December 2019

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Member	Tom Brown		
Member	Steve Cross		

GENERAL NEWS

Website. Dave Briggs runs the club website, check it out at www.nelsonrmc.org, it is being continually updated.

SUBS: If you have not yet paid your subs please contact Hub.

MEETINGS Please check your emails for up to date information.

Committee:

If any of you wish to become more active in the running of our club, please contact a member of the committee.. We need more on the committee to enable the club to be run efficiently and provide fresh momentum.

This edition contains a lot of photos. You can get a clearer view of them by zooming in. To do this just press Ctrl Shift +

To zoom back out it's Ctrl shift -

NELSON ROCK AND MINERAL CLUB – PRESIDENT'S ANNUAL REPORT 2019

Once again we have had a pretty full year, with a wide range of subjects covered bythe speakers at our Monthly meetings. Disappointingly the attendance at meetings was slightly down on the previous year, but this year there was a great number of additional competing geology and science based talks on offer, from the Science Society, the Cawthron Institute, the AusIMM Discussion Group as well as the Hochstetter Lecture. On the positive side, Rock and Mineral members were well represented at most of these talks. Club membership was also slightly down on previous years but we do have a couple of new and enthusiastic junior members and three country members who occasionally manage to join us on field trips or meetings.There were two,very successful, full weekend field trips, the first to Kaikoura and the second to D'Urville Island, as well as three other trips and a micro-mineral workshop. Two other activities undertaken during the year were the hosting of the Tauranga Club for two,one day field trips in January, thanks to the efforts of Clyde Nicholson and Dave Briggs – and the running of a "Show and Tell" afternoon at the Elma Turner Library, where we were almost overrun by school children and had one of the best takings ever from our sales table. Our thanks to the Nelson Institute who set this up and to Stephen Eagar, Paul Henare and Greta Tapper for assistance. A list of the meetings and activities can be found on the reverse of this report.

During the year we had to move the Club's storage shed from Mapua as the land it sat on was sold and fortunately the Steam Museum came to the rescue and made a space for it. In return they would wish for the Club to set up our equipment and layout a geology exhibit space which could be opened for visitors to the Steam Museum. This has still to be actioned, either in space provided by them, or organized by the Club.

I would like to thank the members of our committee, Dave Briggs, Hub Opden-Busch, Tez Hardwick, Tom Brown and Lis Martin for their support during the year. Special thanks to Hub for managing our finances, to Marion Mathews and Alan for managing our Library, to Greta Tapper for handling the sales table specimens and to Dave Briggs for maintaining and improving our website. Thanks also to all those who presented Talks to us and contributed to the Display tables, competitions and field trips.

Finally to Dr. Mike Johnston many thanks for being our patron, for the talks you have given us and our congratulations for the well-deserved Order of Merit you were awarded since our last AGM.

Mike Blowers

Micro Mineral Workshop

On Sunday 21st July Chris Fraser ran a Micro mineral Workshop and his full collection of mounted Micros was available for examination. We had four microscopes available and were able to study Chris' best specimens. We also had unbroken and unmounted rock pieces from a number of locations which we were able to work through and break into micro specimens. For the harder rocks Chris had his home made splitter which successfully reduced a number of hard slag samples from the Champion mine into smaller pieces showing voids with copper growths which we could continue to work on at home. I was particularly pleased with the breaking up of the slags as it revealed a number of good voids which I (Mike) was able to clean up using a mixture of citric acid as recommended in Chris' book. We were also impressed with the cheap USB camera that Chris used to examine samples, which threw a pretty good picture on the computer screen, speeding up the preliminary examination of samples prior to using the microscope. A rewarding morning for those that attended.

Chris with his hydraulic splitter

Copper samle found in split rock from the Champion Smelter

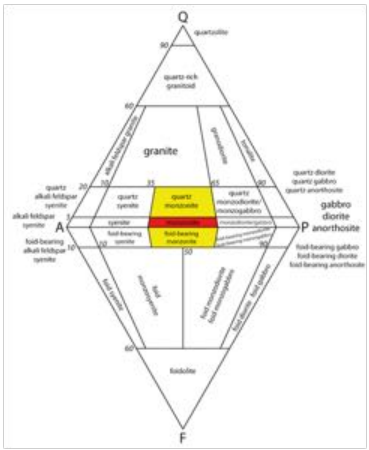
Bohuslan Granite 19 Sept talk by Tom Brown

The band of igneous rock known commercially as the Bohuslan Granite represents the last phase of the Sveconorwegian orogeny, cooling from magma about 920 million years ago. Occupying a relatively small mostly coastal area between Gothenberg& Oslo, it is frequently a distinctive pink noticeable on the coast of SW Sweden. A number of Quarries in SW Sweden and Norway have supplied the rock for construction, sculpture and benchtops.

Rock drawings have been found made by Bronze and iron age people between 3,000 and 2,000 years ago. The ages of some of the drawings can be assessed by the height above sea level as the isostatic lift in this area is estimated at 15 metres over the last 3,000 years. It is estimated the ice sheet retreated from here about 11,600 years ago.

So, what is the rock? The Bohuslan granite is defined as a monzogranite having roughly equal portions of the two types of feldspar, namely Alkali and Plagioclase. To be defined as a granite it should have more than 20% quartz, otherwise it is really a quartz monzonite. The proportions of quartz and the plagioclases are difficult to determine simply by observation, but certainly the salmon pink specimens with high orthoclase are an attractive rock.

Area of Bohusian Granite composition in QAPF diagram (in terms of Quartz, Apatite, Plagioclase, Feldspar)



Tom’s random samples from the area

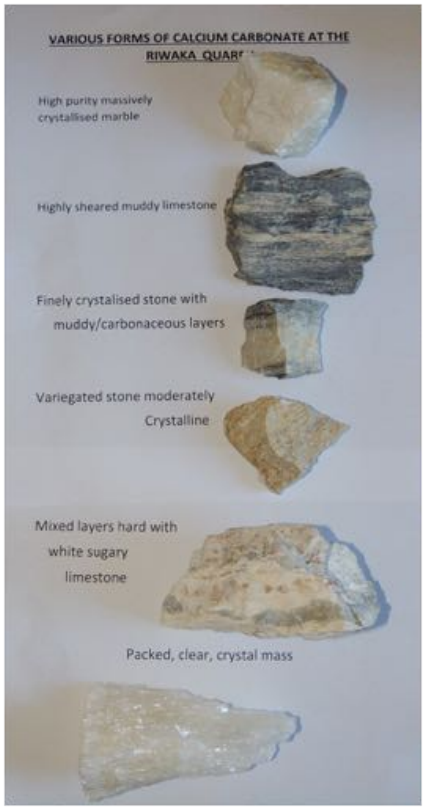
Field Trip , riwaka Quarry revisited

The tightening of Health and safety regulations over the last couple of decades has made visiting some sites of interest far more difficult to achieve. Often the land owner is required to provide personel to keep an eye on visitors such as us. This comes at a cost so we are often refused permission. Tarakhoe quarry was a favourite fossiking spot for many years which is now denied to us. We found remnants of a whale there one time and a number of rare fossils have been found over the years which will now be lost to road fill.

So, when we get permission it is well worth the effort for a visit. This was the case for Riwaka Quarry, and after some delay due to weather etc the trip was on.

