

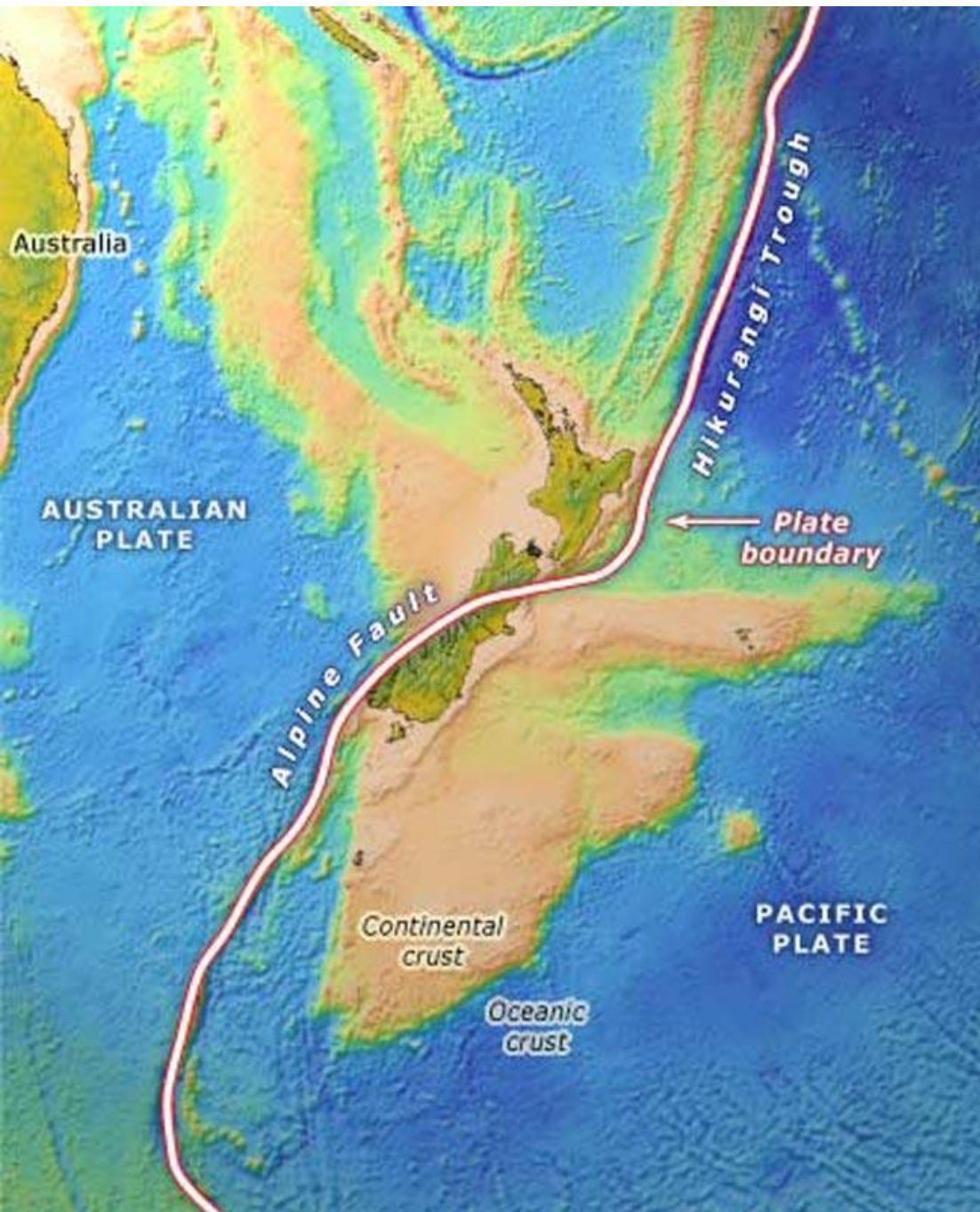
GOJH Field Trip to New Zealand

March 15-31, 2019



Trip organized by Mike Adler, arrangements
done by Brent Schaffer & Marilyn Maier

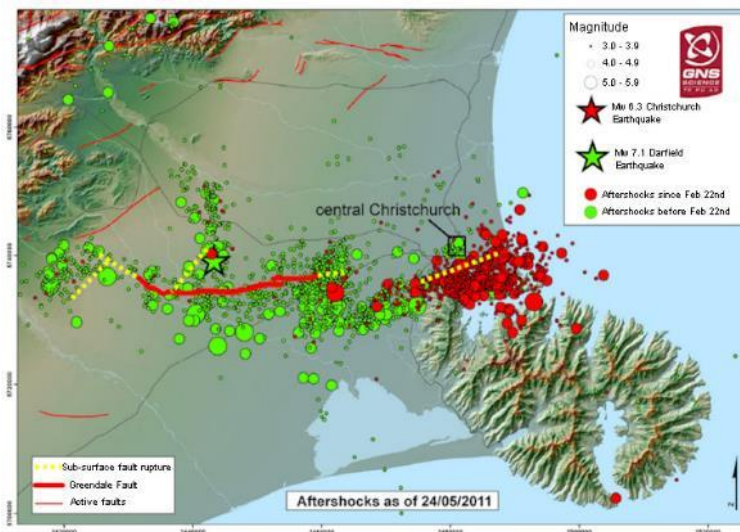
Geology of New Zealand



- The land area of New Zealand is a small part of a largely submerged continental fragment that drifted away from Australia called Zealandia.
- In this diagram, continental crust is shown in orange, and thinner oceanic crust is blue.
- The plates are pushing against each other, causing uplift of the present land area.
- Up until 25 million years ago New Zealand was under the sea

