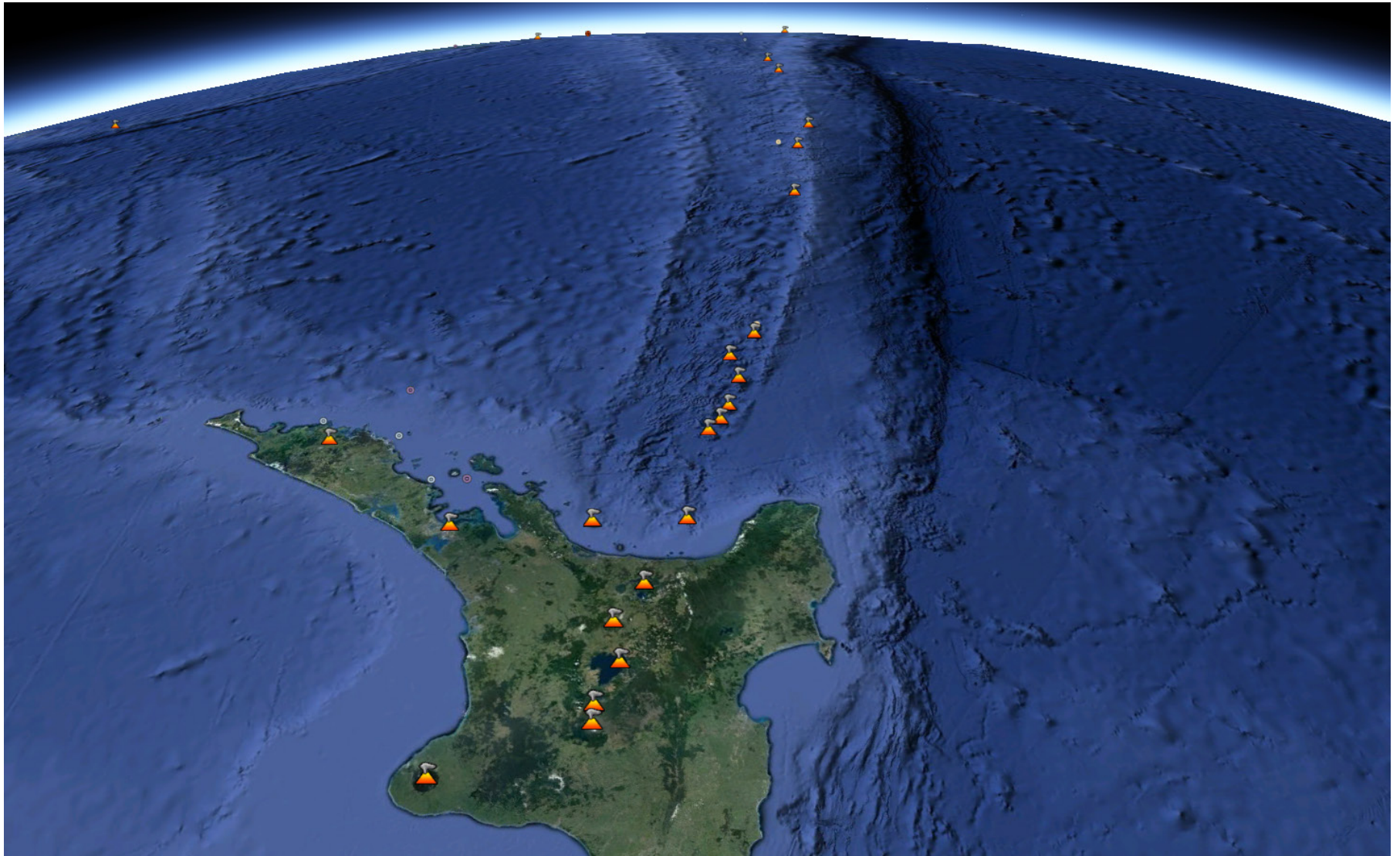
Auckland volcanic field magma

(from new seismic surveys; Nick Horspool et al., 2006).

