



Friends of the Quaternary

Late Pleistocene Geomorphology and Stratigraphy of Northwest Nelson



Field Guide

14th & 15th June 2008

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CONTENTS

Day 1. Onekaka to Howard Valley (return)	4
Stop 1-1.	6
Stop 1-2.	6
Stop 1-3.	7
Stop 1-4.	7
 Day 2. Onekaka to Cobb Valley to Motueka	 9
Stop 2-1.	10
Stop 2-2.	11
Stop 2-3.	12
Glacial Geology of the Cobb Valley	12
Stop 2-4.	13
Stop 2-5.	16
Stop 2-6.	16
 Alternative bad weather option	 16
Stop 2-2.	16
Stop 2-3.	16

Suggested bibliographic reference: Campbell, I.B., Shulmeister, J., Hyatt O.M. 2008: Late Pleistocene geomorphology and stratigraphy of Northwest Nelson. Friends of the Quaternary field trip guide. www.paleoclimate.org.nz

JUNE 14TH: ONEKAKA TO HOWARD VALLEY (return)

Iain Campbell

On this excursion, occurrences of Kawakawa Tephra will be examined within glacial and periglacial environments of the Moutere Depression/Nelson Lakes region.

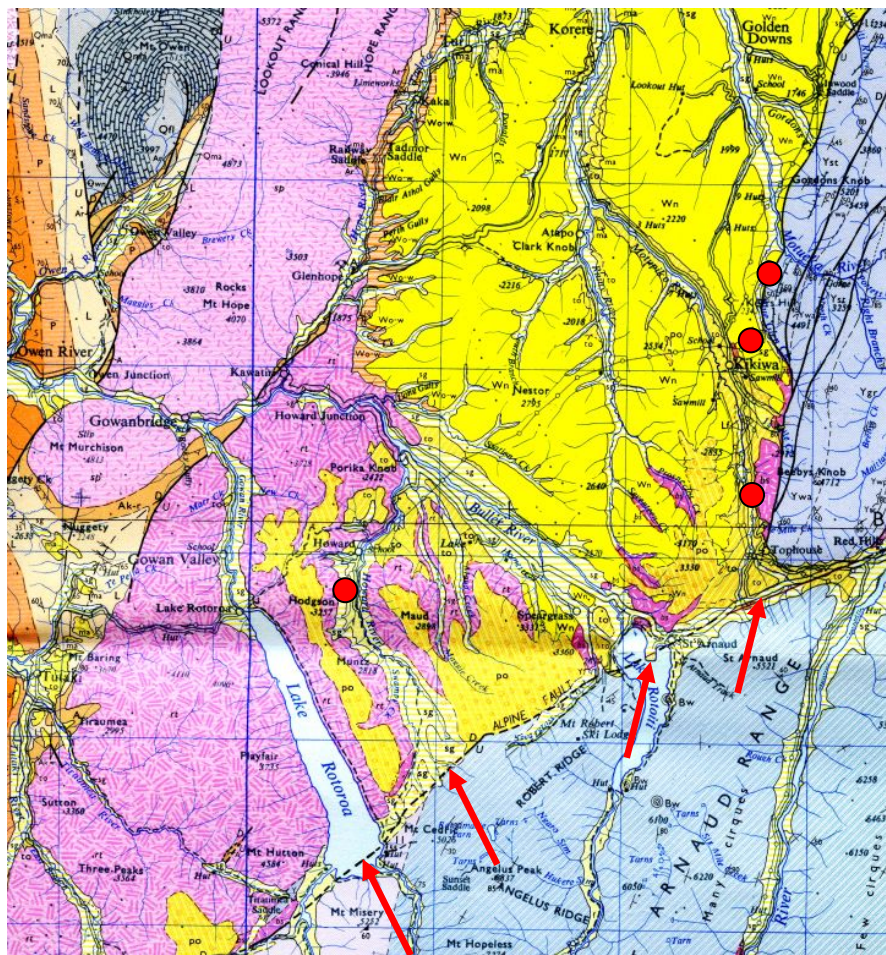


Fig. 1. Geological map of part of the NW Nelson area showing sites visited (Bowen, 1964).