Major Faults in New Zealand

- There are major fault systems running through New Zealand
- Many of the larger faults are oblique strike slip faults, having a combination of sideways and vertical movement
- The north/south running Alpine Fault is the major geological feature and is under constant stress from movement between the Pacific and Australian plates.
- In the South Island, the Marlborough Fault System is another series of major parallel faults.
- These join together further south to form the Alpine Fault which carries most of the total plate boundary strain.
- This is a very distinct feature along most of its length because of the Southern Alps that have been uplifted along its eastern side, making it clearly visible from space.
- It is considered to be at high risk of producing a major earthquake in the next 50 years.
- The fault zone responsible for the 2011 Christchurch is considered a minor one that historically is not very active



New Zealand Geology Guidebooks

- Unlike Scotland and Iceland there is no really good geology guidebooks to New Zealand
- The only current one is The Field Guide To New Zealand Geology by Jocelyn Thornton but it is expensive, eg \$45 and not worth the money(my opinion). Mike Adler has a copy to share
- The best overview with good pictures and descriptions is the NZ website <https://teara.govt.nz/en/geology-overview>
- It has an overview and 12 additional references which offers a good summary of the entire history of the formation of New Zealand and its current situation

The Trip Will be to the South Island

- Christchurch & Banks Peninsula
- East coast and far north including the Able Tasman National Park area
- West coast including Cape Foulwind area and the Oparara limestone arches
- Westland National Park with the Fox and Franz Josef glaciers and the alpine fault
- Southwest including Te Anau, Doubtful Sound and Lake Wanaka
- Southeast including Dunedin and the Otago Peninsula
- Oamaru and the Mt Cook National Park area



NEW ZEALAND TOURING MAP

South Island and Stewart Island

Transport options in New Zealand

Many destinations in New Zealand are just hours from each other. An extensive network of air, train and road services mean most places can be reached by public transport. Buses and coaches link up with rail and ferry operators to take you the length of the country, and air travel is also available to most destinations. If you're going to drive around New Zealand (a popular option) driving tips, licences and permits, road rules, recommended trips and general information can all be found on newzealand.com

Nelson & Marlborough

The top of the South Island has exceptionally beautiful terrain, with three national parks, the amazing Marlborough Sounds and lots of wine sunshine. The region boasts some of the finest scenery in the world and is popular for hiking, cycling, sea kayaking, sailing and fishing. You'll also have many opportunities to improve your art collection – local artists, painters, potters and sculptors welcome visitors into their studios.

Canterbury & the West Coast

Canterbury's landscape is filled with green pastures and friendly country towns – the buzzing hub of the region. Christchurch, a stylish modern city with a mix of interesting architecture and parks, is a relaxing haven. Springs are close by, boasting nature spa baths with stunning views over the hills. Aerial and sea kayaking, for its crystal clear and white watching seals. Approximately 100 hours drive south-west is the spectacular Asgard Mountain. Cook and Nelson Parks, where you'll find the tallest peak in New Zealand. You can helicopter, skydive or hike over Fox and Franz Josef Glaciers or take in their beauty from a scenic vista to their base. Hundale's penitents look like a mist sea.

Southern Lakes

Queenstown and Wanaka's world famous beauty changes in every season. In winter the mountains are alive with snow, sleds and skis. In spring and summer, adventures or offer range from golf and horse trekking to bungee jumping and jet boating. A scenic drive south takes you to Marlborough and offers glacial views, beautiful lakes with deep clear water, connecting waterfalls.

and dense forest is only a short walk or relaxing cruise away. Further south, Central Otago is rich in history and famous for the wine.

Coastal Otago & Southland

Lovers of history and nature will have plenty to see in the deep south. Oamaru, Dunedin and Invercargill have some of the best preserved Victorian and Edwardian buildings in the South. Invercargill has a museum, a stonework to admire, museums to explore and peaceful public gardens to relax in. The coastline and Stewart Island have amazing natural attractions like the Muriwai birdies, the blue penguins and the royal albatrosses and fur seals. Stewart Island is just a ferry ride from Dunedin and offers cage diving with great whale sharks for those who like to take a little bit of the wild side.



