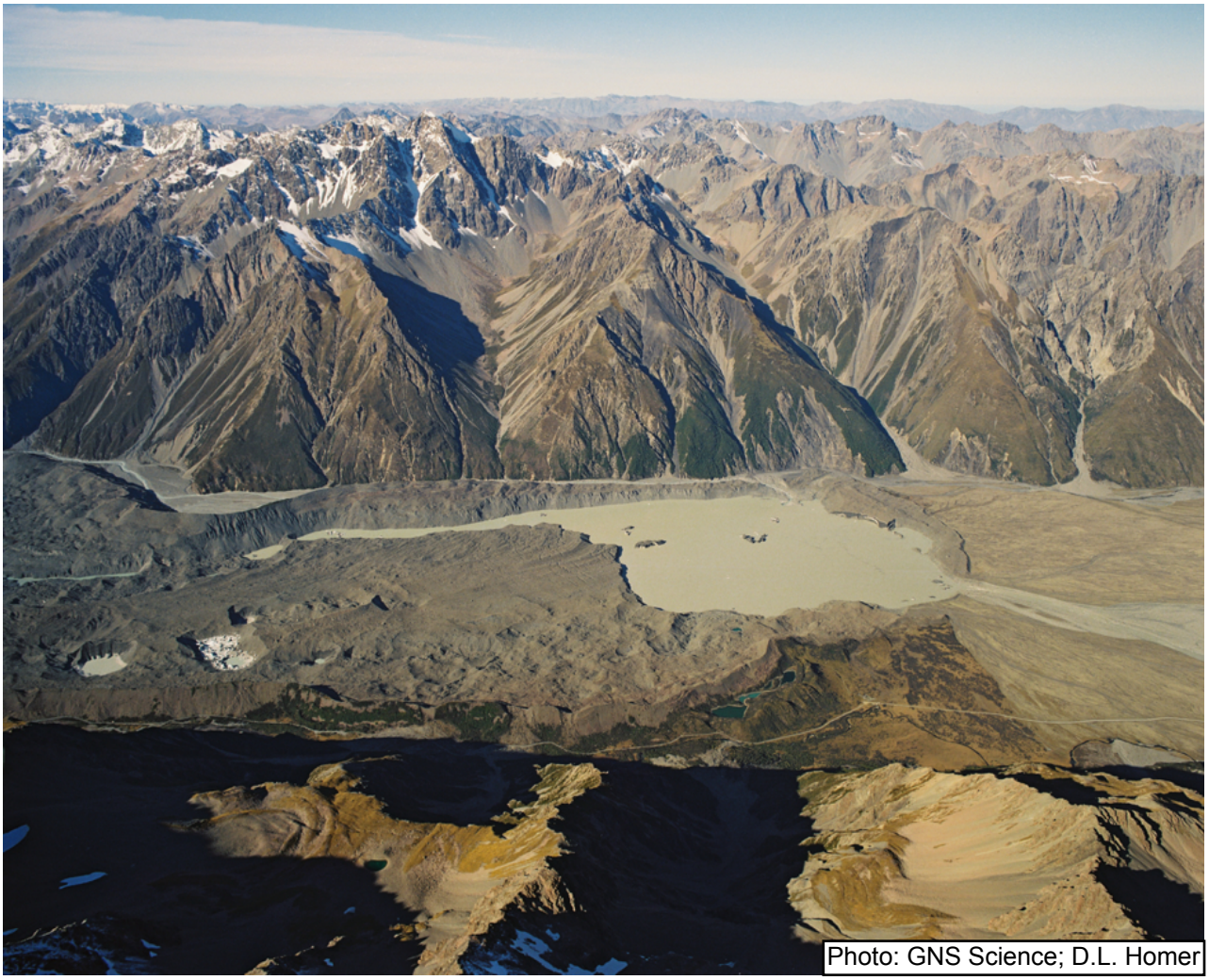


Photo: GNS Science; D.L. Homer

AQUA Meeting

Lake Tekapo, New Zealand

12th – 17th February 2012

Programme and abstracts

Australasian Quaternary Association Inc.
ABN 78 458 664 047
www.aqua.org.au
AQUA

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

GNS SCIENCE
TE PŪ AO

	Monday, 13 Feb	Tuesday, 14 Feb	Wednesday, 15 Feb	Thursday, 16 Feb	Friday, 17 Feb
08:00			Travel to Twizel		
08:10					
08:20					
08:30			SIRG Meeting		
08:40					
08:50					
09:00	Welcome	Field trip		Keynote - Chivas	Keynote – Newnham
09:10	Keynote Mackenzie Basin - Barrell				
09:20					
09:30					
09:40				Williams	Kermode
09:50	Keynote – Vandergoes				
10:00				DeDeckker	Kaufman
10:10					
10:20				*Morning tea*	*Morning tea*
10:30	*Morning tea*				
10:40					
10:50				Moody	Lorrey
11:00	Upton				
11:10				Brookman	White
11:20	Petherick				
11:30				Stahl	Student awards
11:40	posters (Atahan, Smith, Gulyás)				
11:50				McDonald	*Lunch*
12:00	*Lunch*				
12:10				Jara	
12:20					
12:30			*Lunch*	*Lunch*	
12:40					
12:50					
01:00	Callard				Travel back to Christchurch
01:10					
01:20	McGowan				
01:30			Travel to Tekapo	Keynote - Reeves	
01:40	DeDeckker				
01:50					
02:00	Munro		Hesse		
02:10				Bostock	
02:20	*Afternoon tea*		Eger		
02:30				Doughty	
02:40			Gulyás		
02:50	Keynote - Sloss			Barrows	
03:00			*Afternoon tea*		
03:10				*Afternoon tea*	
03:20					
03:30	Chappell		AQUA meeting		
03:40					
03:50	Webb			INTIMATE - SHAPE update,QSR special issue	
04:00					
04:10	Barrell				
04:20					
04:30	Aiken				
04:40					
04:50					

Monday February 13

9:00			Meeting open & Welcome
9:10	Barrell	David	Geological evolution of the Mackenzie basin, central South Island, New Zealand
			Session 1: Pollen and biological Proxies
9:50	Vandergoes	Marcus	Mackenzie Basin Lakes Project: Understanding sub decadal to annual climate variability in the mid-latitude SW Pacific over the last 15 kyrs
10:30			*Morning tea*
11:00	Upton	Phaedra	Lacustrine sediments in Lake Ohau, central South Island, New Zealand – An archive of erosion, earthquakes and paleoclimate since the Late Glacial