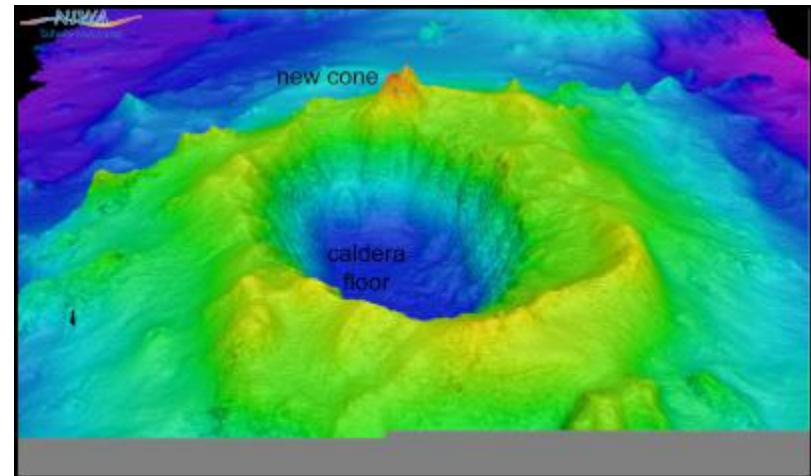
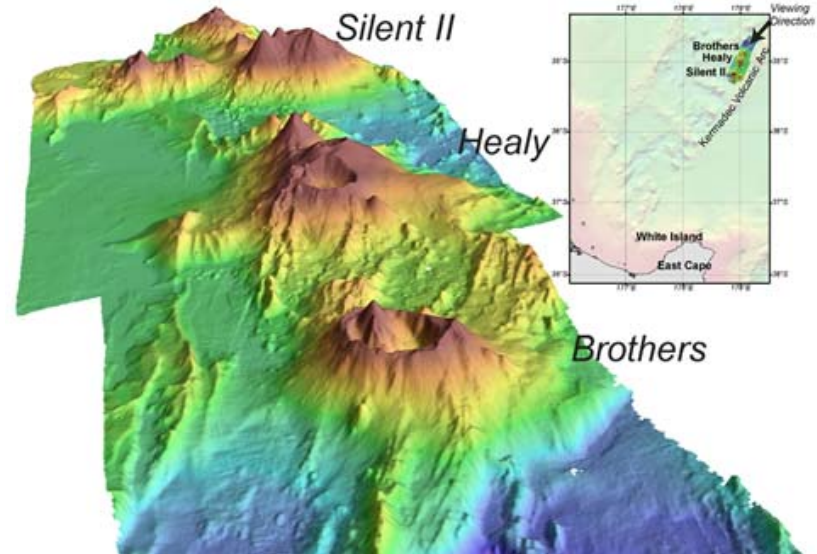
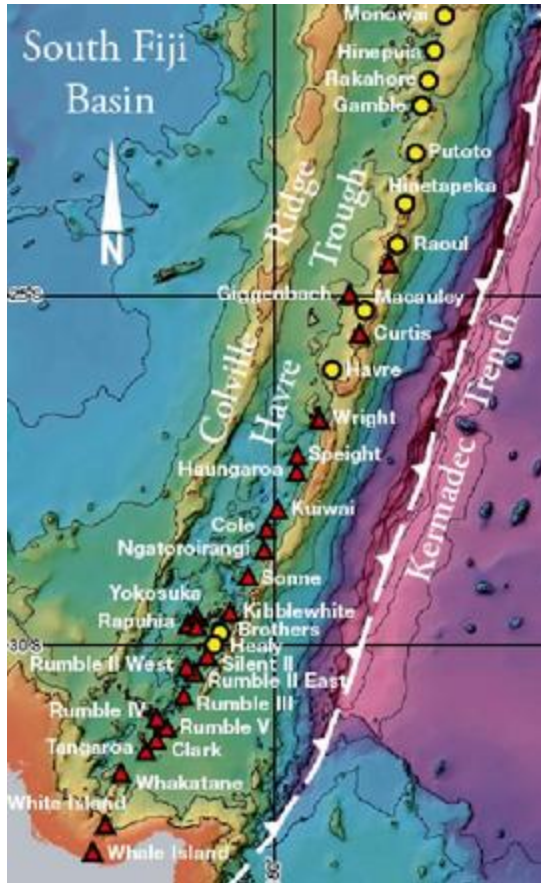
Figure from: Horspool et al., 2006, *Geophys. J. Intl.* 166, 1466-1483