South Island Themed Highways

For more information visit newzealand.com/int/themed-highways

- **The Inland Scenic 72 Route:** Perfect for travellers who like to get off the main highways and into rural NZ. Starting at Amberley, in north Canterbury, the route links to State Highway 1 at Winchester. There are fabulous views of the Southern Alps on one side of the road, complemented by the green serenity of the Canterbury Plains on the other.
- **Alpine Pacific Triangle:** This route takes you to the wine and food experiences of Waipara, the spa delights of Havelock Springs and the marine mammal encounters of Kaikoura. Between destinations, you'll enjoy beautiful country scenery.
- **Southern Scenic Route:** From historic Dunedin city, follow the wild southern coast to Invercargill, then continue north-west to Te Anau before ending at Queenstown. Highlights include wildlife encounters along the Catlins coast, taking the Tapanui Pump Ridge Track, chasing Huias and walking the Milford Track – one of New Zealand's 'Great Walks'.

• **West Coast Touring Route:** Between Invercargill in the south and Kaikoura in the north, the West Coast is one adventure after another. Watch the oceanic performance at Pukekura's blow holes, stop for geostones in Greymouth and Lillooie, explore old gold workings and hike over one of the massive glaciers.

• **The Great Alpine Highway:** From Christchurch, this route travels west across river plains before rising to traverse the Southern Alps through Hororua Pass and Arthur's Pass National Park. Highlights include the impressive Waimakariri and Otira River gorges, the Otira Viaduct and the Castle Hill Rocks and Cave Stream Reserve.

• **Southern Heritage Route:** Head inland past Mount Hutt and south to Lake Tekapo to see the beautiful Church of the Good Shepherd. Continue on to Mount Cook Village for alpine adventures. Drive on to Wanaka or Queenstown, then loop back to see the heritage architecture of Dunedin.

Other South Island Scenic Routes
These routes are not specifically signposted.

- **Treasured Pathways:** Enjoy a mix of history, hiking and paddocks as you discover heritage sites, wineries, national parks and beautiful scenery. From the Otago town of Invercargill, travel across the top of the South Island to the scenic dunes of Kaitiaki Spit. The city of Nelson provides a dash of urban fun in the middle of the journey.
- **Alpine Traverse:** From Christchurch, enjoy awe-inspiring views as you cross Arthur's Pass to the West Coast. Drive north to Kaitiaki and take the Lewis Pass up to the spa resorts at Wanaka Springs and Lake Tekapo. Journey back via Kaikoura, where the whales are waiting to meet you.



i-SITE is New Zealand's official visitor information network with over 80 i-SITES nationwide. For more information visit www.i-site.co.nz

100% PURE NEW ZEALAND
newzealand.com

We have three guides from the Geology Department of the University of Otago which will do different parts of the trip

Dr & Professor Virginia Toy

BSc MSc(Auckland) MPhil(ANU) PhD (Otago, Geology)

- structure of shear zones
- microstructure and texture analysis
- coseismic fault rocks
- SW Pacific tectonics



Dr & Professor Michael Palin

BA(Calif State Fullerton) MS(New Mexico Tech) PhD(Yale)

- Isotope Geochemistry and Geochronology
- Igneous Petrology
- Hydrothermal Mineral Deposits



Dr Dushan Jugum

BS MSc(Auckland), PhD(Otago, Geology)

- Dun Mountain Ophiolite Belt
- Geological Research, Geological Society of London,



Day 0,1 March 15,16 2019- Arrive and Stay in Christchurch,
Rendezvous Hotel, Group Arrival Dinner, (Guide Dushan Jugum)

Geology

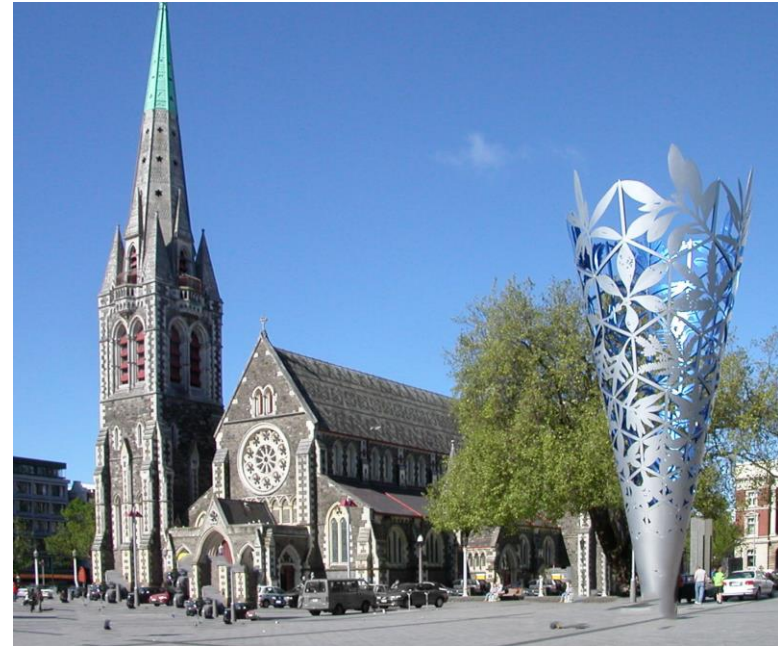
- Canterbury Earthquake fault scarps (2010)
- Banks Peninsula volcanic sequence and lookout
- Christchurch earthquake damage (2011)

Cultural

- Canterbury Museum
- Arts Center(Quake Museum)
- Shopping Tannery, New Regent St



Canterbury
Museum



Anglican church & Chalice sculpture, Cathedral
Square- Before and After 2010 Earthquake





- Image shows the Banks Peninsula, with the snow-covered Southern Alps in the background.
- Akaroa Harbour is at the centre left. Volcanic activity between 11 and 6 million years ago led to the formation of two overlapping volcanic cones.
- After this activity ceased, the volcanic complex became eroded to half its original height, and deep valleys formed.
- The present harbors at Akaroa and Lyttelton were formed when the valleys were flooded as the sea level rose to its present height about 6,000 years ago.