11:20	Petherick	Lynda	The termination of the Last Glacial Stage in eastern Australia: multi-proxy, high resolution reconstructions from lake sediment cores on North Stradbroke Island
11:40	Jara	Ignacio	Long-term climatic and short-term volcanic responses of vegetation in western Patagonia
12:00			*Lunch*
1:00	Callard	Louise	A palaeovegetation record from Howard Valley, New Zealand spanning the period 38-21 cal ka BP
1:20	McGowan	Sarah	Using the past to plan for the future: sea-level rise in Hexham Swamp, NSW Australia
1:40	DeDeckker	Patrick	High-resolution Holocene lacustrine records from southern Australia
2:00	Munro	Helen	Reconstruction of past trophic states using diatoms: a case study from of Lake Spectacle, northern New Zealand
2:20			*Afternoon tea*
			Session 2: Late Neogene and Quaternary Climate and Archaeology
2:50	Sloss	Craig	Integrated Ocean Drilling Program Expedition 339 Mediterranean Outflow: Quaternary mid-slope deposits in the Gulf of Cádiz
3:30	Chappell	John	Mid-Pliocene deserts wetter, ice-caps smaller, and CO_2 higher: analogues for future greenhouse earth

3:50	Webb	Esmee	Bedrock geology, landscape evolution and aboriginal usage of the Western Desert and Murchison Basin
4:10	Barrell	David	Glacial geomorphology of the central South Island, New Zealand
4:30	Aiken	Simon	Major sedimentological units of the Tongde Basin telescopic alluvial fan complex

Tuesday February 14

9:00			Field trip – all day

Wednesday February 15

8:00			Travel to Twizel
8:30			SIRG Meeting
12:30			*Lunch*
1:30			Travel back to Lake Tekapo
			Session 3: Loess
2:00	Almond	Peter	Can palaeoclimatic information be extracted from the presence of loess deposits in New Zealand?
2:20	Eger	Andre	The chemical signature of loess deposition and concomitant pedogenesis in soils
2:40	Gulyás	Sándor	Quaternary paleoenvironment and loess molluscs of the Carpathian Basin, Central Europe
3:00			*Afternoon tea*
3:30			AQUA

Thursday February 16

			Session 4: Isotope studies
9:00	Chivas	Allan	Clumped-Isotope Thermometry
9:40	Williams	Paul	Speleothem-based high-resolution reconstruction of New Zealand palaeo-temperatures during the last 2700 years