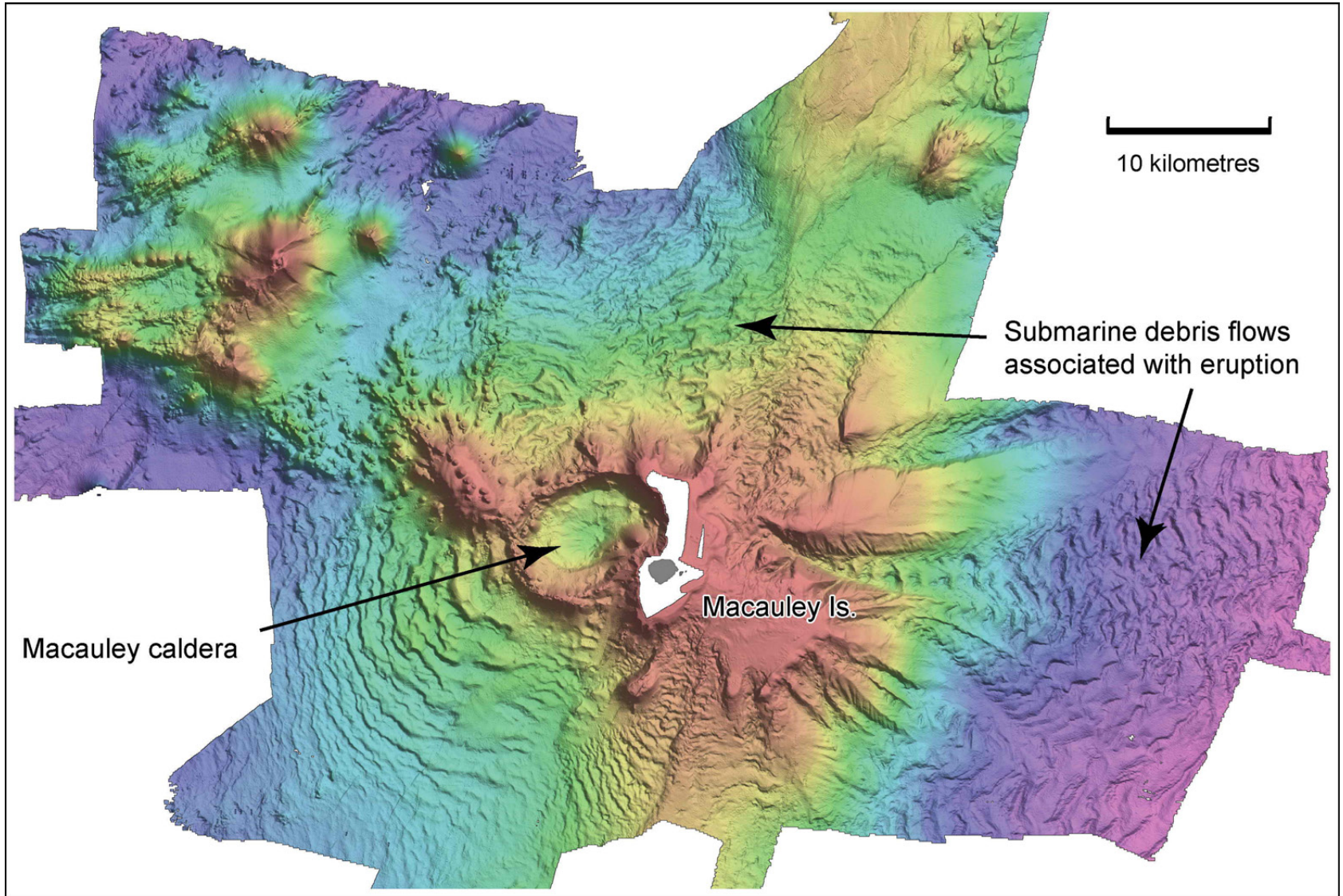
# Tonga-Kermadec arc



# Kermadec arc NIWA images



# Macaulay Volcano (NIWA image)



# White Island and Raoul Island (andesite)



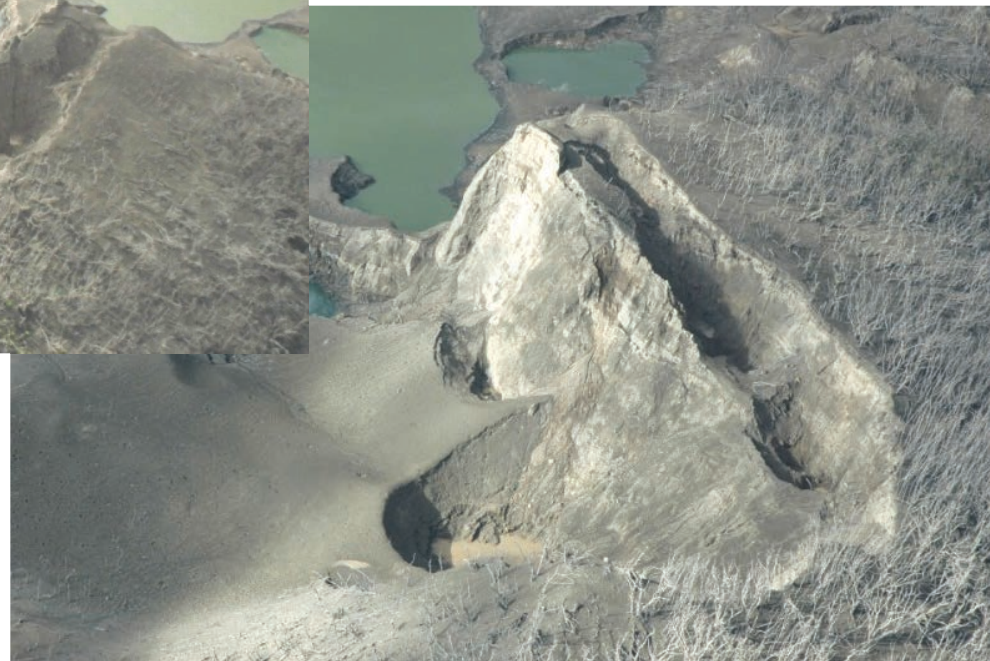
