



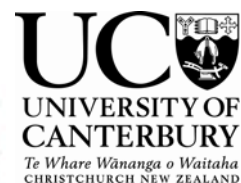
2008 Australasian INTIMATE Meeting



Programme and Abstracts

12th & 13th June

Onekaka, New Zealand



Organisers

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Cover image: Dracophyllum traversii (mountain nei nei), Kahurangi National Park. Olivia Hyatt.

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INTRODUCTION

The organising committee would like to welcome all attendees to INTIMATE 2008 at Onekaka. This meeting follows on from the very successful first phase of the AUS-INTIMATE project, which culminated with presentation of NZ and Australian Climate Event Stratigraphies (CESs) at the 2007 XVII INQUA Congress in Cairns.

The three year funding period for the first phase of AUS-INTIMATE ended in 2007 and the second phase was rebid in January of this year. The new proposal for continued recognition and funding of the AUS-INTIMATE project is still under consideration by PALCOMM. I'm sure those of you who have participated in NZ-INTIMATE so far will agree that Phase I was a very worthwhile project and one which galvanized the NZ paleoclimate community. Even if the latest proposal is unsuccessful in securing funding we would like to think NZ-INTIMATE can continue. To this end we see the meeting as a venue in which we can review progress to date in Phase I, discuss the present proposal, and debate the future of NZ-INTIMATE in the context of the larger AUS-INTIMATE project over the next three years heading toward the next INQUA Congress. As has become the tradition, this workshop is also an opportunity for people to present, in an informal setting, papers and posters of their new data and ideas.

ONEKAKA

Onekaka, situated in beautiful Golden Bay, is well known for its beaches, national parks, fishing and culture. This tiny settlement was once a major industrial area. In the 1920's and 30's local iron ore was turned into pig-iron and iron pipes at the Onekaka Ironworks. Northwest Nelson is home to many endemic species of plants. Kahurangi National Park has the largest range of flora of any of the New Zealand National Parks, hosting many South Island and North Island species.

Onekaka Field Station (*Victoria University of Wellington*)

Onekaka field station is a rustic building used by Victoria University students as a base for their introduction to geological mapping. There is a fireplace, wood in the shed, a kitchen, a small living area and bunk bed accommodation for 22 people. Showers are possible but need to be short. Two stoves, pots and pans, crockery and cutlery are available. There is cell phone reception but no landline. The field station caretaker, Irene Turner, lives 650 metres before the intersection with Onekaka Iron Works Road on the left if travelling from Takaka, telephone number 03 525 9363.

MEETING FEES

Accommodation at Onekaka Field station	\$5 per night
Breakfast & Lunch (meeting) 12 th & 13 th June	\$30
Breakfast & Lunch (field trip) 14 th & 15 th June	\$30

PROGRAMME

Thursday June 12

Morning- Arrive, ice breaker, welcome **P. Almond**

10.30 am The PALCOMM perspective **J. Shulmeister**

11.00 am The status of the OZ and NZ event stratigraphies **P. Almond/D Barrell**

12.30 pm Lunch

1.30 pm Oral papers

- LGIT climate signals from an Auckland maar **J. Shulmeister, et al.**
- Paleoclimate of Tasmania: New Initiatives **L. Cwynar** & A.B.H. Rees
- Glacial forest in the Howard Valley, South East Nelson, New Zealand. **M. Marra**
- Stable Isotopic Paleoenvironmental Proxies, New Zealand **T. Horton**

3.30 pm Afternoon tea and posters

4.00 pm NZ-INTIMATE Phase II proposal **P. Almond**

Discussion

Friday June 13

9.00 am Oral papers

- Glacial activity in Park Valley, Tararua Range: chronology and landforms **M. Brook**
- Glacial History of the Darwin-Hatherton glacial system, Transantarctic Mountains; Field Mapping and Sampling for Cosmogenic dating. **D. Hood et al.**
- Marine paleoclimate reconstructions in the SW Pacific. **G. Cortese**
- Modelling New Zealand ice extent during the Last Glacial Maximum. **A. Mackintosh et al.**

10.30 am Morning tea and posters

11.00 am Oz-INTIMATE initiatives **T. Barrows**

11.30 am Oral papers

- Attribution of recent New Zealand temperature change and paleoclimate modelling plans. **S. Dean, et al.**
- Vegetation at the extended LGM interstadial: evidence from the phytolith record for the northern South Island **C. Smith et al.**

- Interpreting ancient kauri (*Agathis australis*) tree ring records and prospects for a high-resolution climate reconstruction for the OIS3- LGM transition **A. Lorrey et al.**

12.30 pm Lunch

1.30 pm INTIMATE Phase II workshop **M. Vandergoes**

Future direction, objectives and milestones **P. Almond**

Leadership and meetings **A. Mackintosh**

4.00 pm Summary and farewell **P. Almond**

ABSTRACTS



Aciphylla (spaniard), Mt Arthur, Kahurangi National Park. Olivia Hyatt.