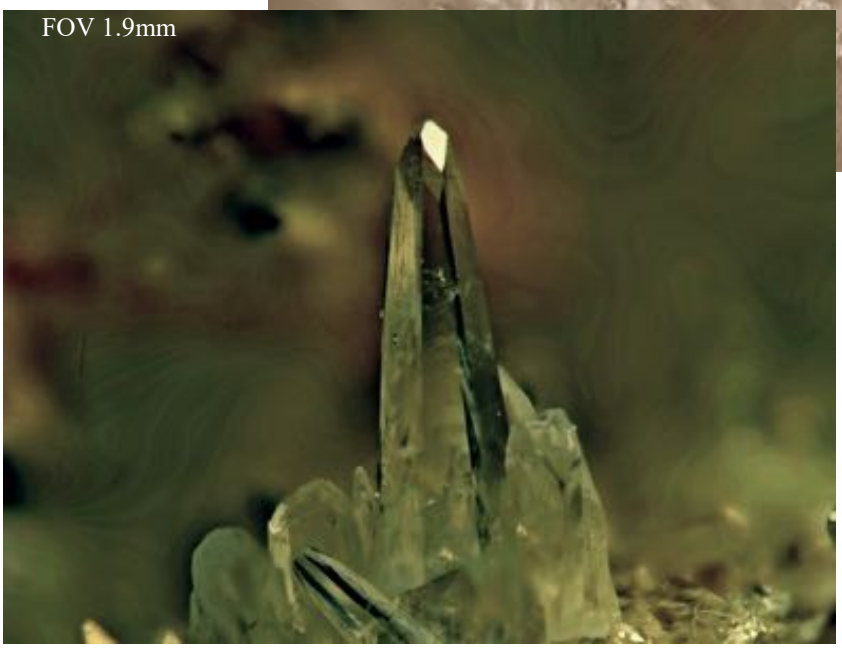
We had been there the previous year but as the quarry is a working quarry albeit on a part time basis, there is alway the possibility of new discoveries.

Like the previous visit, most of the group immediately headed up the track but one or two picked through the various piles of lime lying around before heading upwards. About 100 metres along and up the track was an old bench to the right where a number of us spent a good deal of time scratching about. The face was somewhat weathered but the layers of lime could be clearly seen dipping at an angle of about 45 degrees to the west. The layers were of very uneven quality, some quite hard and crystalline, other layers microcrystalline, some hard, some soft, here and there were layers of earthy material and in some places the limestone had been faulted and sheared. There were areas where the shearing and faulting had somehow allowed the incorporation of carbonaceous material, as when this black streaked limestone was dissolved in acid it resulted in a residue of finely divided carbon.



Pink thulite with epidote and black manganese dioxide

Calcite samples from Riwaka Quarry



IMPRINTS OF THE ICE AGE

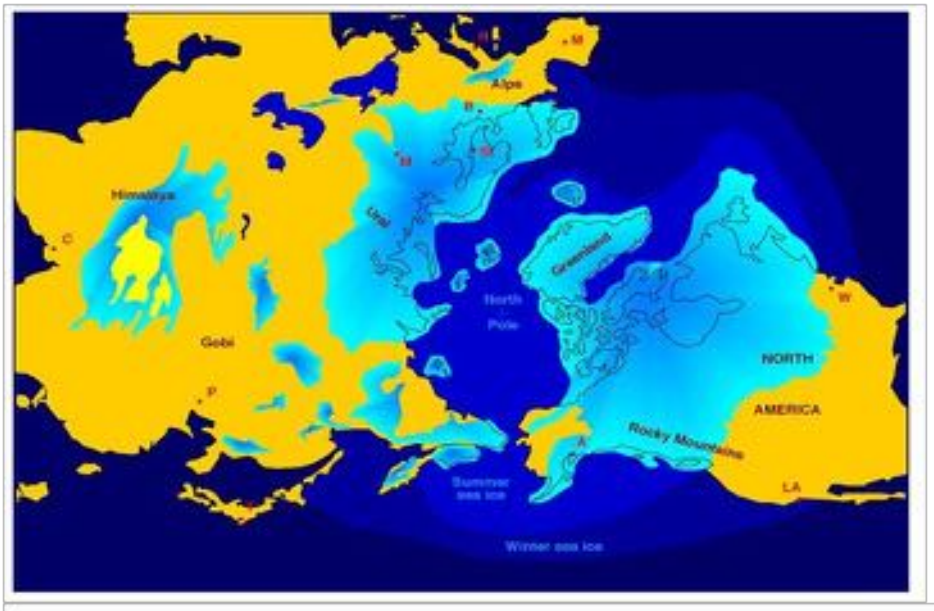
Glaciation in the Nelson Area, Talk by Dave Briggs

Dave commenced this very interesting talk by introducing some general facts about glaciation, dispelling some misunderstandings and giving us a perspective of world glaciation, before turning to the specific glaciation of our area.

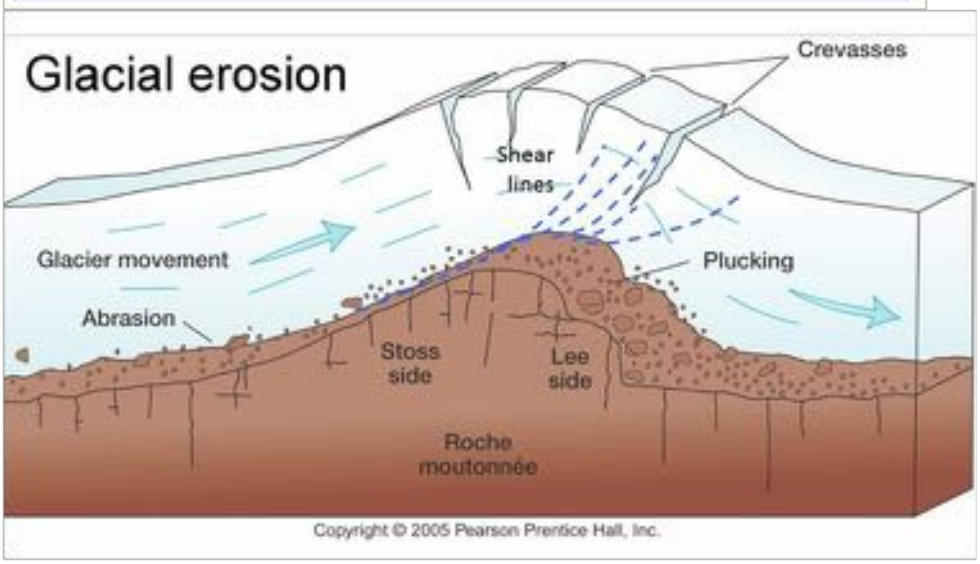
Age (m yrs)	Period
2400 - 2100	Archean (Snowball Earth)
830 - 635	Late Pre-Cambrian (2nd Snowball Earth??)
420 - 450	Silurian
260 - 360	Permian/Carboniferous
2.6 – 0.01	Quaternary

We were introduced to the ice age periods and given a look at the enormous spread of the Northern hemisphere glaciation and areas which still glaciated. The characteristics of present glaciations were detailed, with reference to Antarctica, Iceland and Franz Joseph.

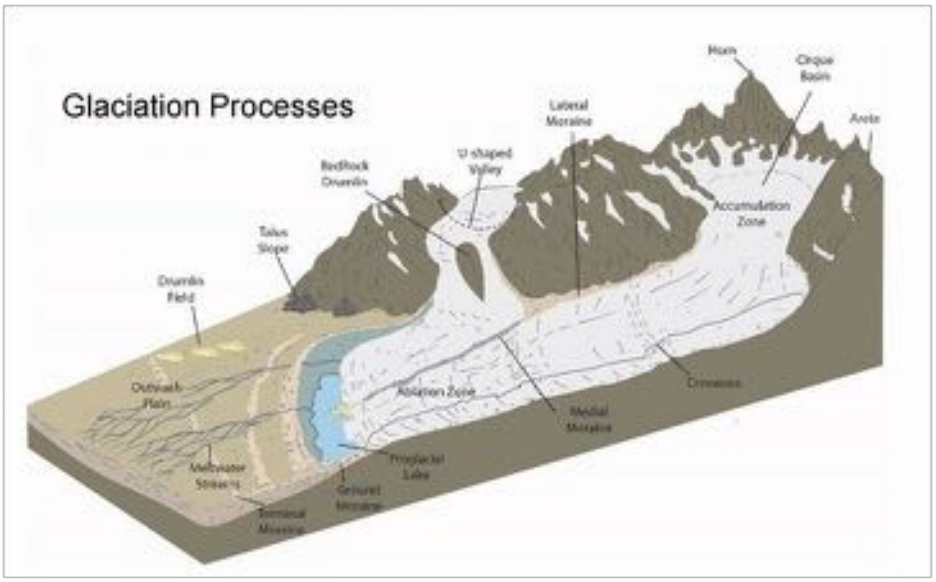
Northern Hemisphere Quaternary Glaciation