Courtesy of Vulcan Helicopters



# White Island 2012 ( 11 days at Level 2)



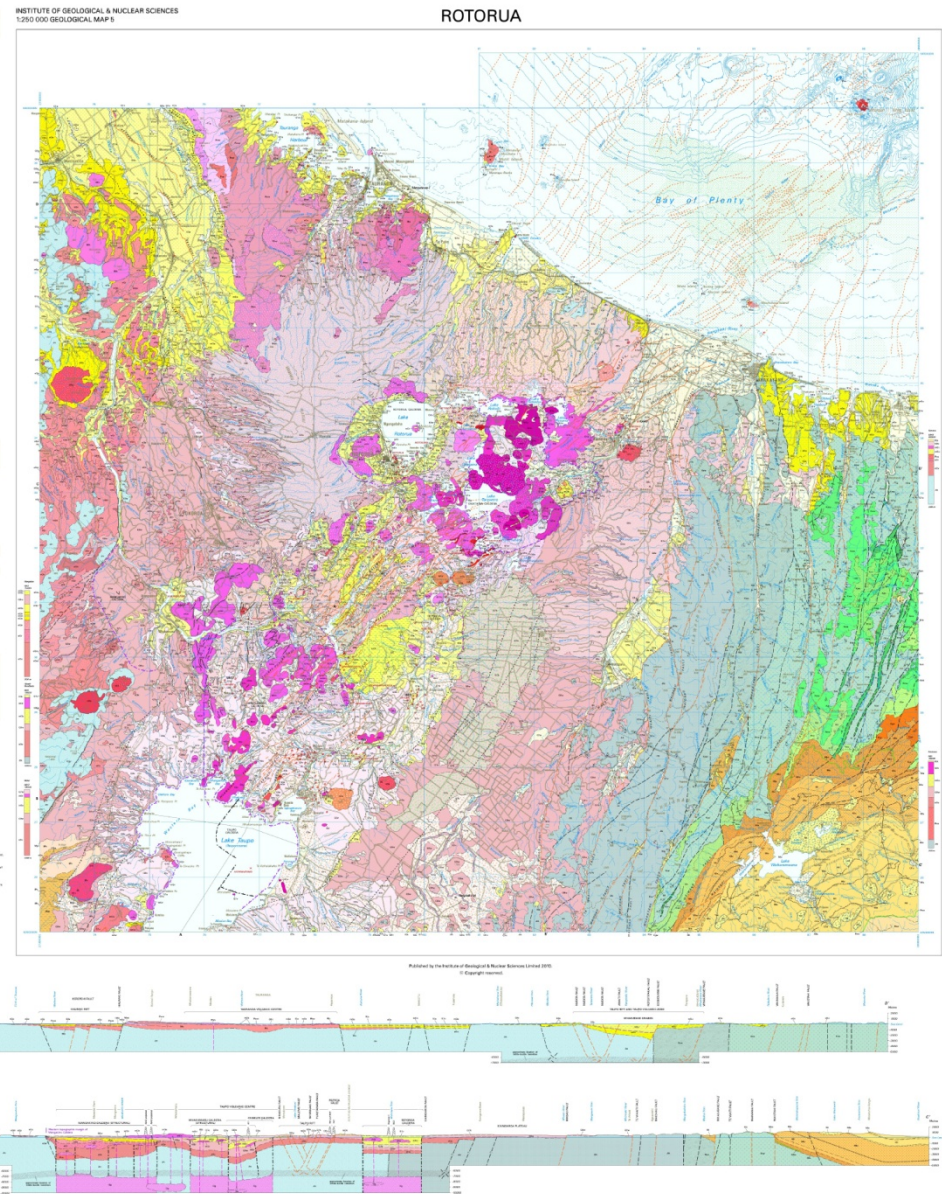
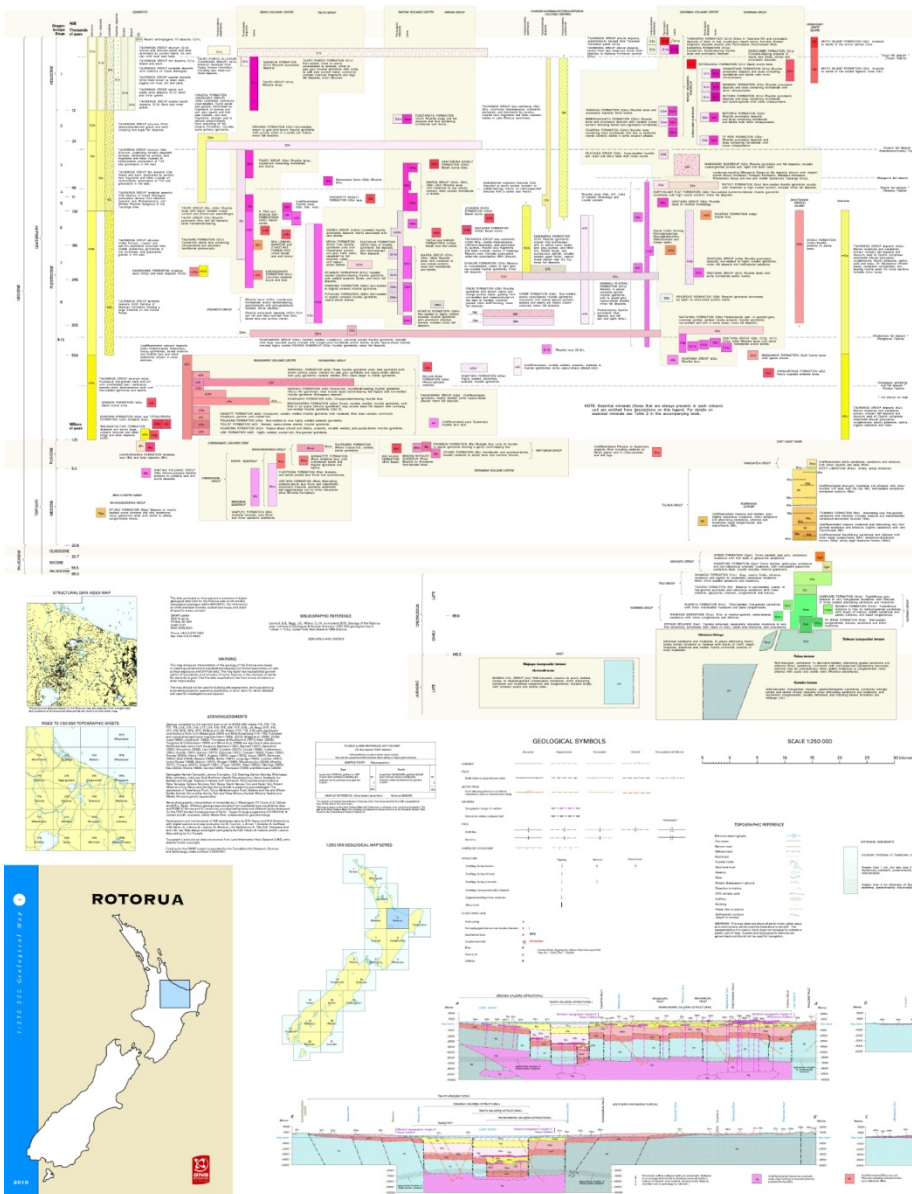
# Raoul Island 2006