Glacial activity in Park Valley, Tararua Range: chronology and landforms

M.S. BROOK

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ORAL

Mt Ruapehu, the volcanic massif in the North Island's centre is currently glaciated and probably sustained glaciers throughout the late Quaternary, yet no numeric ages have been reported for glacial advances anywhere on the North Island. Geomorphologic and sedimentologic investigations in Park Valley, Tararua Range, part of the North Island's axial ranges, have identified the presence of a lateral moraine toward the head of the valley. This section of Park Valley is U-shaped, southwest facing with the elongate ridge situated on the true right (north-western) side of the valley. A variety of approaches is used to test the possible process origins of the ridge, including topographic and spatial positioning, sedimentology and palaeoclimatic extrapolations. Results indicate the ridge consists of glacial diamict deposited as a lateral moraine, supporting recent hypotheses about late Quaternary glaciation and erosional development of valleys and cirques of this sector of the range. An inter-bedded layer of Kawakawa tephra, with a calibrated age of 26.5 ka (Wilson 2001) suggests either an MIS 3 or an early MIS 2 glaciation of this part of the range. The first cosmogenic ages for late Quaternary glaciation on the North Island of New Zealand are also reported. Cosmogenic ^{10}Be ages are described from the surface layers of a glacially-transported boulder and glacially-polished bedrock from Park Valley. Results indicate a limited valley glaciation occurred, culminating in recession at the end of the last glacial coldest period (LGCP, ca. 18 ka). If one ignores the presence of Kawakawa tephra, the cosmogenic ages provide an initial age for deglaciation on the North Island during the last glacial-interglacial transition (LGIT). It appears that glaciation occurred in response to an equilibrium-line altitude (ELA) lowering of ca. 1400 m below the present-day mean summer freezing level. Ages for glaciation in the Tararua Range correspond closely with exposure ages for the last glacial maximum (LGM) from the lateral moraines of Cascade Valley in the South Island, and in Cobb Valley, in northern South Island. The corollary is that glaciation in the Tararua Range coincided with the phase of maximum cooling during MIS 2, prior to the Antarctic Cold Reversal (ACR), during the LGCP.

Key words North Island, glaciation, chronology, MIS 2

REFERENCES

Wilson, C.J.N., 2001. The 26.5 ka Oruanui eruption, New Zealand: an introduction and overview. *Journal of Volcanology and Geothermal Research*, **112**: 133-174.