Overlooking Akaroa Bay and Onawe Peninsula



On the Onawe Peninsula, there are igneous rocks such as basalt, but there are also metamorphic rocks present.

These are metamorphic rocks of a type called *Migmatite*, which has been formed by the igneous volcanic rocks being subjected to great temperatures and pressures, causing the rock to partially re-melt and start mixing the minerals.

This produces a rock with bright colors and very interesting swirls and patterns

Day 2 March 17 2019- Drive up East Coast and Stay in Nelson, Saxton Lodge

Geology

- Cliff exposures Cretaceous-Oligocene sedimentary rocks (seen along whole coast)
- Modern earthquake uplift (seen along whole coast)
- Kaikoura peninsula highly deformed Oligocene sequence

Cultural

- Shopping
- Cathedral and World of Wearable Art museum



Curious Seals and Greywacke-Amuri Bluff



Black Swans



Kaitorete Spit-Bangs Peninsula



Day 3 March 18 2019- Drive to North Coast and Stay in Takaka, Mohua Hotel

Geology (Dun Mountain Ophiolite and Karst geomorphology, our guide's PhD thesis)

- Maitai Valley, Permian stratigraphy following the path of New Zealand's first geologist (Von Hochstetter 1859)
- Maitai Valley, view and stream sampling of international type locations of Dunite and Rodingite
- Harwoods Hole (50m wide and 183 m deep karst hole in Ordovician marble) 1.5 hour return walk

Cultural

- Interesting Shops and Cafes, Nicest little town in New Zealand
- Able Tasman National Park





Able Tasman National Park

Day 4 March 19 2019- Stay in Takaka, Mohua Hotel

Geology (Bluffs and wave cut geomorphology and Palaeozoic terranes)

- Fairwell spit
- Wharariki Beach (40 min walk)
- Pupu Springs (outflow from karst network)
- Cobb Valley Palaeozoic terranes and trilobites, with a little imagination or Able Tasman National Park granites

Cultural

- Interesting Shops and Cafes, nicest little town in New Zealand
- Golden Bay Museum(7min walk)
- Able Tasman National Park





Cretaceous(100Mya) Sandstone,
Cape Farewell-Northern Most Point on the South Island

Day 5 March 20 2019- Drive and Stay in Westport, Chelsea Gateway Hotel

Geology

- Buller Gorge (Cretaceous Hawks Crag Breccia) New Zealand's best source of Uranium
- Maruia Falls (waterfall exposed via earthquake 1929, with drop stones and trace fossils)
- Nelson Lakes (glacial valley lakes)

Cultural

- Mining and earthquakes and a little New Zealand (and family) history



Murchinson-Eroded
Oligocene(30Mya)
Sandstone



Buller Gorge, Paleocene(60Mya) limestone over
Devonian(400Mya) Karamaea granite

Day 6 March 21 2019- Stay in Westport, Chelsea Gateway Hotel

Geology

- Natural arches exposing an unconformity between granite and limestone
- Kohaihai Bluff
- Oparara limestone arches (small bus or mini vans preferable)
- Walk in cave with cave wetas and spiders (optional)
- Cape Foulwind gneiss

Cultural

- Seal Colony
- Kawatiri River Trail



Cape Foulwind Seal Colony



In 1770 Captain Cook named this place, Cape Foulwind after persistent rain, and gales. The name has persisted.



Kohaihai Bluff-End of Road NW Coast

- A sheet of limestone was deposited over much of the South Island in the late Oligocene period, about 25 million years ago.
- As the land began to rise, about 10 million years ago, much of the limestone was eroded, and only remnants are left.
- Image shows a thin, resistant band of limestone that forms Kohaihai Bluff, north of Karamea.
- Originally horizontal, the limestone has been tilted up to 50° by uplift of the granite mountains (right).
- The same limestone band, lying almost horizontal, is found beneath the sea floor to the left.