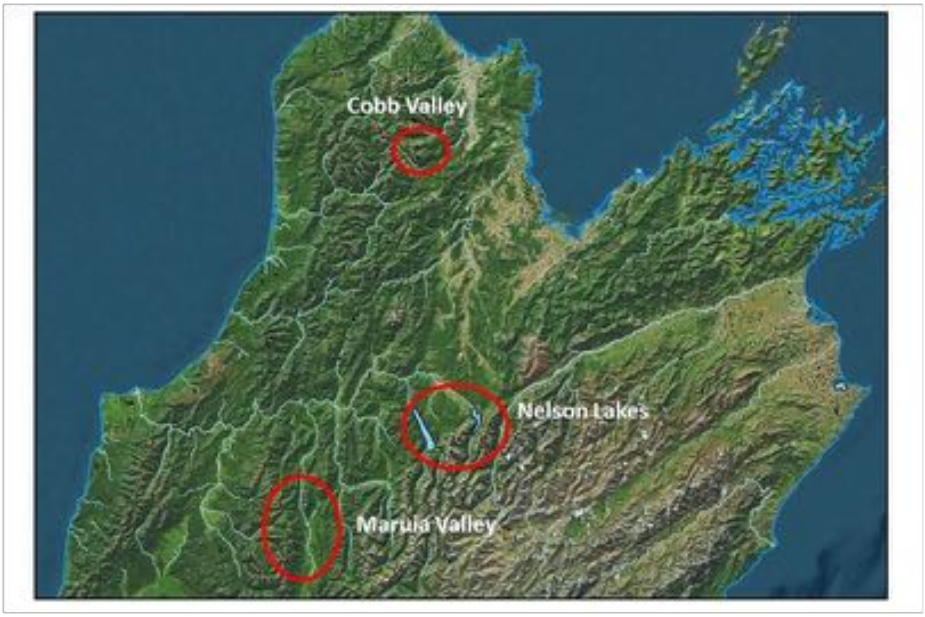
The characteristics of glaciation landscapes was illustrated and the commonly held misconception of a glacier as a bulldozer were dispelled. The digging and gouging caused by glaciers is due to entrained stonesfrozen in the ice which do the grinding and abrading of the ground under the glacier (see diagram)



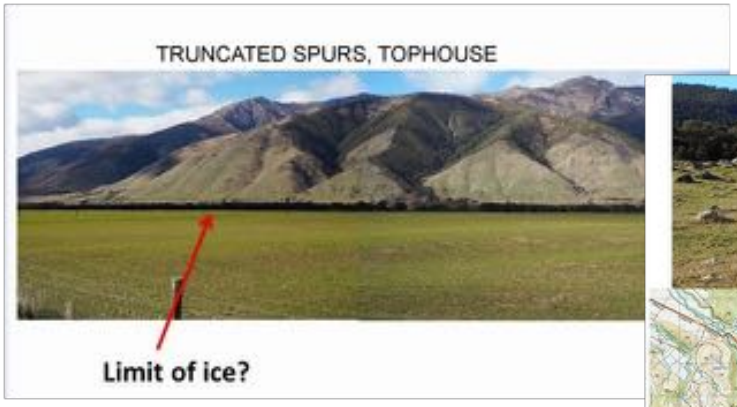
In addition to the abraded material, glaciers carry debris from the surrounding mountains on their surfaces (supraglacial till), or within their ice mass (englacial till), and considerable material can be transported by melt water running under the glacier. Large rocks carried by glaciers and then dropped are known as erratics. Debris and scars left by glaciers can tell the story of their advance and retreat if properly interpreted.

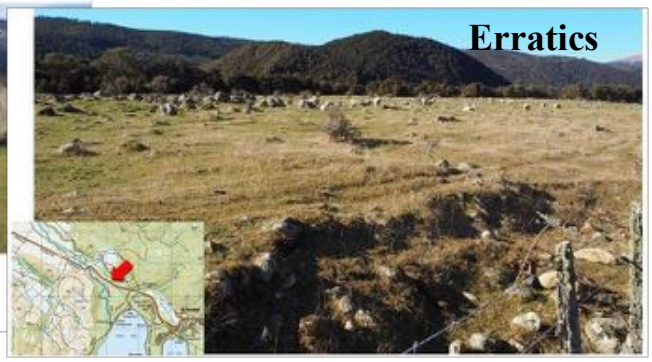


Dave went on to describe the various glacial markings left by glaciers in our area of the South Island, cirques, U-shaped valleys, terminal and lateral moraines till deposits and erratics. The areas affected and mentioned in this presentation are circled in red.



The following images illustrate the glacial landforms to be found at the top of the South Island.