An Ancient Atmospheric $^{13}\text{CO}_2$ Record from Phytolith Occluded Carbon

J. A. CARTER

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POSTER

The best records of atmospheric change of glacial cycles are those from ice cores. However, missing from these records are definitive data indicating changes in $^{13}\text{CO}_2$. One of least understood and important influences on the changes to the isotopic composition of atmospheric CO_2 is that of vascular plants. While marine benthic $\delta^{13}\text{C}$ records have been used to infer past changes in terrestrial vegetation, accurate estimation of changes in carbon storage on land during ice ages has proved elusive. Other estimates have been made using reconstructing terrestrial biomes from pollen records but a large discrepancy between marine and land based estimates remains. A new method of deriving an ancient atmospheric $\delta^{13}\text{CO}_2$ record using phytolith-occluded carbon as a proxy is described here. The method is designed to measure the carbon-13 in ancient phytolith occluded carbon and convert this signal into an atmospheric carbon record of the atmosphere. Phytoliths are very small particles of silica (between 5 and 100 micron) that form distinctive and repeatable shapes in most plants. When phytoliths form within a plant, some of the host organic matter is trapped inside the phytolith. Phytoliths have been shown to contain occluded carbon, and are present in most terrestrial sedimentary deposits. Moreover, because they survive well in most soils and sediments, the trapped carbon remains intact, and preserved from contamination and alteration. When plants assimilate atmospheric CO_2 they fractionate against ^{13}C , leaving the atmosphere relatively enriched in ^{13}C . Therefore any record of isotopic change in plant tissue can be used as a proxy for change in atmospheric $^{13}\text{CO}_2$ and by extension a record of changes in global vegetation. Experiments were conducted to characterise and measure the natural variability of modern phytolith-occluded carbon. These included measurement of carbon isotopic fractionation effects between the atmosphere and whole plant material, measurement of carbon isotope fractionation between whole plant matter and phytolith-occluded carbon, and a determination of carbon compounds present in phytolith-occluded carbon. A formula was developed for separating the plant physiological factors from the atmospheric $^{13}\text{CO}_2$ value in the phytolith-occluded carbon, thus providing a basis for estimating atmospheric $^{13}\text{CO}_2$ values. Phytoliths were extracted and occluded carbon analysed from a 7.4m loess core. Changes in phytolith assemblages were used to create a direct record of changes to the local vegetation cover, and isotopic analyses of carbon in phytoliths to generate a record of atmospheric $^{13}\text{CO}_2$ for the last 120,000 years. The record exhibits a number of periods when the atmosphere had very low $\delta^{13}\text{CO}_2$ values that correspond with CH_4 peaks in the Vostok ice core. It is hypothesized here that these low values are a consequence of the release of large volumes of methane released from marine hydrate (clathrate) deposits into the atmosphere, thereby, diluting atmospheric $^{13}\text{CO}_2$.

Key words phytolith-occluded carbon, atmospheric $^{13}\text{CO}_2$, late Quaternary.

Marine paleoclimate reconstructions in the SW Pacific

G. CORTESE

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ORAL

GNS is currently developing a modern analogue dataset for the oceanic area around New Zealand. The planned projects for the ocean around New Zealand will be presented, as well as insights given on relevant previous work by several of the team members, both in the southwest Pacific area and elsewhere.

This project will use surface sediment samples to investigate variation in the relative abundances of pollen and spores, calcareous-shelled (planktonic foraminifera), siliceous-shelled (diatoms, radiolarians) and organic-walled (dinoflagellate cysts) plankton species. Quantitative estimates of sea surface temperature and nutrient characteristics of surface waters will be derived from these data by using various statistical techniques.

Such an integration of investigations based on multiple microfossil groups will cross-validate data and interpretations, and provide a baseline for future marine paleoclimate investigations in New Zealand.

The ultimate aim is to test the developed paleotemperature equations on sediment cores from the New Zealand area, and reconstruct paleoclimate variability in this area over several climatic cycles, with a focus on the early Holocene and marine isotope stages 5 and 11.

Paleoclimate of Tasmania: New Initiatives

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ORAL

We have developed a transfer function based on midge subfossils in order to model mean temperature of the warmest quarter (TWARM) in Tasmania. Our transfer function is based on midge assemblages and 21 environmental parameters sampled from 47 lakes. Canonical correspondence analysis (CCA) revealed seven variables that account for a significant ($P \leq 0.05$) portion of the explainable variance. In order of explanatory power, these were pH, TWARM, annual radiation, magnesium, annual precipitation, SiO_2 , and depth. TWARM was modeled using weighted averaging partial least squares (WAPLS) and generated a model with $r^2_{\text{jack}}=0.72$ and $\text{RMSEP}=0.94$. We intend to apply this model to 3 sites from which we have collected cores of lake sediment: Platypus and Eagle Tarns in Mount Field National Park, and Lake Selina in unglaciated western Tasmania that has a complete record spanning the past ~120,000 years (Colhoun et al. 1999). Preliminary results from Eagle Tarn will be presented.

Key words climate change, Tasmania, Australia, midges, chironomids, transfer function, paleoclimate

REFERENCES

- Colhoun, E.A., Pola, J.S., Barton, C.E., and Heijnis, H. 1999. Late Pleistocene vegetation and climate history of Lake Selina, western Tasmania. *Quaternary International*, **57/58**: 5-23.
- Rees, A.B.H. and Cwynar, L.C. 2008. Midges (Chironomidae, Ceratopogonidae, Chaoboridae) as a temperature proxy: a training set from Tasmania, Australia. *Journal of Paleolimnology*: in press.