Oparara River Arches

- Oparara limestone arch is the largest natural rock arch in the southern hemisphere
- It is 220m long, 43m high, and 79m wide
- The limestone was formed 30 Mya below the sea on top of 350Mya Devonian granite that once was a part of Gondwana
- At that time New Zealand was largely under water drifting away from Gondwana, stretching and thinning, losing buoyancy and sinking
- Starting 20Mya the Australian and Pacific plates starting moving together and in the process created the present New Zealand



Day 7 March 22 2019- Drive and Stay in Hokitika, Stumpers Accomodation,

Geology

- Gneiss and granite pegmatites at Little Beach, Charlestown
- Trueman track (30 min return) fossils and native forest
- Pancake Rocks (blow hole and obligatory stop)
- Oligocene limestone at Greymouth

Cultural

- The best coastal road in Australasia





Charlestown on west coast- Precambrian gneiss, oldest rock in New Zealand



- Pancake Rocks has irregular chasms and ridges, typical of limestone country.
- The layers of resistant bands of limestone are separated by softer, thin, mud-rich layers
- This type of layering, found in limestones worldwide, is called stylolite bedding.





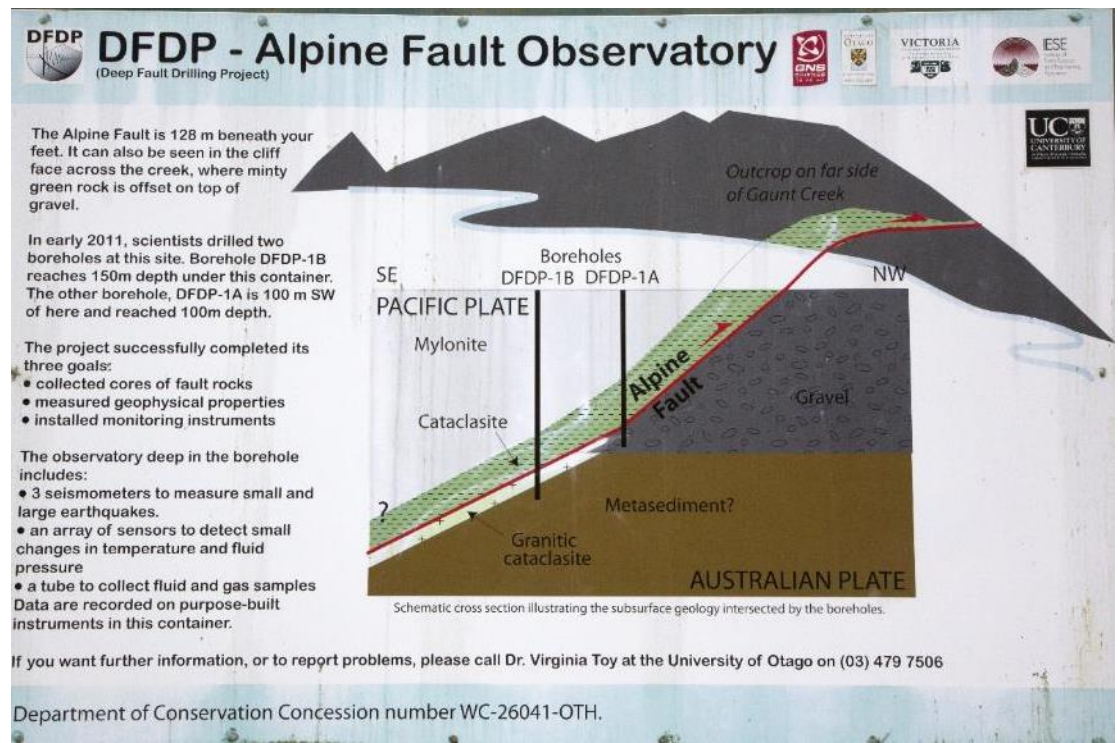
Day 8 March 23 2019- Drive and Stay in Franz Josef, Alpine Glacier Motel(Guide change, Virginia Toy)

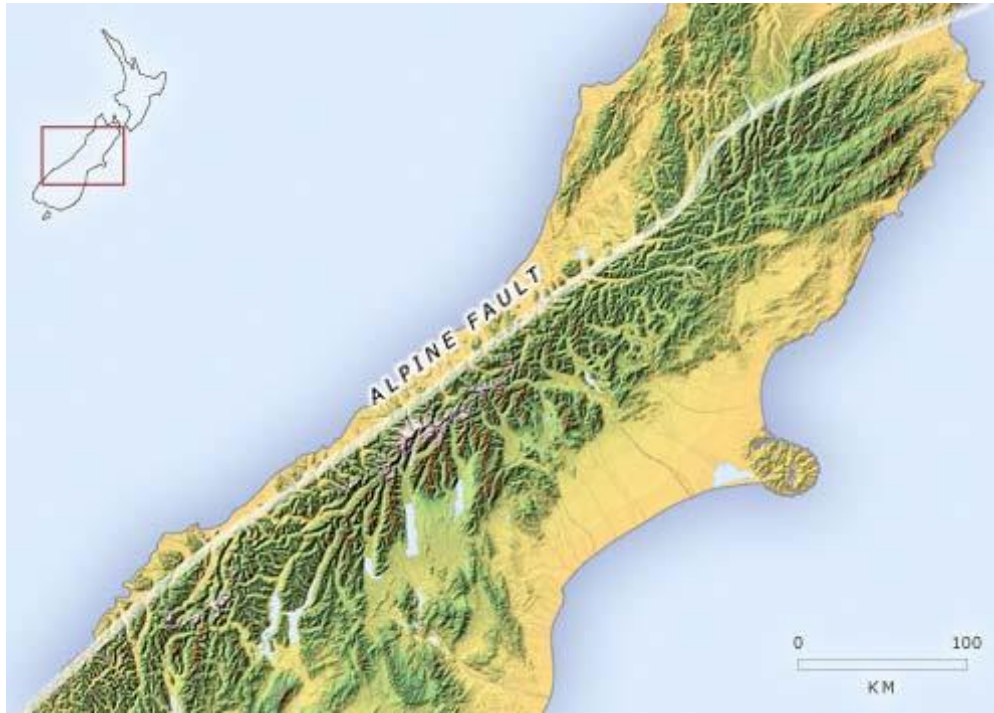
Geology (Alpine Fault bedrock geology + Alpine Fault Drilling Project)