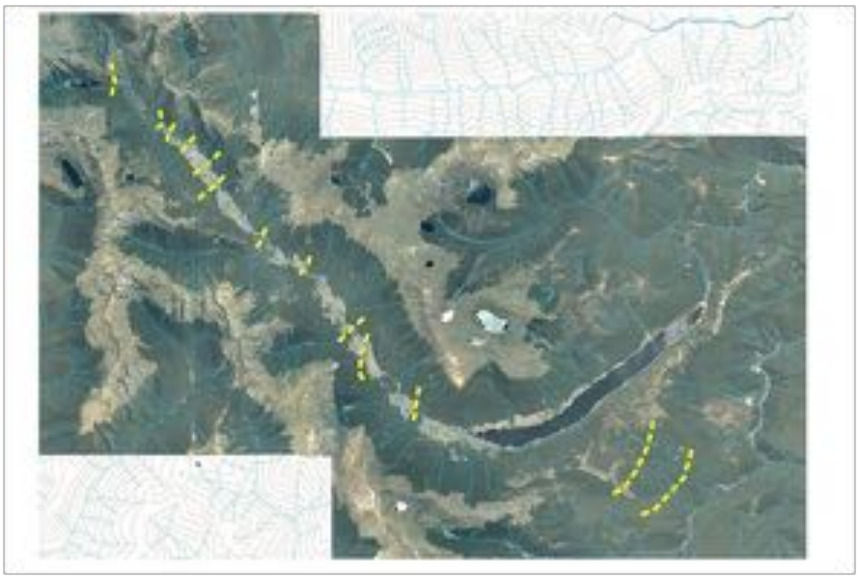




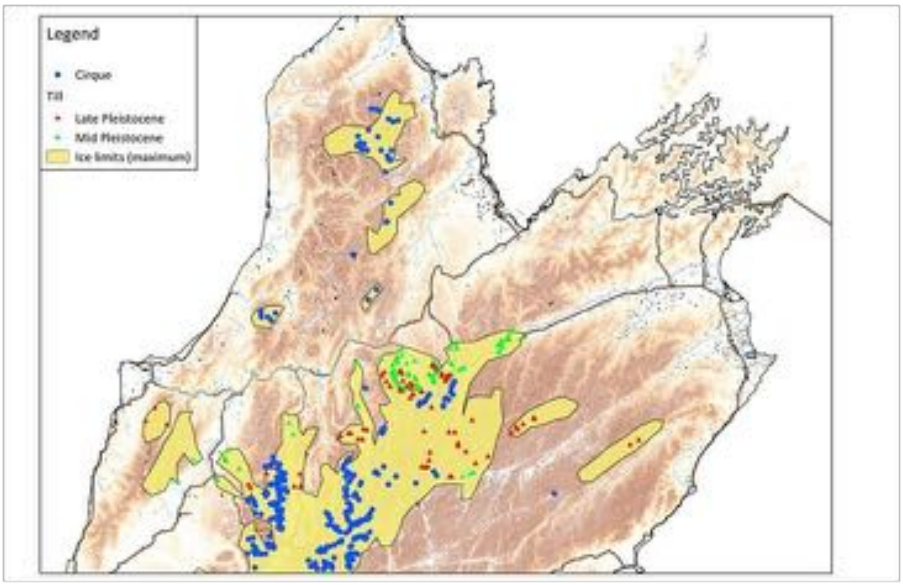
Nelson Lakes

Retreating terminal moraines in the Cobb Valley

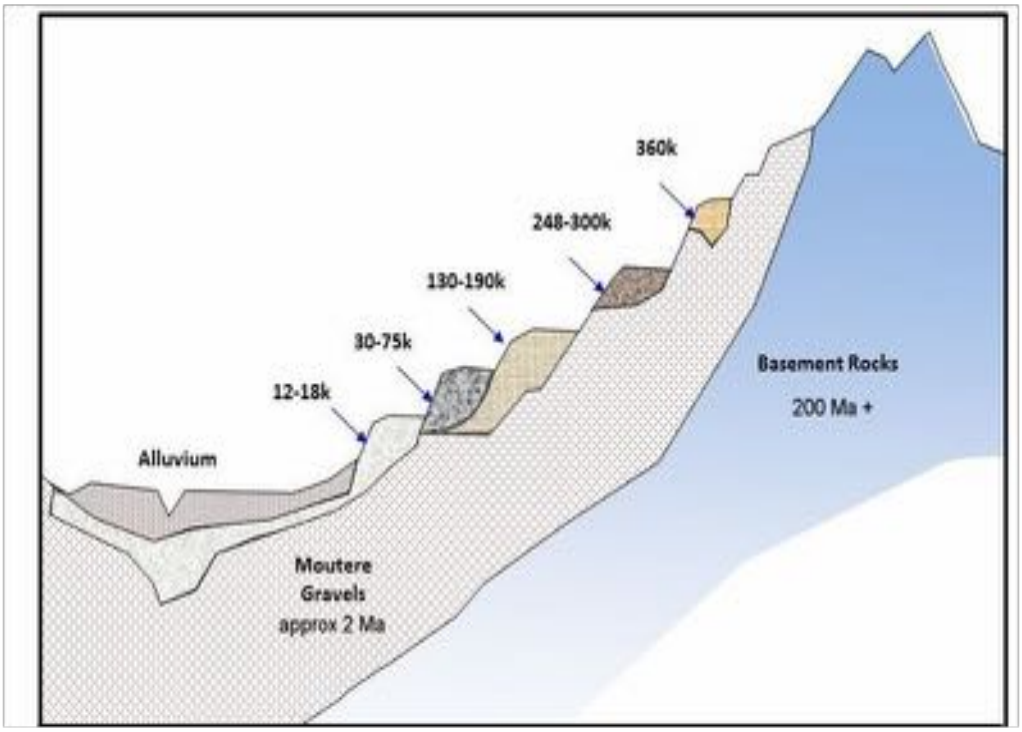
The sequence of terminal moraines above the dam show that ice retreat at the end of the Otiran Glaciation happened sporadically, with periods of melting interrupted by colder phases when the ice front remained static (still-stands) or re-advanced a short way. In the Maruia Valley, terminal moraines are larger but much less frequent. There, retreat seems to have occurred in three or four main phases, with major advances between. During these advances, ice -dammed lakes formed in the valley.



Glacial features by age and maximum extent of glacial ice



A schematic diagram of the river terraces in the Wai-Iti and Motueka valleys, showing the height and estimated age of the terrace deposits. The terrace deposits were laid down mainly in cold-stages, when the rivers became choked by debris eroded from the bare valley sides and by sediment-laden outwash from glaciers in the mountains. The terrace flats (i.e. the surfaces) tended to be formed in warmer periods; downcutting (leaving the deposits as a bench) probably occurred mainly during periods of climatic cooling, when sea-levels lowered and the rivers adjusted their profile to the new base level.

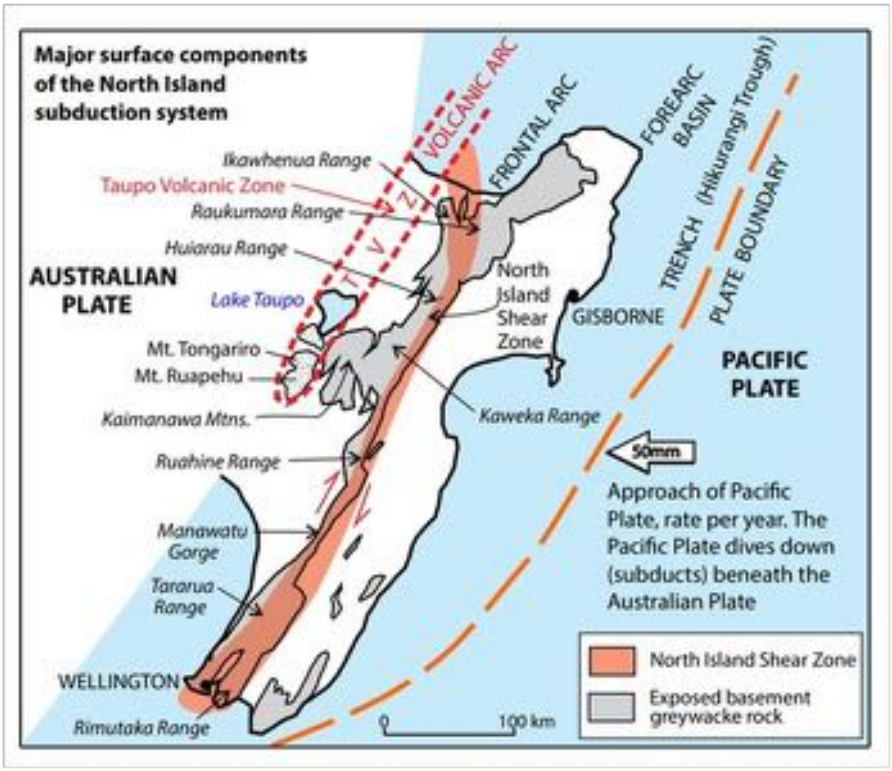


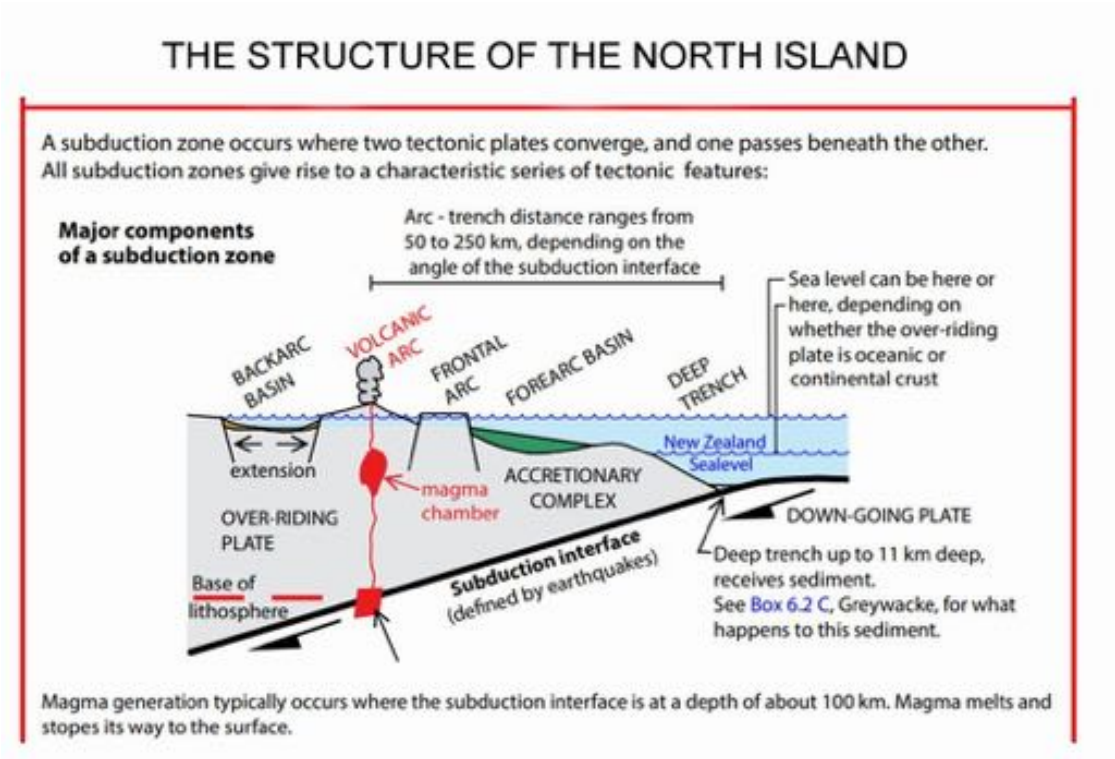
Conclusions

1. The Nelson area lay at the northern limit of Quaternary glaciation in the Southern Alps
2. Most evidence relates to the most recent (Otiran) glaciation – ca. 75-10,000 years ago. During the Otiran glaciation, ice formed in cirques and extended into the higher valleys.
3. The imprint of earlier glaciations (pre-Otiran) is limited, but the evidence suggests that that ice extended further.
4. The major legacies of the Ice Age are the glacially eroded mountain areas, and the extensive river terraces in the valleys.
5. We still know very little about glaciation in NZ, so we need to keep investigating. (More research is needed!)