Attribution of recent New Zealand temperature change and paleoclimate modelling plans

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ORAL

Over the last 100 years the temperature of New Zealand has risen by about 0.9 degrees, a similar change to that of the global average temperature. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change declared that “Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations”. This paper considers whether the warming observed in New Zealand can be similarly attributed to anthropogenic greenhouse gases. By using climate model simulations which include and exclude the effect of anthropogenic and natural forcings of the climate system we consider whether the temperature change observed over the small region of New Zealand is statistically significant. The possibility to validate the models simulated variability against paleoclimate observations in order to understand longer term trends also is considered. Finally we outline paleoclimate simulations planned by NIWA for the next few years using the UK Met Office climate model.

Key words climate change, detection and attribution, climate modelling

Glacial History of the Darwin-Hatherton glacial system, Transantarctic Mountains; Field Mapping and Sampling for Cosmogenic dating

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ORAL

Predicting the response of the East Antarctic Ice Sheet (EAIS) to future climate change requires an accurate understanding of its past behaviour and the influence of climate change on this response. Despite having a good understanding of the EAIS cryosphere, we know relatively little about how the outlet glaciers respond to climate change. Along the length of the Transantarctic Mountains (TAM) there are numerous outlet glaciers draining the EAIS into the Ross Sea. The complex behaviour of these glaciers is interconnected to the behaviour of the EAIS and is an essential part in understanding the influence of climate change on the EAIS. Among these, the Darwin and Hatherton glacier systems offer a unique opportunity to study the response of the EAIS to future climate change displaying a sequence of glacial deposits with numerous glacial platforms and end glacial moraines. The Darwin-Hatherton glacial system is significant in understanding climate change, as it is only one of a few sites in the TAM that offer such clear evidence of recent past (Holocene) glacial activity.

This talk reports on fieldwork conducted in the Lake Wellman area on the margin of the Hatherton Glacier in December 2007. Our research aims to accurately assess the rate of the last major ice retreat in the Darwin and Hatherton glacier system. The maximum heights of glacial features identified at Lake Wellman indicate previous ice elevations were 800 meters higher than today. There are numerous recessional moraine deposits that are very well preserved and older deposits which have experienced major reworking making drift boundaries hard to identify. We conducted extensive sampling of glacier erratics for cosmogenic age dating. Data collected during our field work will be used to improve models on the extent of past ice elevations.

Key words Outlet glacier, moraine, erratic, geomorphology, cosmogenic dating.

REFERENCES

Bockheim, J.G., Wilson, S.C. Denton, G.H. Anderson, B.G., and Stuiver, M., 1989. Late Quaternary fluctuations of Hatherton Glacier, Transantarctic Mountains. *Quaternary Research*, 31: 229-254.

Isotopic Paleoenvironmental Proxies, New Zealand

HORTON, T.

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ORAL

New Zealand's natural history affords unique opportunities to apply stable isotopic climatic and environmental proxies to problems of global significance. Advances in stable isotopic research indicate the oxygen, nitrogen, and carbon isotopic compositions of biominerals are robust quantitative proxies for temperature, mean annual precipitation, and relative dietary significance of C₃ versus C₄ plant matter. These relatively new methods, particularly when coupled with traditional biomineral proxies (e.g. carbonate $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values), have the potential to produce relatively high resolution terrestrial records of both climatic and environmental change - provided suitable pre-historic specimens are present. Application of multiple proxies to common biominerals provides the attractive advantage of allowing for the discovery of system-level responses to natural and anthropogenic mechanisms of pre-historic environmental change, advancing our ability to best anticipate how regional and local ecosystems will respond to the current period of global climate change and related environmental impacts.

However, establishing empirically derived isotopic environmental lapse rates and fractionation factors at the regional scale precludes application of biomineral proxies to ancient specimens. In an effort to evaluate the potential application of biomineral isotopic proxies to New Zealand systems, the oxygen, nitrogen, and carbon isotopic compositions of modern chitinous exoskeletons, avian eggshells, and gastropod shells - collected across major environmental gradients - are currently being determined in the University of Canterbury Stable Isotope Biogeochemistry Laboratory.