# My research

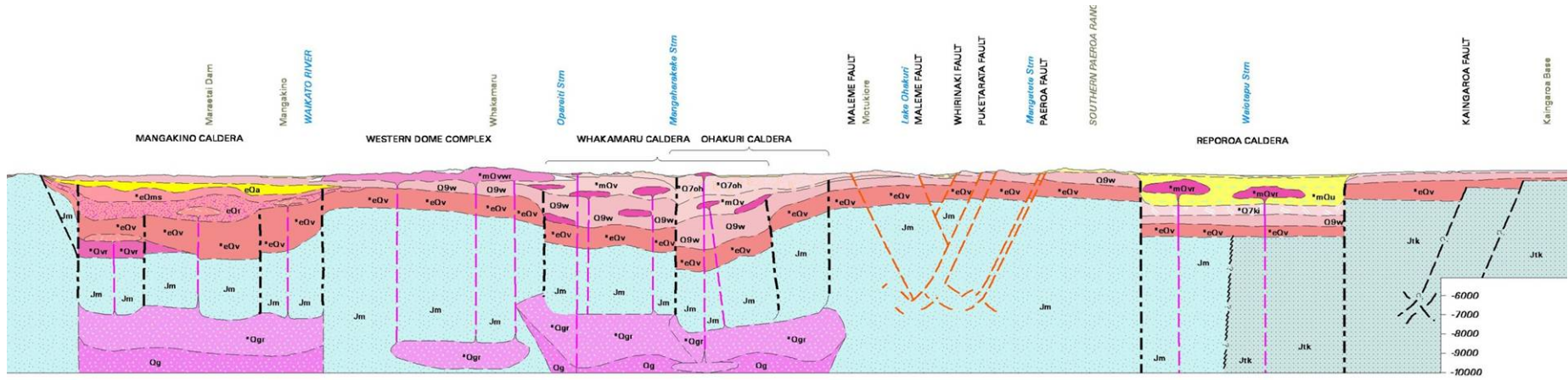
- **Volcanic mapping**
- **Volcanic geology**
- **Geochronology**
- **Stratigraphy**
- **Hazard mapping and planning**