Report on the East Coast North Island, by Jean Gorman

Off the east coast lies the Hikurangi Trough, the place where the Pacific Plate dives under the Austro-Indian plate. The boundary has the potential for a thrust quake, like Northridge or Sendai.A thrust fault motion is more upwards than for transcur-rent faulting – such as the Alpine Fault – generating tsunamis if undersea.

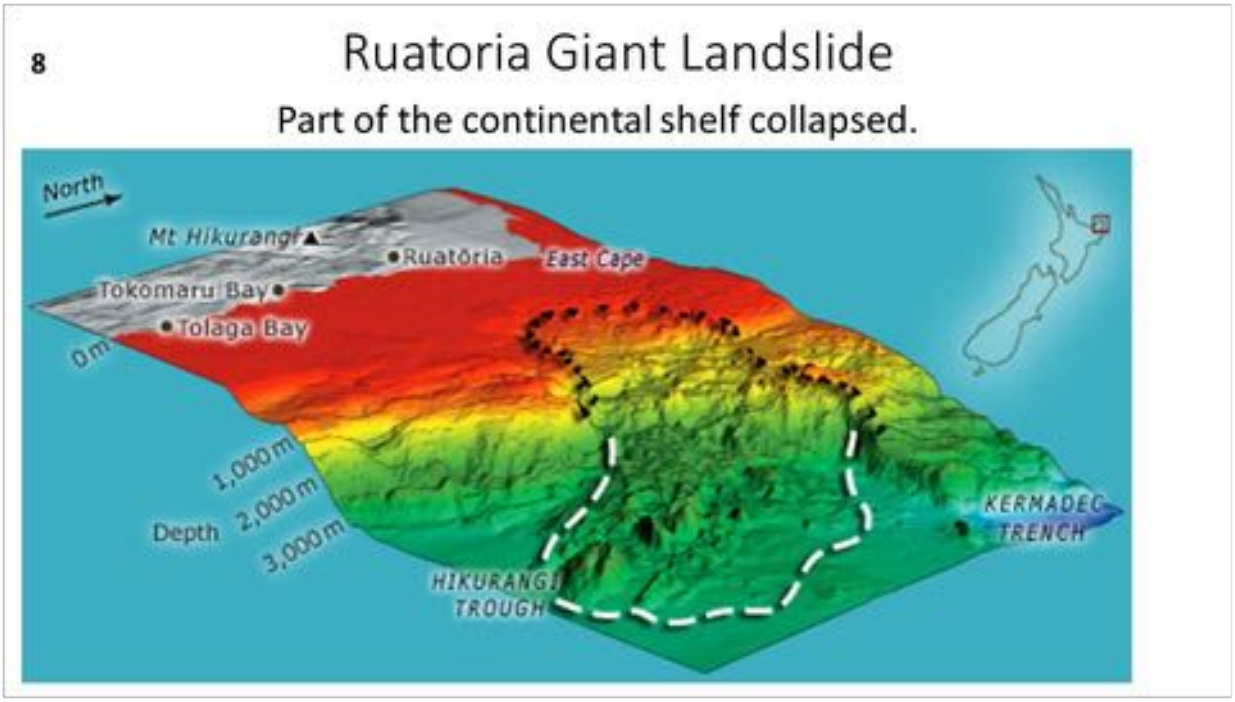




A recent study found the last large quake the Hikurangi generated, about 500 years ago was about Richter 8.0, and before that, about 850 years ago, was over Richter 8.5.In 1947 an R7.2 quake generated a tsunami from this general area.

Quakes are not the only source of problems. There can be silent tsunamis without a

quake, which give no notice at all, like the Ruatoria Giant Landslide. This massive underwater landslide occurred off Ruatoria, 140,000 years ago and part of the continental shelf collapsed into the Hikurangi Trough. Events like this can cause “silent” tsunamis, with no quake forewarning. Other silent tsunamis can originate from the Kermadec chain of volcanoes north of NZ.



Quakes cause many onshore landslides and the resulting increase in sedimentation rates as rivers flow out onto the seabed mean that offshore seabed cores give us a way of interpreting historical events. Thus turbidite beds make a library to unravel earthquakes – a rate of one in 200 years seems common, and we can use foraminifera to date them.

One reason why NZ ‘floats’ so high on the crust is the presence of the buoyantHikurangi Large Igneous Province (LIP). It was formed by a mantle plume (like Hawaii).Now called the Hikurangi Plateau, ithas pushed the entire Pahau Terrane under the NZ Margin and squeezed it under the Rakaia Terrane. We presume there is also ocean crust under the Rakaia terrane.There is a great difference in the gravity measurements due to the different underlying terranes.It was the further SW under-thrusting of this Pahau/Rakaia convergent margin that caused the Kaikoura Quake. This wasa thrust quake.

The LIP is why the plate boundary shallowand accessible to us. Slow slip occurs right up to the seafloor boundary.Recent research shows there are four centres of slow slip and the Wellington bitis stuck.Slow slip faults are being found all over the globe. They creep aseismically and commonly occur at 30-40km where they happen continuously but are not accessible to us. 50 km off Gisborne they are occurring at shallow depths so scientists can study them.

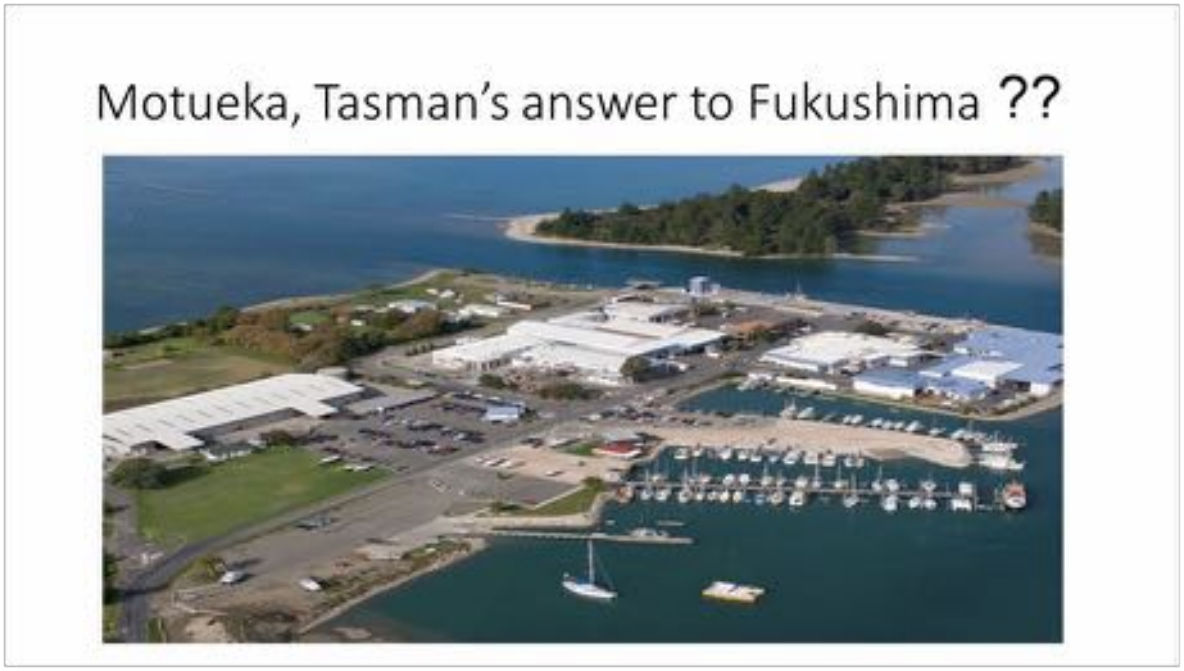
Slow slip near Gisborne became very active after 2016 Kaikoura Quake. So it tells us it’s extremely responsive to stress. Slow slip can increase strain on other areas and it has a relationship to large damaging quakes here, in Japan and in Oregon so the international

community is very supportive of the International Ocean Discovery Program IODP, their drilling ship theJoides Resolution has placed observatories at an active fault behind the east coast plate front.