- Ross Mine (open cast gold mine right by the town/road – also don't miss out on 'Flossie's Cafe')
- Pseudotachylytes (fossil earthquakes) at Harold Creek
- Natural hot springs in Wanganui River
- Whataroa Valley and site of phase 1 of Alpine Fault Drilling Project
- Alpine Fault outcrop at Gaunt Creek (with www.alpinefaulttours.co.nz) and site of phase 1 of Alpine Fault Drilling Project

Cultural

- Westland National Park
- Fox Glacier & Franz Josef
- Glacier Hot Pools
- Tartare Tunnel Walk





- The major geological feature of New Zealand is the Alpine Fault
- The Alpine Fault is remarkably straight, bisecting the South Island and forming the western edge of the Southern Alps
- It was not recognized until 1941 because the area was rugged and isolated, and earlier generations of geologists did not have the advantage of having an aerial view.



Alpine Fault at Gaunt Creek

- Gaunt Creek site is near Franz Josef
- Greenish rock is the Pacific plate and the gray rock is the Australian
- The Pacific plate rock lies over the Australian plate on the South Island even though it subducts the Australian plate on the North Island
- This would be the normal situation since the ocean crust is heavier than the continental crust



Alpine Fault- Activity



- The fault runs 600km up the spine of the South Island and has moved 30m in the last 1000 years
- Earthquakes have occurred 4 times in the last 800 years, the most recent was in 1717AD
- Each time the fault ruptured it also moved vertically raising the southern alps
- In the last 12 million years the alps have uplifted by 20km
- The peaks have remained below 4000m only because of erosion
- Another earthquake is expected soon? since the average time between each is 300 years

Day 9 March 24 2019- Stay in Franz Josef, Alpine Glacier Motel

Geology (Franz Josef Glacier Geology)

- Franz Josef Glacier Valley bedrock geology
- Walk on Franz Josef Glacier with a tour company – OR helicopter flight
- Franz Josef township 'hazard and risk' tour

Cultural

- Sunrise over Lake Matheson
- Shop Fox Glacier and Franz Josef villages



Mt Tasman(left)
& Mt
Cook(right)
reflected in Lake
Matheson at
dawn

Mt Tasman(left) & Mt Cook(right) reflected in
Lake Matheson



Mt Cook 12,290', from the Air



Day 10 March 25 2019- Drive and Stay in Wanaka, Edgewater Resort(Group dinner at hotel)

Geology (Southern Alpine Fault + Haast-Otago Schist)

- Tertiary sequence at Moeraki
- Likely to see Fiordland Crested Penguin on the coast
- Quaternary record of Alpine Fault activity in the Haast area
- Alpine → Haast Schist transition in roadside outcrops across Haast Pass and shores of Lake Hawea

Cultural

- Wine tours
- Lake Wanaka



Central Otago Wine Country





Cretaceous(100mya) Schist- Lake Wanaka,Central Otago



Overlook of Lake Wanaka

Day 11 March 26 2019- Drive and Stay in Te Anau, Fiordland Hotel(Change in guide, Dr Mike Palin)