# QMAP Rotorua – rhyolite volcanoes (2010)

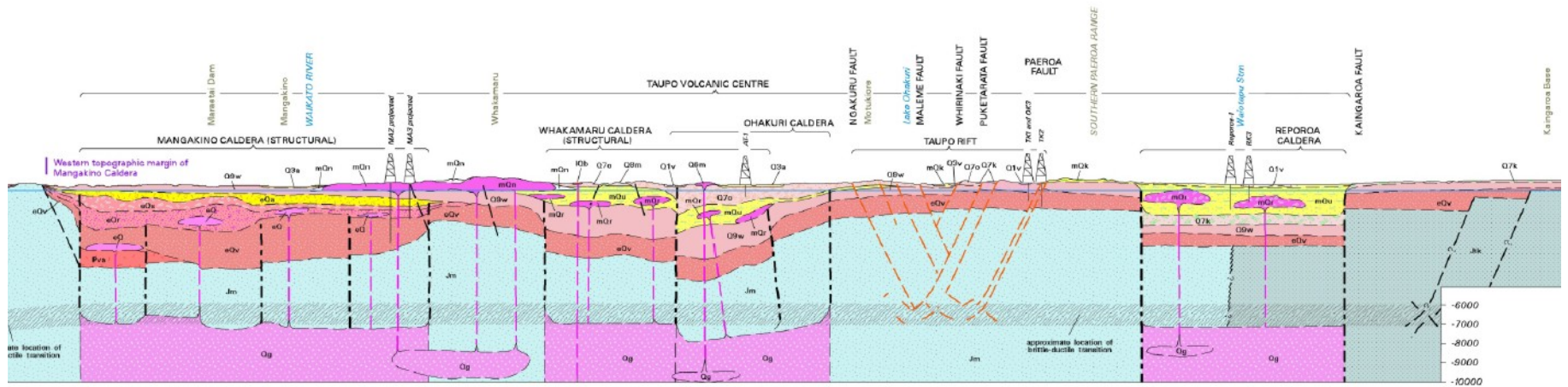




# QMAP Rotorua (2010) shows TVZ calderas in cross section – but which model(s) are less wrong?

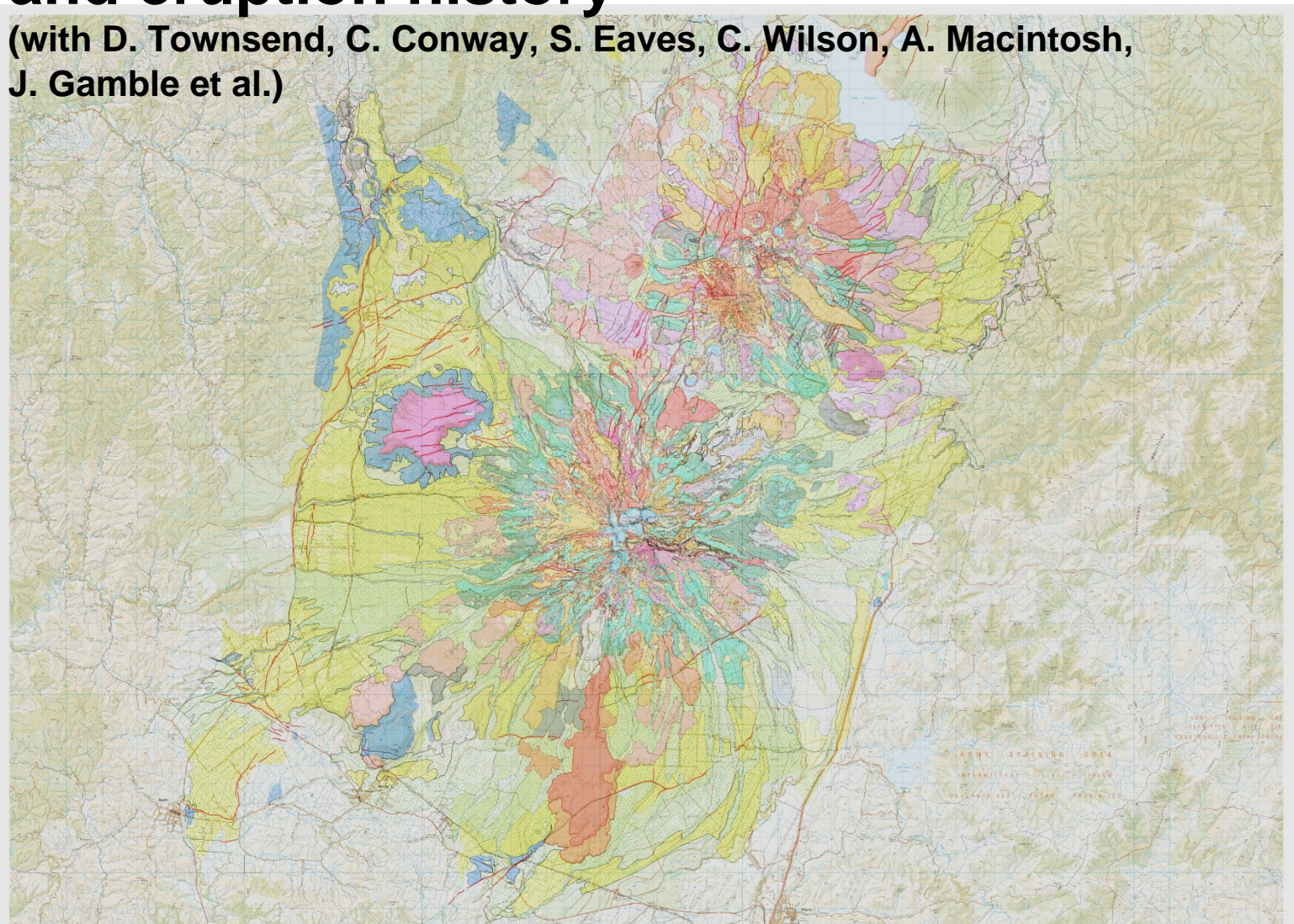


b



# 2010 onwards: Tongariro National Park volcano mapping and eruption history

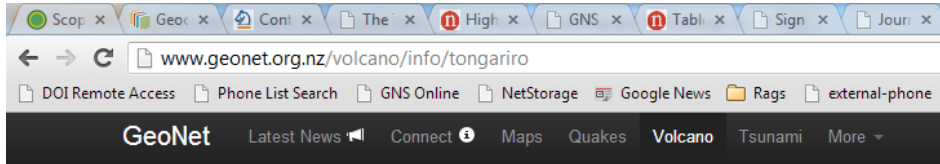
(with D. Townsend, C. Conway, S. Eaves, C. Wilson, A. Macintosh,  
J. Gamble et al.)



# Glacio-volcanism at Tongariro National Park



# www.geonet.org.nz



## Tongariro

### Volcano Alerts

The current status of Tongariro.

Volcanic Alert Level:  
**1**

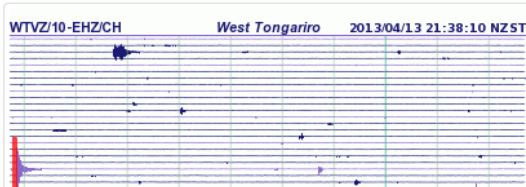


Aviation Colour Code:  
**GREEN**



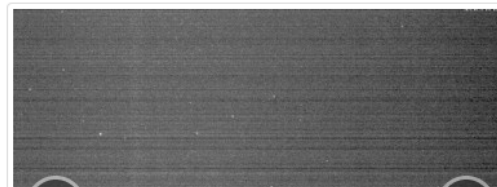
### Volcano Drums

Showing seismic activity over the last 24 hours.

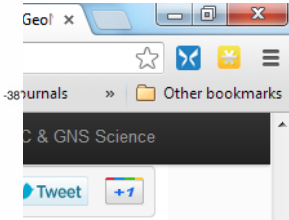
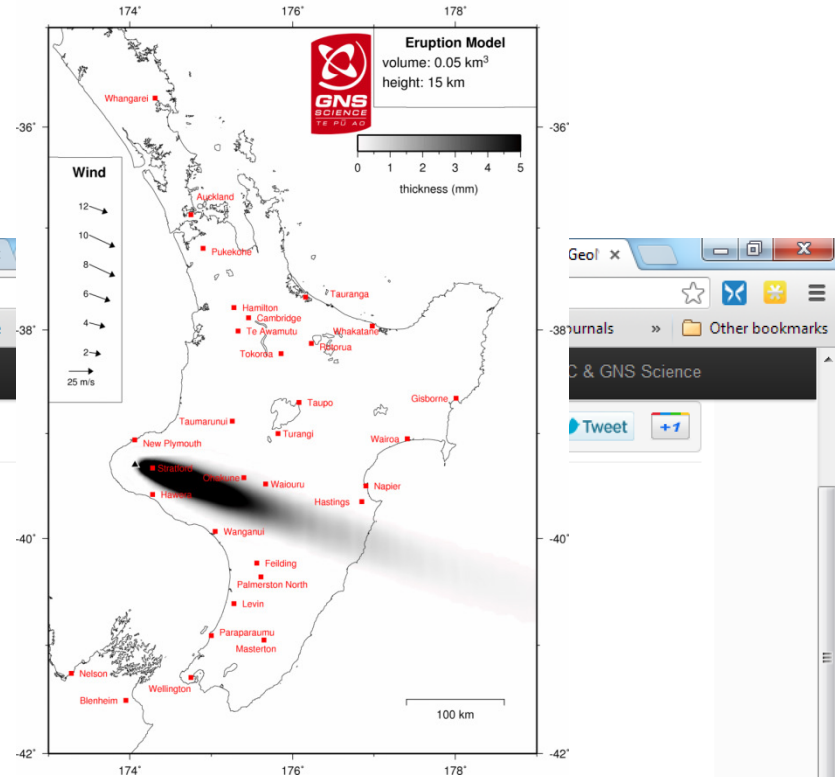


### Volcano Cameras

Showing the most recent images from our cameras.