There is a lot of discussion about the role of sea-mounts in slow slip zones. Do they cause sticking? Large seamounts are coming in to the subduction in the Gisborne area. There isup to 2km of relief in the subducting plate; it's rough. One can see tremor occurring in some places around a subducting sea-mount and slow slip in others.MagnetoTellurics (and NIWA) tell us it's not a seamount that is causing the sticking, but a lack of clay at the plateboundary.The locked part is aseismic.

The maximum horizontal speed of plate collisionis just south of Cape Kidnappers.There is cumulative slow slip north of Porangahau/Dannevirke but not under Wellington. It is estimated that a Richter 8.4 is presently constrained by the locked zone, and will cause a massive tsunami on the East Coast.

Locally Motueka will suffer inundation in any tsunami over 1m at high tide.Public information from TDC shows that Talleys stores diesel, Phosphoric Acid, Sulphuric Acid, Ammonium etc. on the wharf. It is unfair to single out Motueka. NZ should rethink how many ports store huge tanks of diesel, petrol etc. We should learn from what happened at Fukushima, there's nothing radioactive here, but we can't have everything.



Fougèrite in Champion Copper Smelter slag

A few years ago, I was in the process of examining some pieces of slag I had collected from the Champion copper smelter in the Aniseed Valley. Amongst the small crystals present in the cavities in the slag were shiny, blackish-green hexagonal plates. Sometimes these crystals are thin enough that they are transparent and deep green.

It is only recently that I have managed to identify what this mineral is – a hydrated iron carbonate called fougèrite (named after the type locality Fougères Forest, in France). The chemical formula for fougèrite is $Fe^{2+}{}_4Fe^{3+}{}_2(OH)_{12}[CO_3]\cdot 3H_2O$

Fougèrite is a common mineral in iron-rich smelter slags and is sometimes called 'green rust'. It is unstable and will convert to limonite within a few days after opening a cavity containing these crystals as they react with oxygen in the air. The crystals will retain their shape but will gradually turn orange in colour and become limonite pseudomorphs after fougèrite.

The Champion copper smelter produced iron-rich slag because much of the ore smelted there contained pyrrhotite – an iron sulphide. The pyrrhotite contained a small percentage of copper too.

I went through my remaining pieces of slag from the smelter in order to find some fresh crystals to photograph but to little avail – all I managed to find were some extremely tiny crystals which don't really give a good impression of what they like. These are some photos which I took years ago using a Dino-lite digital microscope, but they are not great quality.

Figure 1. Tiny blackish fougèrite crystals on a 1mm copper wire from Champion smelter slag.

Figure 2. The same copper wire several days later – the fougèrite has altered to limonite.

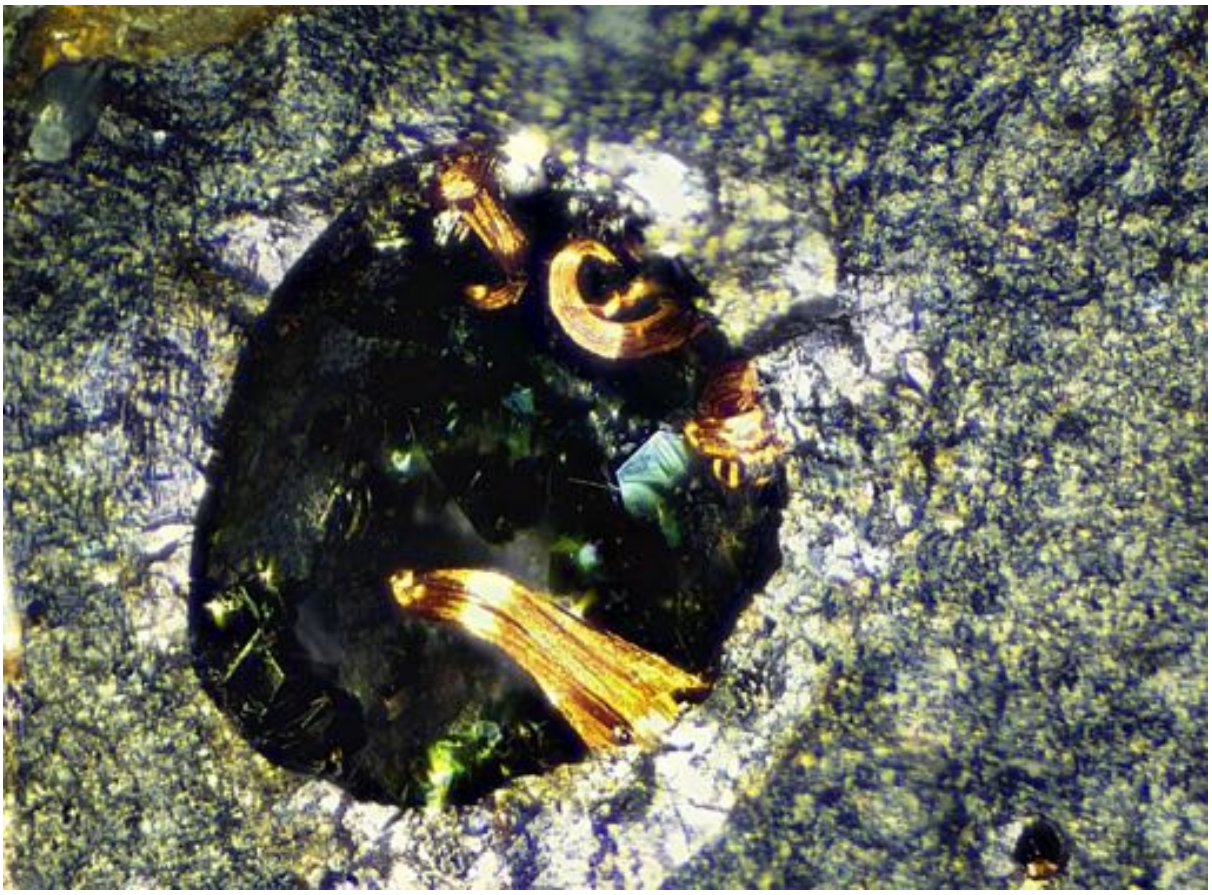


Figure 3.Copper wires and blackish-green hexagonal crystals of fougèrite.