The Moutere Depression is a 25 km wide lowland that extends from the Alpine Fault and Waimea/Flaxmore Fault in the SE and E to the foot of the Arthur Range. It comprises a deposit of gravel (Moutere Gravel Formation) over 1000 m thick, of Late Pliocene age and derived predominantly from greywacke with clasts up to 0.6 m (Fig. 1). The gravels are partially weathered to considerable depth with accumulation of kaolinitic clay. To the south, the Moutere Formation merges with and is overlain by the Porika Formation, (Suggate 1965) the oldest recognized Quaternary glacial deposit which pre-dates the distinctive dissection pattern of the Moutere Hills.

Dissection of Moutere Gravel during the Late Pleistocene has involved periods of erosion and gully formation followed by phases of infilling, commonly with angular or subangular fine gravel or fossil scree deposits. Weathering profiles along with the presence of Kawakawa Tephra within the fossil scree deposits (Campbell 1979, 1986,

Campbell & Mew 1986) indicate that landscape infilling and slope rounding was widespread in the Nelson region in Late Otiran time. For example, fossil screes are widely found through the Marlborough Sounds, northwest Nelson and Moutere Depression regions, in many places occurring to quite low altitudes (<300 m). The existence of gully-filling fossil screes in landscapes in the Moutere Hills necessarily implies that ridge tops or upper slopes as low as 300 m altitude were devoid of vegetation and soil. Exposed clasts must have fragmented under frost action to produce the angular clasts and fossil scree deposits that are observed. On lower slopes, Kawakawa Tephra is commonly found within slope deposits that consist of a mixture of fine and angular or subangular material.

The Late Quaternary formations and glacial deposits recognized in this area (Suggate 1965, Johnston 1990) are as follows:

Speargrass	Otiran
Roundell	Otiran
Tophouse	Waimean
Harry	Waimaungan
Manuka	Nemonan
Porika	Nukumaruan

In the upper Motupiko Valley, Harry and Manuka Formation tills are mapped by Johnston (1990) near Kikiwa with successively younger deposits towards the head of the Motupiko Valley. It seems likely that Manuka and Harry tills must have been deposited about the time that the Travers Valley/Lake Rotoiti and Motupiko Valleys were in a more direct alignment (i.e. prior to approximately 5 km movement along the Alpine Fault) as it would be impossible for a glacier in the Travers Valley to reach Kikiwa with the present geomorphic configuration.

The upper Buller Valley, west of Lake Rotoiti, is a young valley system cut largely in Moutere Gravel. The Buller River probably captured water from the Travers River/Lake Rotoiti as movement along the Alpine Fault made it impossible for drainage waters to continue to flow northwards down the Motupiko River. The more recent glacial advances have thus tended to flow west down the Buller rather than north towards the Motupiko.

In the Howard Valley and the valley occupied by Lake Rotoroa, a similar Alpine Fault offset is suggested by the alignment of the valleys occupied by the Sabine and Howard Rivers and the D'Urville River and Lake Rotoroa. Old glacial deposits and weathered soils occur in the upper slopes in Howard Valley and have been preserved because later ice movements were effectively cut off by truncation of the valley head from the Sabine Valley by the fault movement. The combining of ice streams from the Sabine and D'Urville Valleys in later advances has resulted in valley widening at the head of Lake Rotoroa. Otiran tills in the Howard Valley are restricted to a minor overflow till at the head of the valley.

STOP 1-1. Roadside, near the top of Kerr's Hill

A brief stop to view a well formed fossil gully deposit, typical of periglacial activity found in the Moutere Hills. Was permafrost/patterned ground present in this region?



STOP 1-2. Roadside, towards the bottom of Kerr's Hill near Kikiwa.