**PREDICTED ASHFALL AREA**  
For a Taranaki eruption at 0600 Monday 22 October 2012



# Infrastructure Ash Management Posters

## VOLCANIC ERUPTION

### ADVICE FOR ELECTRICITY NETWORK MANAGERS

#### ASH IMPACTS ON ELECTRICITY DISTRIBUTION

Recent ash or heavy rain storms may result in reduced electricity supply or power outages. The following information is provided to help you prepare for such events. This information is intended to provide a general overview of ash impacts on electricity distribution. For more detailed information, please refer to the relevant standards and codes of practice.

#### INSULATOR FLASHOVER

Insulators are used to support overhead power lines. Ash can build up on insulators, reducing their ability to insulate. This can lead to flashovers, which can cause power outages. Regular cleaning of insulators is essential to prevent this.

#### RECOMMENDED ACTIONS

Regularly inspect overhead power lines for ash build-up. Clean insulators regularly. Monitor weather forecasts for ash fall. Have contingency plans in place for power outages.

## VOLCANIC ERUPTION

### RECOMMENDED ACTIONS FOR ROADING MANAGERS

#### VOLCANIC ASH

Volcanic ash can cause significant damage to roads and infrastructure. It can reduce visibility, damage road surfaces, and block drainage systems. Roading managers should have contingency plans in place to deal with ash fall.

#### REDUCTION

Develop a Volcanic Hazard Management Plan. Regularly inspect roads for ash build-up. Clean roads regularly.

#### RECOVERY

Regularly inspect roads for ash build-up. Clean roads regularly. Monitor weather forecasts for ash fall.

## GUIDELINES ON PREPAREDNESS BEFORE, DURING AND AFTER AN ASHFALL

## THE HEALTH HAZARDS OF VOLCANIC ASH

### A guide for the public

Volcanic ash can be harmful to your health. It can irritate your eyes, nose, and throat. It can also be inhaled, which can cause respiratory problems. People with asthma or other respiratory conditions should be particularly careful.

#### WHAT TO DO!

- Wear a mask and goggles when you are outdoors.
- Stay indoors as much as possible.
- Close your windows and doors.
- Do not breathe in the ash.
- Do not drink water that has been contaminated with ash.

For more information, visit <http://volcanoes.usgs.gov/ash/>

## VOLCANIC HAZARDS AT WHAKAPAPA

### MT RUAPEHU

This map shows the hazard zones around Mt Ruapehu. The zones are color-coded: Red (High Hazard), Orange (Medium Hazard), and Yellow (Low Hazard). Evacuation routes are shown in blue. The map also shows the locations of Crater Lake, Taohurangi Peak, and Panotaitonga.

#### WHAT TO DO!

- If there is an eruption, move out of the valleys, especially those that low areas are likely to flow.
- Ruapehu is an active volcano. Eruptions can occur at any time. Low flow down valleys in a dark cloud.

## VOLCANIC ERUPTION

### ADVICE FOR WATER SUPPLY MANAGERS

#### IMPACTS ON WATER SUPPLIES

Volcanic ash can cause significant damage to water supplies. It can block intakes, reduce flow, and contaminate the water. Water supply managers should have contingency plans in place to deal with ash fall.

#### WATER DEMAND

High demand for water typically occurs after an eruption. This is because people are often unable to use their normal water supplies.

#### EFFECTS ON EQUIPMENT

Volcanic ash can cause significant damage to water supply equipment. It can block filters, reduce flow, and contaminate the water. Regular cleaning of equipment is essential to prevent this.

#### RECOMMENDED ACTIONS

Regularly inspect water supply equipment for ash build-up. Clean equipment regularly. Monitor weather forecasts for ash fall.

## VOLCANIC ERUPTION

### RECOMMENDED ACTIONS FOR AIRPORTS

#### REDUCTION

Develop a Volcanic Hazard Management Plan. Regularly inspect runways for ash build-up. Clean runways regularly.

#### RECOVERY

Regularly inspect runways for ash build-up. Clean runways regularly. Monitor weather forecasts for ash fall.

## NEW Ash-Impacts Website

### VOLCANIC ASH

This website provides comprehensive information on volcanic ash impacts. It covers topics such as ash fall, ash in the air, and ash in water. It also provides guidance on how to protect yourself and your property from ash.

#### What is Volcanic Ash?

Volcanic ash is a mixture of very fine particles of rock and glass. It is produced during volcanic eruptions. Ash can be inhaled, which can cause respiratory problems.

#### Guidance for homes, businesses & communities?

Take action before, during and after an ash fall can prevent or reduce many of the damaging effects of ash. Regularly inspect your property for ash build-up. Close your windows and doors. Do not breathe in the ash.