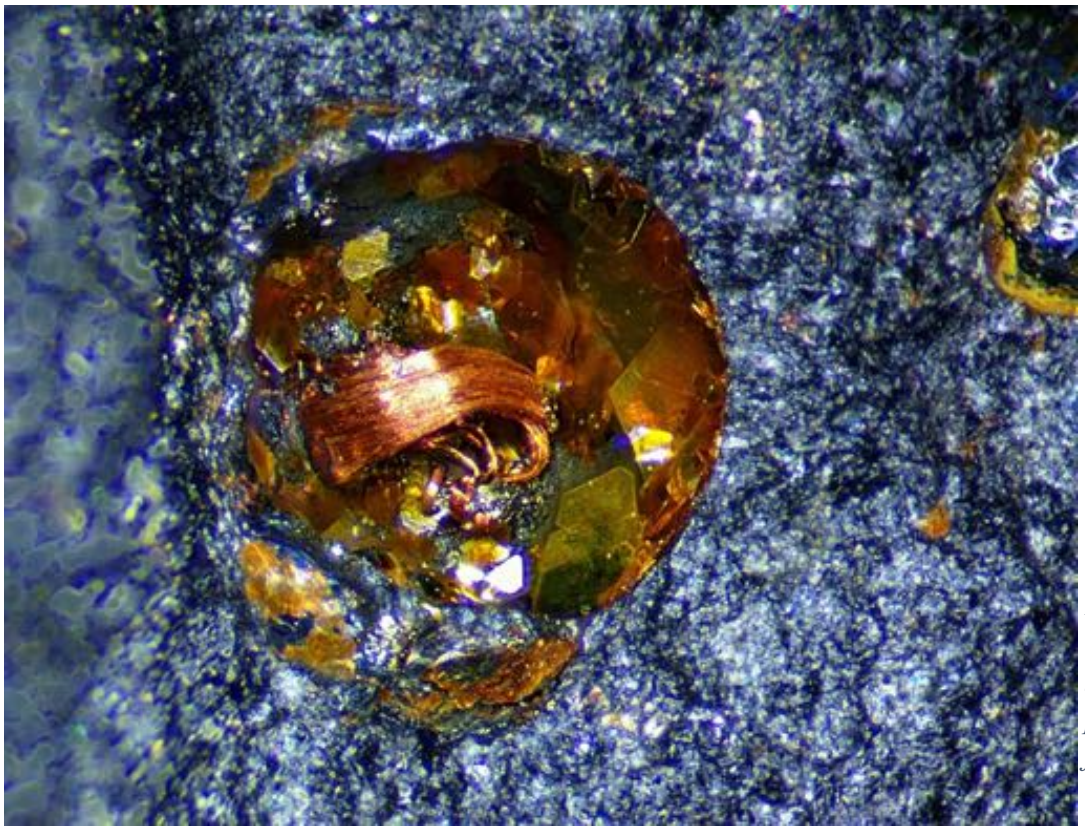


Figure 4.Copper wire surrounded by partly altered fougèrite crystals.

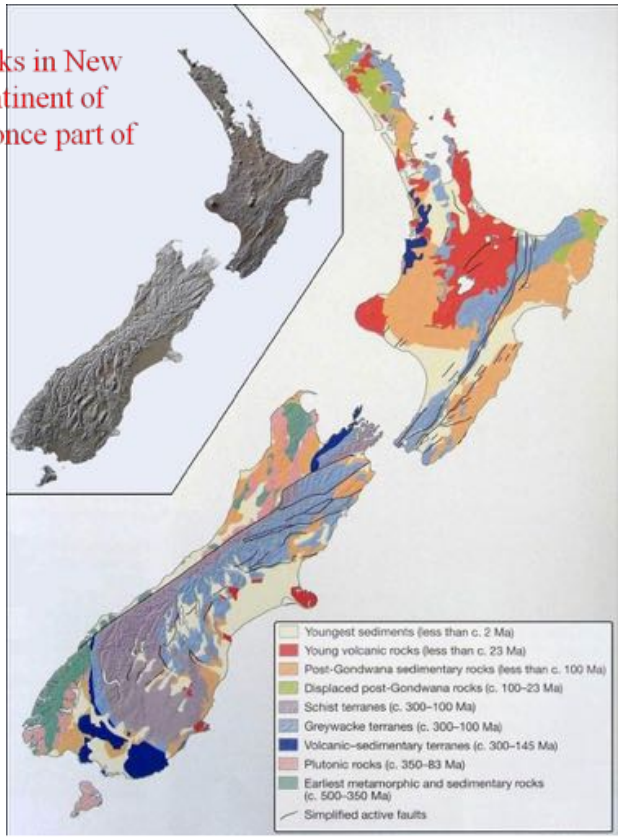
Article by Tim Saunderson.

And here is some fougerite that has morphed into limonite, from the Champion Mine, (found by Tez Hardwick in 2017)

FOV 2.5mm

Permian Rocks in Nelson, talk by Mike Johnston

Areas of Permian rocks in New Zealand (part of continent of Zealandia which was once part of Gondwana



The Permian lasted from about 299Mya to 251Mya. The climate was cold at first but later fluctuated between warm and cold. What became NZ was largely marine, sediments that accumulated off the edge of Gondwana. It ended with mass extinctions, the cause of which is not known, but suggestions include: flood basalt eruptions, massive release of hydrogen sulphide in the oceans, methane or a meteorite. 90% of oceanic life was extinguished and 70% on land.

The Permian in NZ is largely found in the Nelson and Otago-Southland regions, the rocks being displaced by c.470 km of movement on the Alpine Fault that has occurred since the breakup of Gond-

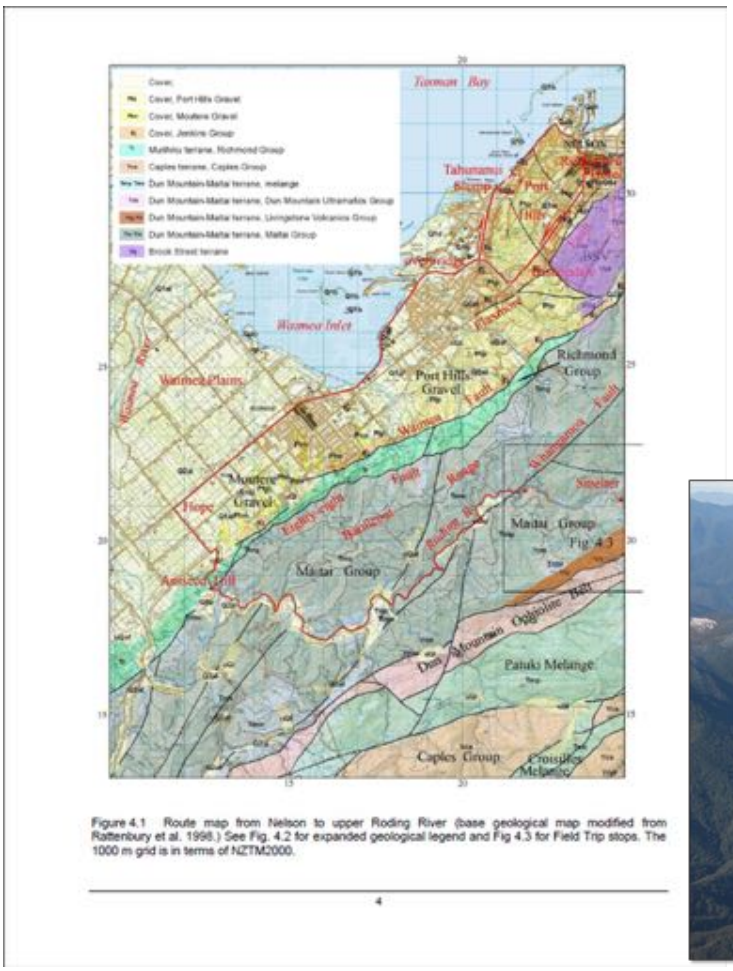
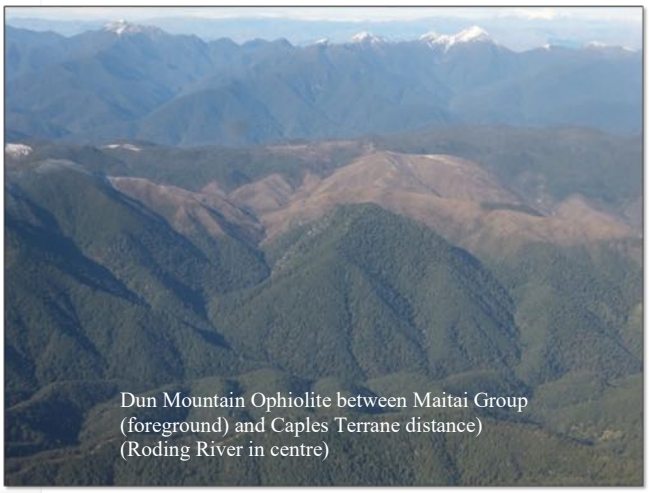


Figure 4.1 Route map from Nelson to upper Roding River (base geological map modified from Rattenbury et al. 1998.) See Fig. 4.2 for expanded geological legend and Fig 4.3 for Field Trip stops. The 1000 m grid is in terms of NZTM2000.