A good exposure of Kawakawa Tephra in lower slope deposits. The presence of subangular clasts in material above and below the tephra implies deposition in cold climate times. There may be several layers within the Tephra here. The base of the deposit may be weathered Waimaungan material (Terangian weathering).

STOP 1-3. Roadside 2.5 km S of Tophouse

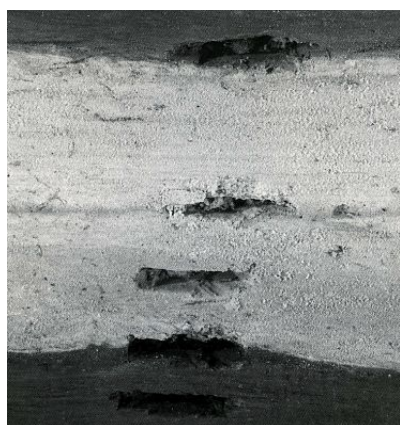
In this section, subangular slope deposits are separated by thin loess? with a thin older loess layer lower in the section. Traces of glass were found.



Stop 1-4. Examine Kawakawa Tephra at Howard Valley section.

An occurrence of Kawakawa Tephra buried within peat was recorded by Campbell (1986) along with other observations from northern South Island. These new sites allowed the NZ wide distribution of the Tephra to be reassessed. At the Howard River section, three layers appeared to be visible, including the characteristic basal silt, about 2 mm thick.

^{14}C dates for the organic material immediately above and below the Tephra are:



$21,281 \pm 457 \text{ }^{14}\text{C yr B.P.}$

$21,329 \pm 437 \text{ }^{14}\text{C yr B.P.}$

The excavations are positions of sampling for pollen.

Pollen from the peat above and below the Tephra yielded typical grassland pollen spectra (N Moar pers. com.) for the period around 20 ka. No pollen was found within the Tephra layer.

The tephra is presently visible in two places. Alongside the stream, the tephra is underlain and overlain by organic material. At the second exposure, the immediately overlying organic material is not present.



The sedimentary sequence at the Howard site (grey silty sands, organic layers, gravel cap) is similar to that which can be seen at numerous South Island localities. An initial aggradation of fine sediments and organic materials in cold climate conditions was followed by more vigorous aggradation of coarse materials as the climate warmed and the supply of coarse debris increased. Numerous deposits of organic material have been sampled by Suggate and gave ages around 18-20 k ^{14}C yr B.P..

Day 2. June 15th: Onekaka - Cobb Valley - Motueka

Iain Campbell

En route to the Cobb, two short stops will be made to look at terrace deposits related to aggradational events associated with former cold climate periods. These “outwash” deposits give an interesting contrast with the glacier derived tills etc to be examined later in the Cobb vicinity and provide some clues as to the magnitude of the past cold climate periods.

Geological mapping in the Golden Bay region by Grindley (1971) identified the following sequence of terrace gravel formations:

Bainham	Otiran
Kaituna	Waimean
Rockville	Waimaungan
Collingwood	Porikan
Table Hill	Okehuan

The sequence is best represented in the Aorere Valley to the northwest, where the five formations can be found in a contiguous sequence. In the Puramahoi area and Takaka Valley, only the three youngest formations are widely occurring.



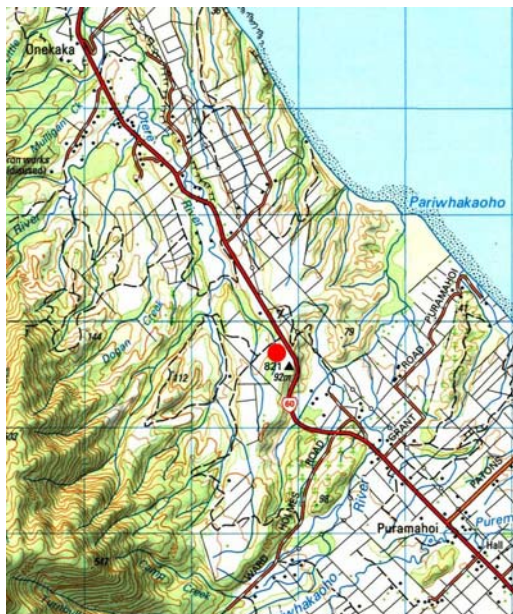
The Bainham Formation (map symbol, **in**) in the Takaka valley is represented by the gravels that form a prominent low terrace around 20 m above river level. This is the prominent terrace surface, which the highway traverses about 4 km south of Takaka. The terrace gravels, which can be seen in roadside sections, have a medium texture, a mixed lithology reflective of rocks in the upper catchment area and are little altered but with a weathering profile that extends to about 80 cm.