Interpreting ancient kauri (*Agathis australis*) tree ring records and prospects for a high-resolution climate reconstruction for the OIS3-LGM transition

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ORAL

Ancient swamp kauri (*Agathis australis*) tree ring chronologies are some of the world's oldest annually resolved climate proxy records. These chronologies have potential to be used in ENSO reconstruction within Oxygen Isotope Stage 3 (OIS3), for which few records exist globally. Interpreting the growth patterns in these unique tree ring records requires an understanding of the underlying climate and environmental factors that the trees experienced. Here, we describe findings to date from Omaha and Mangawhai, two swamp kauri sites north of Auckland. Alignment of existing chronologies and proto-chronologies to available environmental proxy data suggests ancient kauri preservation closely corresponds to times when northern New Zealand was warmer and wetter than normal. Increased sedimentation rates and anoxic conditions in bogs would have accompanied these climatic conditions. This was probably important for helping preserve buried wood through the subsequently cold, dry, and windier LGM, when surficial material at many nearby sites in the Far North of New Zealand were subject to erosion. The burgeoning ancient kauri data set indicates climate reconstruction during OIS3 substage A may be possible in the near future. Radiocarbon dates on kauri from Far Northland swamps also suggests chronology extension into the LGM transition might be possible. The direction of future palaeoclimate analyses using ancient kauri will be discussed.

Modelling New Zealand ice extent during the Last Glacial Maximum

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³ *GNS Science, Dunedin.*

⁴ *National Institute for Water and Atmospheric Research, Wellington.*

ORAL

A preliminary ice-modelling experiment for New Zealand during the Last Glacial Maximum (LGM) is presented. The model is based on a 'degree-day' mass balance model coupled to a sophisticated ice sheet model which includes longitudinal deviatoric stresses and produces output at a 500 m grid scale. Model boundary conditions are established using a Digital Elevation Model for New Zealand on a grid encompassing the area between Mt. Ruapehu and southern Fiordland, offshore bathymetry supplied by Phil Barnes (NIWA) and present-day climatologies (gridded monthly mean temperature and precipitation fields) supplied by Landcare and NIWA.

Models for incremental 0.5°C cooling steps were run until equilibrium ice extents were achieved. A sizable cooling seems necessary for the development of an ice cover which approaches the Last Glaciation extent observed in the landform record. It took ~4 °C of cooling to produce significant lowland glacierization in the central South Island, and a ~7.5 °C cooling for marginal areas (from north to south: Ruapehu, Tararuas, Kahurangi, Nelson Lakes, Lewis Pass, Fiordland) to reach 'Otiran' Last Glacial Maximum (Marine Isotope Stage 2) ice limits compiled by David Barrell and Pat Suggate for New Zealand. The next step is to carry out a long (100,000 year) integration of the model forced by a climate proxy record such as the EPICA Dome C ice core.

Glacial forest in the Howard Valley, South East Nelson, New Zealand

M. J. MARRA

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ORAL

The Howard river Valley, a tributary of the Buller River, is located between Lakes Rotoiti and Rotoroa in South East Nelson. This area was extensively glaciated at the height of the last glaciation when glaciers flowed from the St Arnaud Range down the Rotoiti and Rotoroa Valleys and extended to the St Arnaud township¹. During glaciation, outwash gravels aggraded in the main Buller Valley and there was an associated peat accumulation in side valleys such as the Howard¹. Radiocarbon ages in the upper Buller area and a Kawakawa deposit in the Howard Valley show peat accumulation occurred between c. 26,000-22,000 cal yr BP².

In the Howard Valley, suite of low terraces (<30 m) shows sequences of gravels, sands and organic silts. Fossils of insects and leaves were extracted from organic sediments at three locations; one in the main Howard Valley and two from a tributary stream at c.600 m asl. Additional radiocarbon ages show there are two sequences of peats in the tributary stream; one aged c.34,000-27,000 cal yr BP and the other c.20,000- 18,000 cal yr BP. The age of the third section in the main valley is assumed from the kawakawa deposit at the site. Sixty-eight fossil insects and spiders were identified and show a paleoenvironmental change from mainly forest to mainly grass. Fossil leaves of *Nothofagus menziesii* were recovered from peats aged c. 34,000-26,000. These samples also contained forest beetle taxa such as *Nesamblyops oreobius* (Carabidae). Tussock and grass-habitat beetles (e.g. *Notogonum feredayi* (Carabidae)) dominate samples aged c. 20,000-18,000 cal yr BP, although these samples also contain forest beetles such as *Bembidion actuarium* (Carabidae), which is now extinct from South Island. Fossils of *Neoferonia integrata* (Carabidae) occur in one sample only aged between 20,000-18,000 cal yr BP. This species occupies above-tree-line habitat and indicates the paleo-tree-line at this time was lower than 600 m asl. The modern tree-line in the area is sharply delineated at 1,400 m asl indicating the paleo-tree-line was lower by >800 m, and this equates to a temperature depression of at least 4-5°C.