4

wana. The Permiam rocks are most extensive in the geological Eastern Province and comprise the Brook Street, Caples and Dun Mountai-Maitai terranes. The latter terrane is made up of the Dun Mountain Ophiolite and Maitai Group (a terrane is a fault bounded area with a distinctive stratigraphy, structure and geological history that may have travelled thousands of kilometres by sea-floor spreading). In the Western Province (separated



Dun Mountain Ophiolite between Maitai Group (foreground) and Caples Terrane distance) (Roding River in centre)

from the Eastern Province by igneous rocks of the Median Batholith) is the Parapara Group. It was not rafted in like the terranes of the eastern province and attached to Gondwana. Instead it was deposited unconformably onto Gondwana. In the past is was difficult for geologists to comprehend how so many different rocks of different provenance, but approximately of similar age, could be represented in Nelson. Things didn't stack up! However, the advent of plate tectonics provided a mechanism as to how this might have occurred.

The "Dun Mountain "Inoceramus" *Inoceramus* a Mesozoic mussel v *Atomodesma* a Late Paleozoic mussel

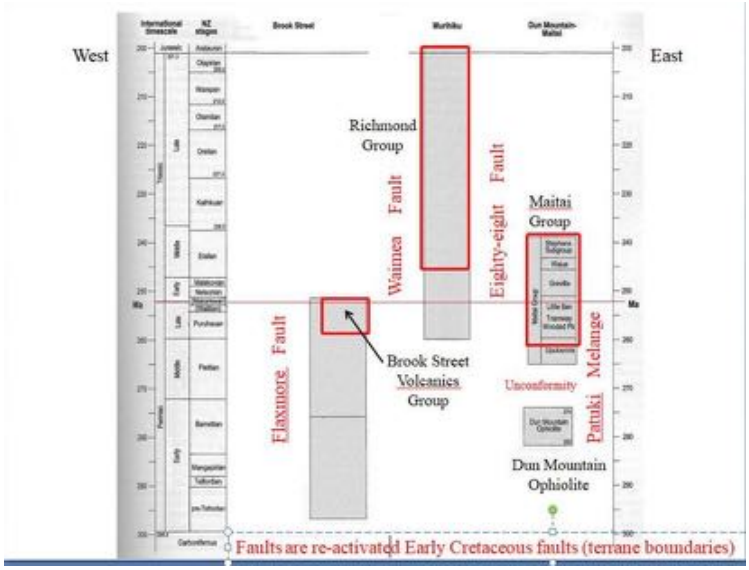
These rocks comprising the Eastern province terranes are mostly marine but there are pathetically few fossils, which made life hard for geologists to date them. The classic fossils for dating the Permian are *Atomodesma*, a mussel-like fossil that can be very large (30cm). Dr Johnston showed us a wonderful new book, 'Paleozoic-Mesozoic Geology of South Island, NZ' edited by AHF Robertson (published by the Geological Society of London) to which he is a contributor. It is currently unavailable in NZ but one can see a part of it by Googling the magic word 'Atomodesmatid'.

Once the theory of Plate Tectonics was accepted, the province was interpreted as different terranes having rafted in and become part of the edge of Gondwana. The Flaxmore, Eighty Eight and

Waimea faults were then seen as terrane boundaries. These faults have subsequently been reactivated as present day New Zealand began to take shape.


Wooded Peak Limestone at the base of the Maitai Group, United Creek, Nelson

During the Permian, the sea-bed to the north of Gondwana was subducting beneath the continent, but after millions of years, the upwelling part (the mid-oceanic ridge) was drawn ever closer to the edge of the land, eventually colliding. The Brook Street volcanics are the frozen remains of this ridge. In the collision, part of the sea-bed ridge and the mantle below it was scraped off (obducted), overriding the edge of the land and forming and incorporated into the continental crust of Gondwana to form the Dun Mountain Ophiolite.



There is great interest in the Triassic-Permian boundary (because of the mass extinction), and there are several rock sequences in the province where this must be represented. The most likely candidate is between the Tramway and Greville formations of the Maitai Group. In places there is the intermediary Little Ben Sandstone – a greenish sandstone with a magnetic anomaly. Unfortunately, precise dating of these rocks has so far eluded geologists but something must be happening there!

We finished with a discussion of how one can date rocks. Chemistry, radioactive dating, palynology (pollens are amazingly tough!) may all play a part. If there are granites, then zircons they contain make it relatively easy to date the rocks, but if it is a sedimentary rock without diagnostic fossils, the age it was laid down cannot be determined from the age of any zircon crystals which it may contain (other than giving a maximum possible age). After deposition, sediments turn to rock (a process of metamorphism) and determining a metamorphic age by radiometric means will give a constraining upper age limit

Composed Jean Gorman, edited by Mike Johnston

England 2019

We (Tez Sheila and Zac our grandson) went to England for an extended holiday this year. Not too much time for rock hounding but we were always on the lookout.


Whalebone arch, Whitby Abbey centre right

We did manage a day out to Whitby. Now there are lots of things to do around Whitby, it's an old fishing village/town. It's most famous inhabitant was Captain James Cook who set sail from Whitby on his round the world adventures. It's second most famous inhabitant has to be Count Dracular who sailed on the Demeter from Varna that carried him to Whitby with a cargo of silver sand and boxes of earth.
The novelist Stoker was to spent years on his novel before it was published, researching the landscapes and customs of Transylvania, but the name of his villain and some of the novel's most dramatic scenes were inspired by his holiday in Whitby. The innocent tourists, the picturesque harbour, the abbey ruins, the windswept churchyard and the salty tales he heard from Whitby seafarers all became ingredients in the novel.

Whitby was also an important whaling port,back in the day.

The coast at Whitby is a treasure trove of Jurassic fossils, especially ammonites. We spent a couple of hours on the rocky beach searching them out. We found many pieces but not many good specimens, by the time we got to where the richer pickings were, we had to leave to meet up with Sheila's family. However I did find this specimen which was different from the others we were finding, I thought it may be a rare find so I sent off details to Andy who is an expert on such things.

He was not as impressed as I was and wrote:

Hi Tez,

Your ammonite is a typical Pseudolioceras lythense.

See also here : https://andysfossils.com/2014/07/31/its-all-in-the-umbilicus-and-in-the-provenance-pseudolioceras/

All the best,

Andy

Andy has spent many years researching the fossils of the area and writes a comprehensive and informative blog which you may peruse if you click on the link.

On our travels we also went to the Yorkshire Dales which was home to a Carboniferous Coral Reef, which must have been stunning in its day. We walked along the river Wharfe near Grassington and found some evidence of the past, well lots of evidence actually, once you get your eye in.

Yorkshire Corals from the River Wharfe

Limestone paving, Malham Cove, Yorkshire (The very spot where scenes from a Harry Potter Movie were shot)

Zac and Uncle John on top of the Calf, Ilkley.

The Calf, Ilkley Moor. Yorkshire

18,000 – 20,000 years ago, an ice sheet covered the whole north Pennine region including Ilkley Moor. It reached a thickness of about 1,000 metres around the head of Wensleydale and Dentdale and thinned southwards to terminate just south of Bradford. The ice had rock fragments frozen into it and as the ice moved these gouged scratch marks or striations onto the underlying bedrock surface giving a clear indication of the direction of ice movement. Examples of such striations are found at the western edge of Hangingstones Quarry, Ilkley and show that the ice was moving from the west.

As the ice moved eastwards over the ‘Cow’ rocks, it may have dislodged and incorporated the enormous boulder known as the ‘Calf’. Later, as this enclosing ice melted, the ‘Calf’ was probably gently let down to come to rest in a stable position on the underlying slope.

Articulated life size Dinosaur, one of many found in Leeds City Centre, Yorkshire.

They were massive.

And Finally, a “Get Xmas Done” Christmas Card greeting from Boris

I look forward to meeting you all again in the year 2020 (does not seem so long ago that we entered the new millennium, where does the time go)

The usual program details will follow by Email after the details have been correlated

PS, The excellent presentation by Tim Saunderson is being sent out with this newsletter in it’s entirety. There was no point in my editing it as I could not improve upon it!