In the Puramahoi district, the Bainham Formation does not form a distinct terrace surface but more resembles fan deposits which in the upper reaches are well incised. The gravels include large boulders and appear to represent deposition in high velocity/high outflow events.

At Puramahoi, the well drained soils on Bainham Formation deposits are Puramahoi soils (rainfall 2500 mm) and in Takaka Valley Hamama soils (rainfall 1800-2000 mm). Soil weathering suggests a Late Otiran age.

Bainham Formation at East Takaka

STOP 2-1. Rockville Formation Terrace gravels and soil weathering, located on the edge of a terrace, west of the lookout on Highway 60, northwest of Puramahoi and 3.5 km SE of Onekaka.



Rockville (map symbol **ro**) and Kaituna Formation (map symbol **kt**) deposits are mapped by Grindley (1971) on the prominent elevated terrace surfaces north of Puramahoi. These gravels were presumably deposited by a more northerly flowing Pariwhakaoho River and again, the coarseness of the gravels suggests large outflows but from a relatively small catchment.

The Parapara Ridge to the west has an elevation of around 900 m, probably high enough to support periglacial conditions that could have contributed to the supply of large volumes of coarse gravel sediments. Rocks in the Parapara Ridge area comprise Onekaka Schist, Arthur Marble, Bay Schist and Walker Quartzite Formations.



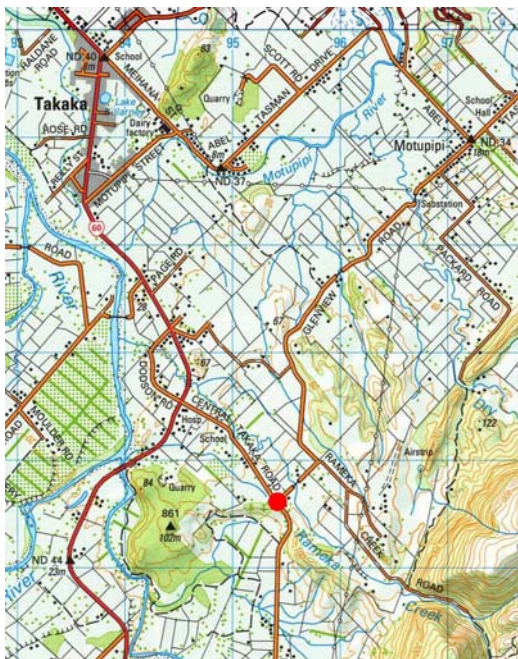
The gravels in the section seen here are dominantly quartzitic and bouldery and form a cover over the underlying Tarakohe Mudstone. The weathering depth is around 2 m but with relatively little alteration of clasts within the gravel, probably owing to the formation of a cemented iron/humus pan which restricts downward movement of water.

The upper layers include AE, Eh/Bh and E horizons with the pale coloured sandy textured E horizon representing the accumulation of silica following the destruction of soluble minerals. The weathering appears consistent with a Waimaungan age for the gravels. This soil is included with Onahau soils.

Elsewhere within this landscape, the composition of the gravels varies and includes appreciable amounts of schist with weathering profiles that may be several metres deep.

Rockville Formation terrace gravel and weathering near Puramahoi.