In summary, fossils of leaves and insects show this site as a glacial refugium despite being 600 m asl and its proximity to glaciers in adjacent Rotoiti and Rotoroa Valleys. At maximum glacial conditions at least one species probably become locally extinct and the forest may have been much reduced and/or at a lower elevation at a time. However a glacial forest at this site supports the hypothesis of multiple glacial refugia in South Island and concurs with fossil insect data from other glacial-aged locations.

Key words Glacial refugium, fossil beetles, paleo-tree-line, *Nothofagus menziesii*

REFERENCES

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- ²Suggate, R.P. and Almond, P.C., 2005. The Last Glacial Maximum (LGM) in western South Island, New Zealand: implication for the global LGM and MIS 2. *Quaternary Science Reviews*, **24** 1923-1940.

Late Quaternary glacial history of the Lake Heron basin, Mid Canterbury, New Zealand

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POSTER

We present a poster that illustrates the glacial geomorphology, sedimentology and vegetation history of the Lake Heron basin, Mid Canterbury, New Zealand. The geomorphology reveals a complex glacial history spanning multiple glaciations. The Pyramid and Dogs Hill Advance are undated but possibly relate to the Waimaungan and Waimean glaciations. The Emily Formation (EM), previously thought to be MIS 4 (Mabin, 1984), was dated using ¹⁰Be to c. 24 ka B.P. The EM was largest advance of the Last Glacial Maximum (LGM). Ice during the LGM was at least 100m thicker than previously thought, as indicated by relatively young ages of high elevation moraines. Numerous moraine ridges and kame terraces show a continuous recession from LGM limits, and supported by decreasing ¹⁰Be ages for other LGM moraines, ice retreat was punctuated by only minor readvances and still stands.

There is relatively little sedimentological outcrop in the area except on the shores of Lake Heron. These beds demonstrate the nature of glacial and paraglacial sedimentation at the later stages of ice retreat and show that ice fronts oscillated across several hundred metres before retreating into Lake Heron proper.

A sediment core from a high elevation tarn within LGM ice limits provides the Holocene vegetation history. Herbs and shrubs, predominantly *Coprosma*, were replaced by a low montane forest, dominated by *Phyllocladus* and *Podocarpus type*, at about 8000 years ago. This montane forest occupied the area through most of the Holocene until c. 1400 years B.P, when beech forest arrived. Fires are persistent through the record extending back to at least 6000 years ago, which is consistent with other inter-montane basins and dates elsewhere in this area. The occurrence of fire events increase in the late Holocene and may have aided the expansion of beech to the site. A late increase in grass concentrations records the presence of humans.

Key words geomorphology, ¹⁰Be, sedimentology, Holocene vegetation change

LGIT climate signals from Auckland maars

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ORAL

Here we present preliminary results from the spectral analysis of laminae couplets from Hopua Maar and Lake Pupuke and compare them against our existing records from Onepoto Maar (Pepper et al., 2004). Between the three sites we have coverage from the end of the LGM through the Holocene, though it is not yet fully worked up. Provisional results suggest that laminae couplets are annual (or close to annual) during the LGM and late Holocene but inter-annual during the LGIT and early-mid Holocene. We note that there are distinct centennial scale episodes which display high spectral power in ENSO and PDO time frames. We also note an apparent increase in the number of cycles per century through the latest LGIT to mid-Holocene.

Key words climate change, ENSO, PDO

REFERENCE

Pepper, A.C., Shulmeister, J., Nobes, D.C. and P.C. Augustinus. 2004. Possible ENSO signals prior to the last Glacial Maximum, during the deglaciation and the early Holocene from New Zealand. *Geophysical Research Letters*. 31:L15206. doi 10.1029/2004GL020236

Vegetation at the extended LGM interstadial: evidence from the phytolith record across biogeographical zones of northern South Island, New Zealand.

C. Smith, P. Almond, F. Shanhun

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ORAL

Estimates for a global LGM agree on a commencement from 19-23 ka BP, however in New Zealand there is a growing body of evidence for an earlier onset of the LGM. The extended LGM (eLGM) in New Zealand is driven by the enhanced flow of the mid-latitude westerlies leading to glacial advances on the west coast of the South Island and increasing aridity on the east coast. There is multi-proxy agreement in New Zealand for 3 advances within the eLGM at approximately 28, 22 and 19 ka BP, with a climate amelioration between 25-28 ka BP.