Geology

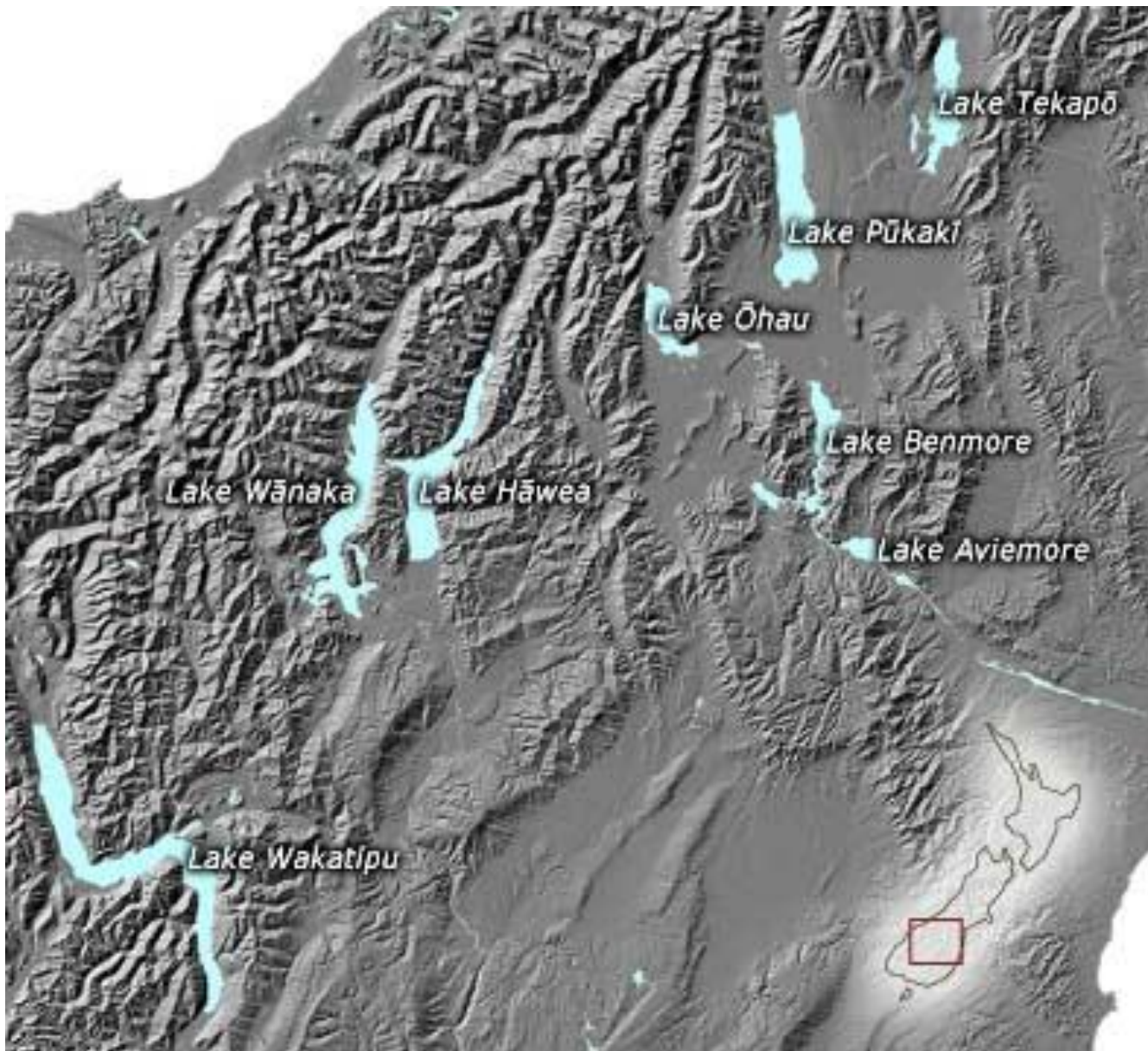
- Gold mining history of the Wanaka – Queenstown area
- Dun Mtn ultramafics in Mossburn area (either at Quarry or Mavora Lakes – also a famous Lord of the Rings site)

Cultural

- Fiordland National Park Visitor Center



Central
Otago and
Queenstown



- Most of the large lakes in the south of the South Island occupy depressions formed by glaciers.
- Most glaciers pile up a belt of rock debris in front of them (called a terminal moraine), and this often acted as a dam, holding a lake in a depression that had previously been filled with ice.

Day 12 March 27 2019- Stay in Te Anau, Fiordland Hotel

Geology

- Doubtful Sound boat trip and geology



Lake Te Anau

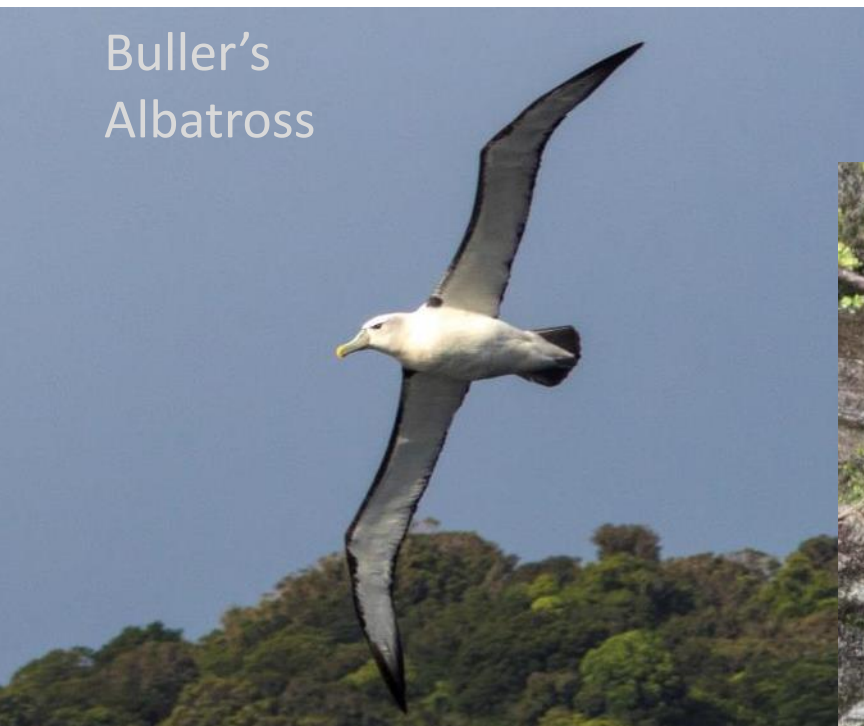
Doubtfull Sound from Wilmot Pass, 2200'