STOP 2-2. Kaituna Formation deposits and weathering located near the junction of Central Takaka Road and Glenview Road, 3.75 km SE of Takaka



Kaituna Formation deposits form a distinct northwest sloping terrace to the southwest of Takaka with small residual patches near East Takaka and also further to the south. The older Rockville Formation sediments are confined here to narrow planar remnants on ridges. Clearly, an appreciable amount of erosion of the underlying Tarakohe Formation mudstones has occurred since Waimaungan time.

The gravels again at times have large boulders, but they differ from those on the west side of the valley in that their composition includes appreciable amounts of diorite, indicative of an origin to the east in the Pikikiruna Range where the rocks are diorite, granite and Arthur Marble.

Streams that drain from the Pikikiruna Range (Rameka Creek and Dry River) have, at present time, insignificant flows that discharge from narrow outlets. The extent of the Kaituna Formation gravels (and also the Rockville gravels) and the size of some of the boulders again suggest that there have been extensive fluvial discharges. Given the somewhat limited catchment area, it seems likely that debris supply may have been aided by periglacial conditions in the Pikikiruna Range, which reaches 1000 m in places.



Kaituna Formation deposits and weathering near Central Road, Takaka.

The deep, brown weathering profile (Rameka soil) associated with Kaituna Formation and Rockville Formation gravels (Pisgah soil) results from the presence of high amounts of ferromagnesian rich material. The contrast between the weathering in the Onahau soil at Stop 1 and the weathering displayed here provides a good example of differing weathering pathways resulting from differing inherent mineralogical conditions.