The Kawakawa tephra (KKT) component of the ~27 ka cal yr BP Oruanui eruption from Taupo volcano in central North Island is an important chronostratigraphic marker, appearing towards the start of the climate amelioration within the eLGM. We have used the phytolith record at the KKT isochron to provisionally reconstruct the vegetation at the time of KKT deposition, for 4 sites in northern South Island. Here, the KKT exists as a distinct layer 100-200+ mm thick. The Maungatapu Road (Nelson) and Acheron (an intermontane basin near Hanmer) sites were both positioned on colluvial mid slopes. We propose that the time span represented by the constraining horizons for Acheron is of the order 10-100 yr and for Maungatapu Road 100-1000 years. The Awatere River site is on a river terrace; for this we propose a time span of 1000-2000 years, while the Howard River site is possibly in the order of 100-1000 years. Samples were taken from the upper and lower horizons constraining the KKT and from within the KKT itself. Phytoliths were extracted according to standard procedures using sodium polytungstate separation.

Results show that the Maungatapu Road phytolith samples are dominated by spherical verrucose tree/shrub phytoliths with Awatere River dominated by elongate grasses. Both Acheron and Howard River were dominated by *Chinochloid* and *Chloridoid* (tall tussock grassland). We suggest that the 200 mm thick tephra layer has had a notable disruption effect on the vegetation at Awatere; a slight increase in spherical verrucose phytoliths may signal that trees were able to survive the tephra fall better than the more prostrate grass species. We interpret the phytolith proxy to represent the vegetation over the short time scale of the KKT deposition. It is suggested that the change in species composition as shown in the phytolith proxy record is a result of the disturbance effect of tephra deposition on the landscape.

From other proxy records of Chironomids and fossil beetles we know that the climate amelioration was in the order of 2-4°C cooler than present day. This suggests that the climate was wet enough for trees at Maungatapu Rd, dry on the east coast (Awatere) and perhaps getting wetter at Acheron (intermontane basin). With only a slight drop in temperature compared to present day (but representing a slight warming during the eLGM), there is a change in vegetation. We suggest that there is some other environmental parameter affecting vegetation growth / limiting forest expansion, perhaps precipitation.

Key words extended LGM, phytoliths, Kawakawa tephra

Towards an expanded chironomid temperature inference model for New Zealand

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POSTER

Robust statistical models from subfossil chironomid (non-biting midges) larvae head capsules are widely used in the Northern Hemisphere to reconstruct past environmental variables including temperature, salinity, lake trophic status and oxygenation. In New Zealand, two chironomid based inference models currently exist for deriving temperature and environmental change. The first of these utilises a 36 lake dataset (Woodward and Shulmeister 2006) while the second is derived from 60 lakes in South Island (Dieffenbacher-Krall et al. 2007). To develop a more robust inference model for quantitative temperature reconstruction, efforts have been made to combine these datasets. This has primarily involved recounting samples from the Woodward and Shulmeister (2006) study to ensure a harmonised taxonomy and setting minimum head capsule count and lake selection criteria for samples to be included in the final dataset. To date, all of the samples from Woodward and Shulmeister 2006 have been recounted and harmonised for taxonomy. Of these, 16 have been included into a combined dataset to provide a preliminary expanded chironomid temperature inference model for southern New Zealand based on 76 lakes.

The strongest performing inference models for mean summer temperature from the expanded dataset are based on Partial least squares (PLS-2) having a root mean squared error of prediction (RMSEP_{jack}) of 1.32 and a coefficient of determination (r^2_{jack}) of 0.73; Weighted averaging-partial least squares (WAPLS-2) and Modern Analogue technique (MAT) having an RMSEP_{jack} of 1.39 and a r^2_{jack} of 0.71; Weighted averaging (WA) having an RMSEP_{jack} of 1.47 and a r^2_{jack} of 0.67. These models are comparable to those produced by the earlier studies.

Here we present a comparison of these models with a previous temperature reconstruction from a South Island, Lateglacial site, Boundary Stream Tarn (Vandergoes et al. 2008). We also outline directions for future research.

Key words Chironomids, temperature inference model, lateglacial, temperature reconstruction.

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