<http://volcanoes.usgs.gov/ash/>

## VOLCANIC HAZARDS AT TONGARIRO

This map shows the hazard zones around Mt Tongariro. The zones are color-coded: Red (High Hazard), Orange (Medium Hazard), and Yellow (Low Hazard). Evacuation routes are shown in blue. The map also shows the locations of Mt Ngauruhoe, Mt Ruapehu, and Mt Taranaki.

#### WHAT TO DO!

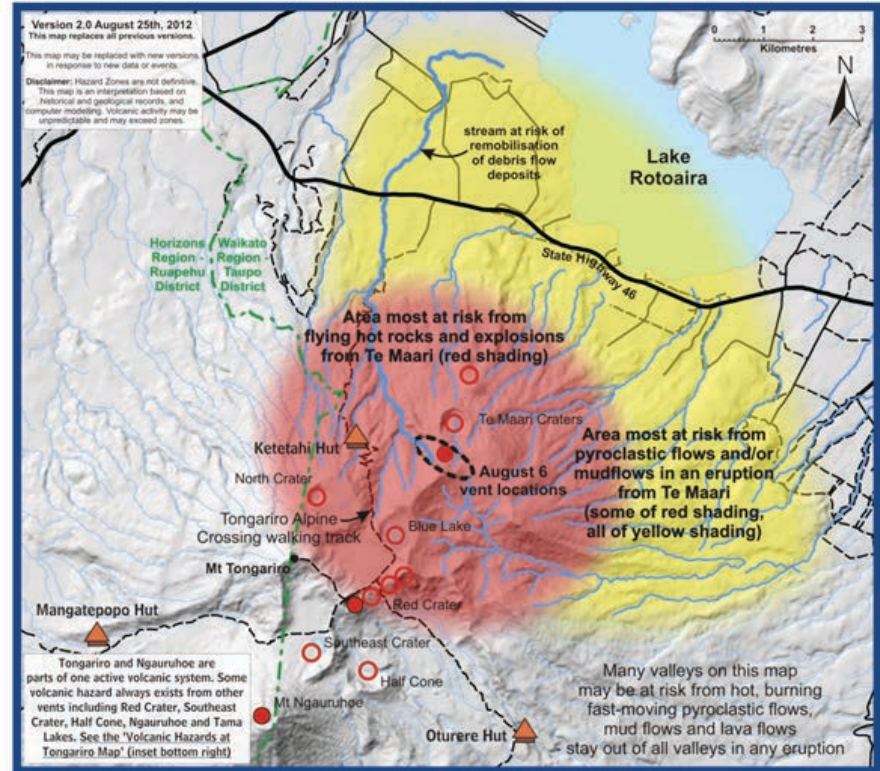
- If there are any signs of an eruption (earthquakes, rumbling, ash-rain, steam, or flying rocks), move as quickly as possible down off the mountains away from the Summit Hazard Zones.
- Stay on ridges, out of valleys and move away from the eruption vent.
- Know where the safer areas are (ridge lines outside of the Summit Hazard Zones).
- Stay in safe areas until you are advised by search and rescue personnel.

#### VOLCANIC HAZARDS

- SUMMIT HAZARDS**
  - During an eruption there may be gas and flying rocks from the summit vents, especially with the Summit Hazard Zones.
  - This area INCLUDES Mt Taranaki.
- PROXIMATE RIDGES**
  - Eruption gas may flow down the ridges of ash, rock and gas during great gullying events. These flows can be very hot and fast-moving.
- LAVAL FLOWS**
  - Lava flows from the ridge are very hot but do not move as fast as proximate flows.

# Crisis hazard maps

## TE MAARI ERUPTION PHENOMENA



### WHAT TO DO!

If there are any signs of an eruption (earthquakes, rumbling, ash-steam cloud or flying rocks):

- Seek immediate shelter from flying rocks if an explosion occurs.
- Move as quickly as possible off the mountain away from the Summit and Flow Hazard Zones.
- Stay on ridges, out of valleys and out of the yellow flow hazard zone - move away from the eruption vent.
- Know where the safer areas are (ridge lines outside of the coloured Summit and Flow Hazard Zones).
- Stay in safe areas until advised otherwise by search and rescue.

### VOLCANIC HAZARDS

#### SUMMIT HAZARDS

- During an eruption there may be gas, flying rocks and flows from recent or new eruption vents, especially within the red shaded Summit Hazard Zone. This zone includes Ketetahi Hut.

#### PYROCLASTIC FLOWS & MUDFLOWS

- Eruptions may generate very hot pyroclastic flows of ash, rock and gas (burning ground-hugging clouds). They also generate mud flows. Both move down slopes very fast - High risk in the yellow shaded 'Flow Hazard Zone' and part of the red shaded 'Summit Hazard Zone'

#### LAVA FLOWS

- Lava flows of molten rock are very hot but do not move as fast as pyroclastic flows.

#### ASH FALL & LIGHTNING

- Any place on this map is at risk from ash fall in an eruption - this will obscure vision and make it hard to breathe, but is non-lethal. Lightning may occur in eruptions and can be lethal.

### LEGEND



Central Plateau  
Volcanic Advisory Group  
Main agencies involved in this map:



# Volcanic hazard management: Areas of comparative study and cooperative planning (with overseas agencies and NZ communities and organisation)

- **Warnings** (timing, message, method, uncertainty)
- Effectiveness of warnings (response)
- **Ash testing:** physical and chemical
- **Airports**
- Stormwater & Sewage
- **Water Supply**
- Ash **cleanup** and disposal
- **Agriculture** (livestock, dairy, horticulture)
- **Electricity** generation and transmission
- **Communications** (emergency and public)
- **Health** and safety in an ash environment
- **Emergency** response and recovery planning
- Research into health impacts to water supply