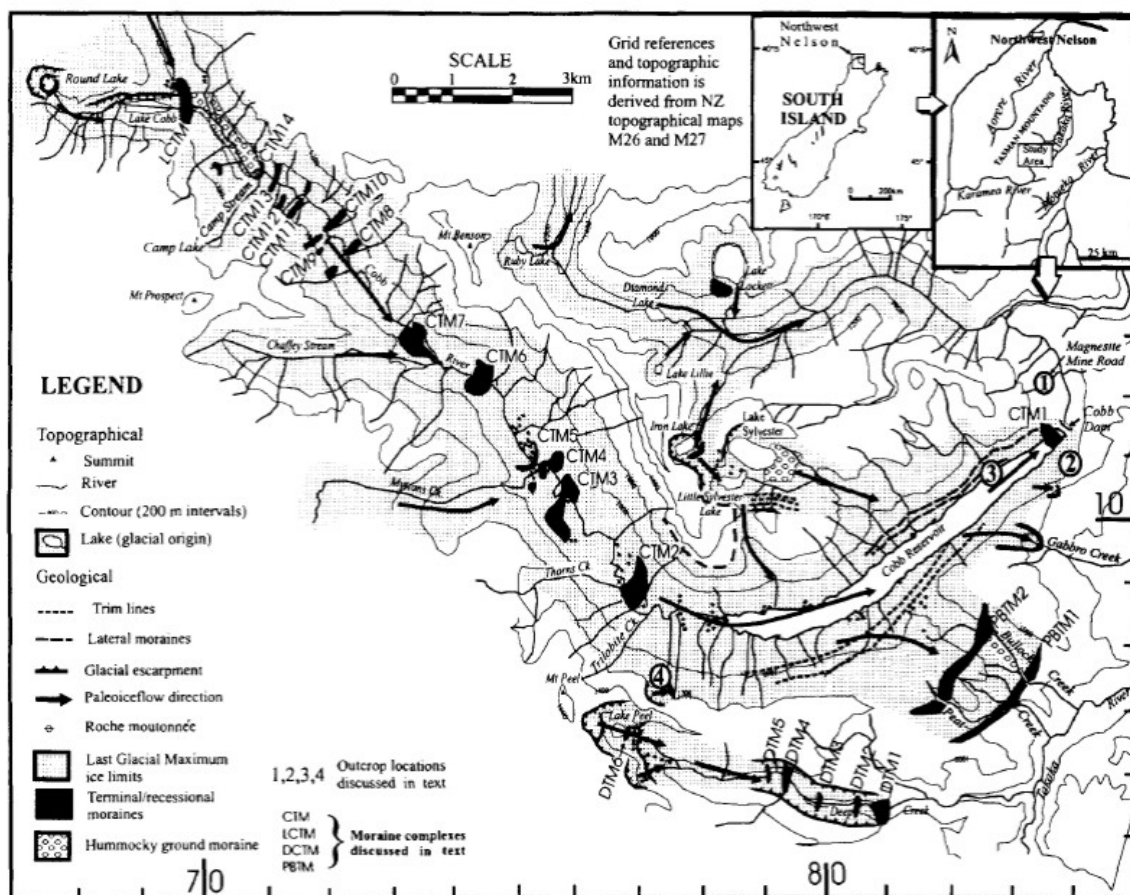
James Shulmeister

STOP 2-3. Pupu Springs

We will start our discussion in the car park at Pupu Springs. The bank of the carpark contains a diamicton that may be of glacial provenance. We will examine and discuss the implications of such a deposit to regional glaciation.

Glacial Geology of the Cobb Valley

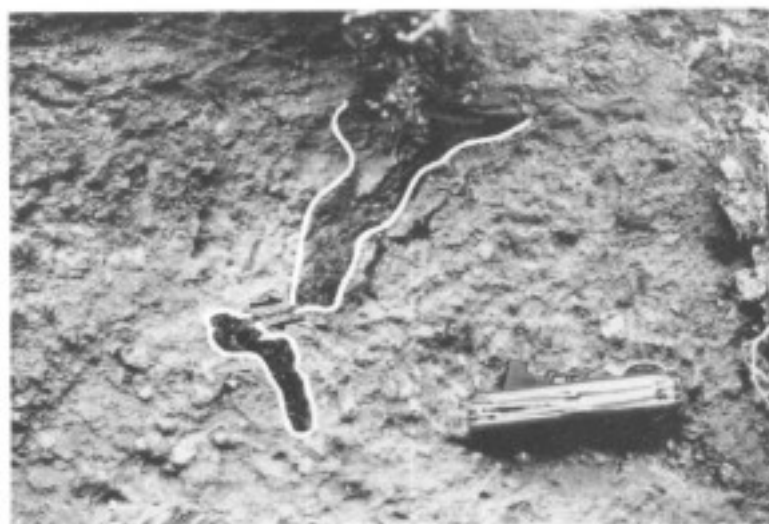
The Cobb Valley is one of the best known glaciated valleys in the NW Nelson region with a prominent U shape and numerous glacial features including a sequence of over 20 terminal moraines and several fields of roches moutonnees. The area was initially investigated by Henderson in the 1920s (Henderson 1931). Detailed glacial geological, geomorphological and paleoecological work was undertaken in the late 1990s and early 00s by Jamie Shulmeister, Bill McLea and a group of VUW graduate students (Chris Hosie, Rob McKay and Christiane Singer). Geochronological (Surface Exposure Dating) work was carried out by Jamie S working with David Fink (ANSTO) and Paul Augustinus (Auckland). More recently Glenn Thackray (Idaho State) has worked with Jamie S on the possibilities of more expanded glaciation in NW Nelson.