Doubtfull
Sound-
Waterfalls
and Pre-
Cambrian
Gneiss



Buller's
Albatross



Western Weka



Paradise
Shelduck

Doubtful Sound Birds



Day 13 March 28 2019- Drive and Stay in Dunedin, Victoria Hotel

Geology (Southland Geology)

- Tuatapere to Riverton mingled magmas, pillow basalts, scenic coastline
- Cosy Dell fossil location south of Gore (Presidential Highway to Clinton)
- Gabriel's Gully normal fault and fault scarp breccia and history of gold mining

Cultural

- On way tour and shop Queenstown
- Heritage Building (or City) Walk & The Octagon
- 2019 NZ BagPipe National Championships



Dunedin
Train
Station

Day 14 March 29 2019- Stay in Dunedin, Victoria Hotel

Geology (Dunedin Geology)

- Dunedin volcanic history on two trips – Tunnel Beach and Aramoana
- Otago Peninsula-Organ Pipes basalt columns
- Albatross colony + penguins

Cultural

- 2019 NZ BagPipe National Championships
- Heritage Building (or City) Walk & The Octagon
- Tour and Shop Dunedin

Otago
Peninsula





Organ Pipes- Mt Cargill, Otago Peninsula

Miocene(20Mya)
pentagonal basalt columns





Day 15 March 30 2019- Drive and Stay in Oamaru, Brydone Hotel

Geology

- Moeraki Boulders
- Oamaru pillow basalts
- Vanished World Trail (amazing vertebrate fossils among other things – see <http://www.vanishedworld.co.nz/>)

Cultural

- Blue Penguin Colony
- Oamaru Victorian Precinct & Public Gardens



Day 16 March 31 2019- Drive and Stay in Christchurch, Rendezvous Hotel

Geology

- Accretionary prism sequence at Benmore Dam
- Dam building in a tectonically active region (on active faults!)
- Mt Cook.

Mt Cook, Mt Tasman, Mt Sefton, Lake Tekapu



New Zealand Overview

Days off from Work	Date	Agenda Day	Guide	Plan to:	Hotel Location
1	13-Mar	-		Depart US	-
2	14-Mar	-		lose a day!	-
3	15-Mar	0		Kick-off Dinner at <u>Twenty Seven Steps</u> 6:30PM Social hour 5:30PM	Christchurch
4	16-Mar	1	Dr. Jugum	Christchurch area, Overview	Christchurch
5	17-Mar	2	Dr. Jugum	Scenic coastal route north	Nelson
6	18-Mar	3	Dr. Jugum	Follow NZ's 1st Geologist's path	Takaka
7	19-Mar	4	Dr. Jugum	Walk on Wharariki Beach	Takaka
8	20-Mar	5	Dr. Jugum	Mining and earthquakes in NZ	Westport
9	21-Mar	6	Dr. Jugum	Natural Arches exposing unconformity	Westport
10	22-Mar	7	Dr. Jugum	Best coastal road in Asutrasia	Hokitika
11	23-Mar	8	Dr. Toy	Phase 1 of Alpine Fault Drilling Project	Franz Josef
12	24-Mar	9	Dr. Toy	Franz Josef Glacier Valley; bedrock geology	Franz Josef
13	25-Mar	10	Dr. Toy	Southern Alpine Fault; Haast-Otago Schist	Wanaka
14	26-Mar	11	Dr. Palin	Gold mining; Lord of the Rings site	Te Anau
15	27-Mar	12	Dr. Palin	Boat trip or Milford Sound	Te Anau
16	28-Mar	13	Dr. Palin	Cosy Dell fossil location	Dunedin
17	29-Mar	14	Dr. Palin	Dunedin volcanic history	Dunedin
18	30-Mar	15	Dr. Palin	Pillow basalts; Vanished World Trail	Oamaru
19	31-Mar	16	Dr. Palin	Benmore Dam	Christchurch
20	1-Apr	17		Depart New Zealand	On our own . . .
21	2-Apr			gain a day!	
	2-Apr			Arrive US	
				New Zealand - 17 days	

Trip Summary

- 6:30 dinner on March 15 – 1 block from hotel
- All hotels and most meals are covered. We are on our own for 9-10 meals. (~6-7 dinners and 3 breakfasts)
- We provide transportation from the hotel back to CHC on April 1st
- You will need “Type I” outlet adaptors as NZ operates at 220V 50 Hz and has a weird plug:
 - <https://www.ceptics.com/products/australia-china-travel-adapter-type-i-dual-usb-ctu-16>
 - Most electronics will work at 220V 50Hz so all you really need is the plug adapters which are readily available and will also work in Australia