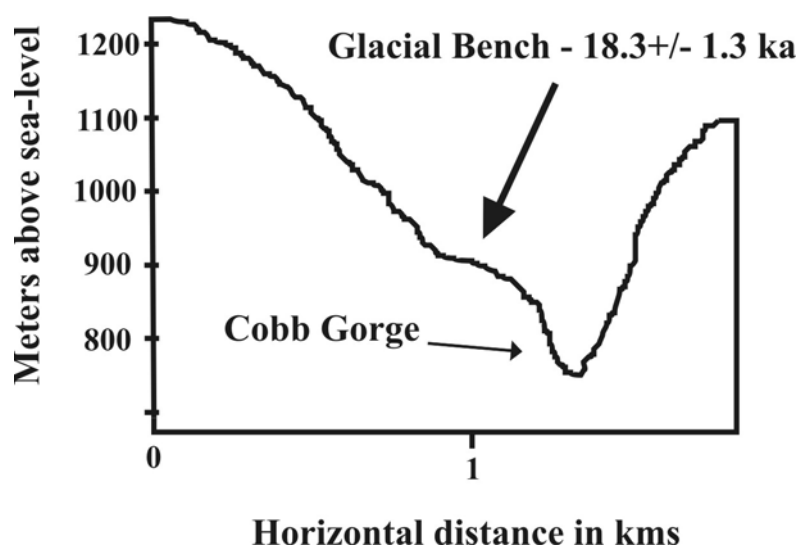
Location map showing the main features of glaciation in the Cobb. (From Shulmeister et al., 2001)

STOP 2-4. Cobb Dam

There are numerous outcrops near the dam that demonstrate direct ice over-run of sediments and bedrock. The following figures reproduce some examples from the Magnesite Mine Road. We will stop at an outcrop on the road down to the dam and depending on time and weather conditions we will wander up the Magnesite Mine Road to examine these outcrops. The deformation indicates significant ice flow over this bench at the time of formation of the sediments. We will consider the implications of young cosmogenic ages from this bench, several hundred metres down valley from the start of the gorge.



Glacitectonite on Magnesite mine road (From Shulmeister et al., 2001)



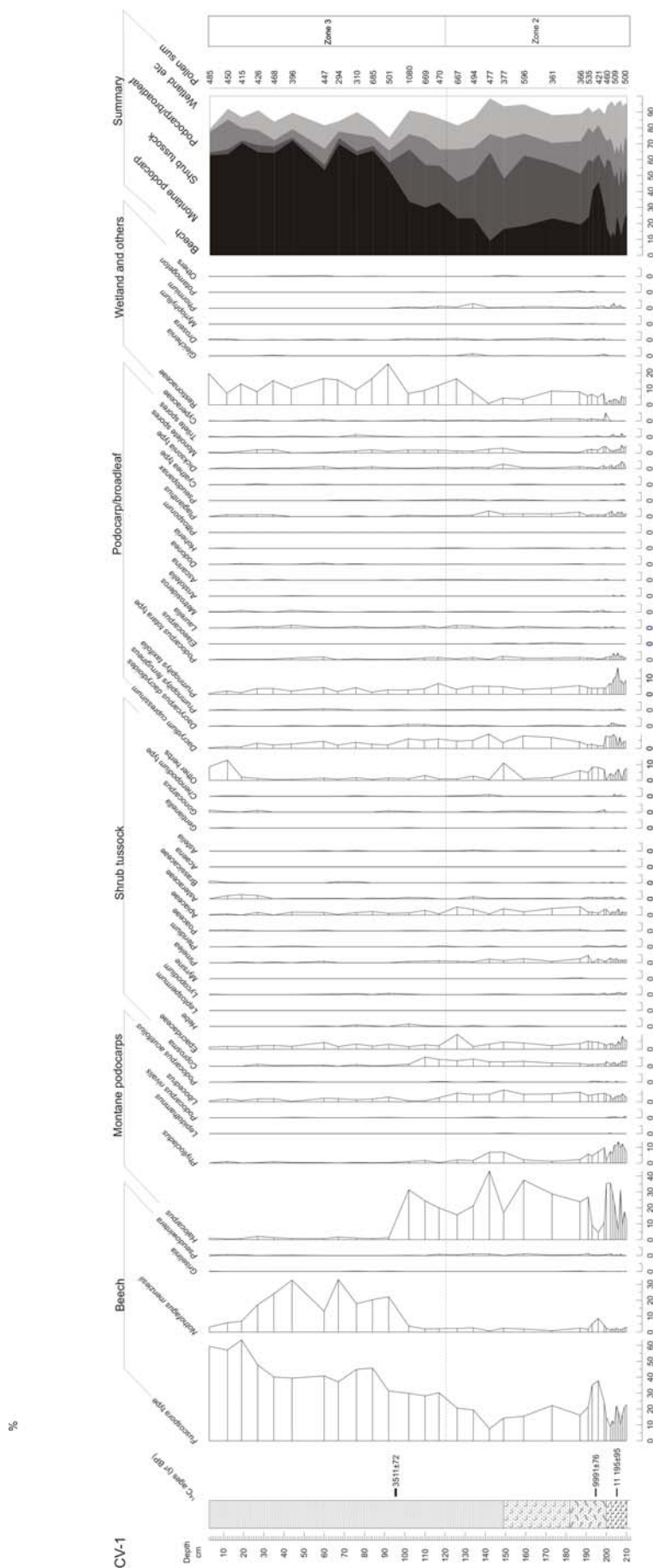
From Thackray and Shulmeister (in prep). Ages from Shulmeister et al., (2005). This bench lies below the dam and implies either a) that ice occupied the gorge at the LGM or b) the gorge is post-LGM. We believe the latter is highly unlikely.

After examining these outcrops we will proceed up the valley by vehicle to the campground at the head of the reservoir. As we drive up the valley on the south bank note that ice overtopped the ridge above us and flowed into the Arthur tableland at maximum ice thicknesses. There are moraines preserved a few tens to hundreds of metres south of the cols on the ridge. Beyond these moraines, evidence for glaciation becomes equivocal, except for a small glacier in Deep Creek. However, trims and glacially carved features along the margins of the tableland suggest significant ice flow onto the tableland.



Roche moutonnee at head of Cobb Reservoir.

On the northern flank of the valley, lateral moraines are preserved and a subsidiary glacier flowed in from the Sylvester Lakes area. [There is superb geomorphology around Sylvester Lakes but it is a trip better suited to summer conditions]. Ice overtopped the ridge on this side also.



From Shulmeister et al. (2003). This site covers the late glacial and Holocene and provides a window on the Younger Dryas. The YD section of this diagram was presented in Singer et al., (1998).

At the head of the reservoir a truncated spur has been reduced to a field of roches moutonnees. Several other fields occur in the valley and in each case the interpretation is that the roche moutonnee field matches an old meander in the Cobb River.

STOP 2-5

If the day is nice we will walk from the carpark through the first terminal moraine and as far as the second moraine complex. Kettle holes in the moraines provided the targets for paleoecological work, and work from the valleys has been supplemented by numerous records from the tableland and Sylvester Lakes area (see Shulmeister et al., 2003). The best known record from this area comes from a swamp on the valley floor (within a moraine sequence), which yielded a window on Younger Dryas age vegetation change in New Zealand (Singer et al. 1998, Newnham et al. 1999). While vegetation changes did take place during the Younger Dryas, we considered that these changes reflected hydrological changes rather than a regional cooling signal (see pollen diagram).

STOP 2-6. Harwoods Lookout

After driving out of the Cobb we will head up Takaka Hill and stop at Harwoods Lookout. Here we can see high gradient (5-7°) terraces exiting the Cobb Valley and extending as far north as Uruwhenua. We will discuss the origin of these dipping terraces. We will also look at landslides and consider the Pikikiruna Fault. If the weather has been good the fieldtrip will finish here.

Day 2. June 15th Alternative (Bad weather option)

STOP 2-2. Go Ahead Creek

Here is evidence for a fairly recent (but undated) glacial advance onto the lowlands near Takaka. Shulmeister and Thackray envision ice overflowing from the Anatoki River through a low col. Putative terminal moraine ridges, possible till and outwash fans are preserved in this small valley.

STOP 2-3. Harwoods Hole

Harwoods Hole is a major karst feature in the NW Nelson landscape. We will drive to the carpark area for Harwoods Hole and walk down to examine the Hole itself. We have some pollen diagrams (Andrews-Cookson, 2004), from the forest on the way to the Hole and we will discuss karst limestone and Holocene paleoecology of Takaka Hill.

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