10:00	DeDeckker	Patrick	High-resolution record of environmental changes recorded in a deep-sea core offshore Kangaroo Island and comparison with continental records over the last 35ka
10:20			*Morning tea*
10:50	Moody	Louise	Investigating a new modern coral proxy for the tropical southwest Pacific
11:10	Brookman	Tom	Stable Isotope Dendroclimatology in New Zealand: Palaeoclimatic Potential and Methodological Challenges from a $\delta^{13}C$ and $\delta^{18}O$ Case Study of the Southernmost Stand of Kauri (*Agathis australis*)
11:30	Stahl	Tim	Preliminary results of relative dating of fluvial terraces and outwash plains using a Schmidt Hammer
11:50	McDonald	Janece	Using radiocarbon to date young speleothems and assessment of the Suess effect recorded in speleothems
12:10	Atahan	Pia	Late Quaternary environmental change at Lake McKenzie, subtropical eastern Australia: evidence from sedimentary carbon, nitrogen and biomarkers [poster]
	Smith	Carol	An alternative mechanism for polygon evolution on hillslopes in Taylor Valley, McMurdo Dry Valleys, Antarctica: implications for surface exposure dating? [poster]
	Gulyás	Sándor	New paleoenvironmental data for the Middle and Late Pleistocene of the Carpathian Basin: preliminary results to the „longest" Danubian loess/paleosol sequence of modern Hungary: Udvari-2A [poster]
12:30			*Lunch*
			Session 5: INTIMATE
1:30	Reeves	Jessica	OZ-INTIMATE: a climate event stratigraphy for the Australian region, 0-35 ka
2:10	Bostock	Helen	A review of the Australian-New Zealand sector of the Southern Ocean over the last 30 ka
2:30	Doughty	Alice	Late-glacial climate in the Southern Alps of New Zealand inferred from glacier modelling
2:50	Barrows	Tim	Late Pleistocene glacial stratigraphy of the West Coast, New Zealand
3:10			*Afternoon tea*
3:40			INTIMATE – SHAPE update, QSR special issue

Friday February 17

			Session 6: The Holocene
9:00	Newnham	Rewi	Should there be formal subdivision of the Holocene?
9:40	Kermode	Stephanie	The limited impact of Quaternary sea level rise on the Shoalhaven River, southeastern Australia
10:00	Kaufman	Darrell	Using tephra beds to assess the age uncertainty of 14C-dated Holocene lake cores
10:20			*Morning tea*
10:50	Lorrey	Drew	The Mid-Holocene circulation transition in New Zealand
11:10	White	Duanne	GRACE satellite data and late Quaternary ice loss in coastal East Antarctica: How accurate are our estimates of modern day ice loss?
11:30			Student awards
11:50			*Lunch*
1:00			Travel back to Christchurch

Major sedimentological units of the Tongde Basin telescopic alluvial fan complex

Simon J Aiken[1], Brierley, G[1]., Huang, Q, H[2]., Wang, Z[3]

[1]School of Environment, University of Auckland
[2]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
[3]School of Civil Engineering, Tsinghua University

Originating from the Bayan Har Mountains, Qinghai Province, the Yellow River is the second-largest river in China, and one of several large rivers that drain the Qinghai-Tibetan Plateau. Unlike other river basins that strike northwest to southeast across the margin of the Qinghai-Tibetan Plateau the upper Yellow River strikes towards the northeast, ignoring major structural faulting that has determined the orientation and development of basins further south. Coupled with the uncertainty surrounding the incisional history of this region (see Craddock et al., 2010 and Perrineau et al., 2011) on shorter, late Quaternary timescales we investigated the Tongde Basin, a critical subcatchment along the course of the upper Yellow River to better establish stratigraphic and age control on the various displaced topographic surfaces found throughout the region. It has long been understood that a multitude of geomorphic and/or paleoenvironmental information is preserved as landforms, for example terrace surfaces record prolonged periods of baselevel stability and subsequent abandonment, greatly aiding our interpretation of post-incisional landscape evolution. In this context, alluvial fans have developed on many terrace levels in the Tongde basin, potentially providing information on local sediment production rates and base-level stability between the various periods of stability and incision of the upper Yellow River. Based upon preliminary field investigations during 2011 three broad different longitudinal sedimentary environments were identified in the main alluvial fan complex. The results of this analysis suggest a cyclic development with the confined upper reaches of the fan exhibiting a cut and fill morphology whereas the peripheral edge of the fan interacted or even forced the planform evolution of the upper Yellow River. This paper will examine these different sedimentary environments and explore their significance in the wider context of fan evolution in the Tongde Basin.

Can palaeoclimatic information be extracted from the presence of loess deposits in New Zealand?

Peter Almond[1], Philip Tonkin[1], Matthew Hughes[2], André Eger[1]

[1]Lincoln University, [2]University of Canterbury

Loess is a terrestrial, silt-dominated aeolian deposit. Its accumulation is episodic with breaks in accumulation marked by well expressed topdown pedogenesis. Loess accumulation has been generally linked to cold climate phases, but the particular climatic features of these phases that favour loess accumulation are not clear. This fact and the questionable performance of luminescence dating in New Zealand (NZ) loess limit its interpretation as a climate proxy. Loess accumulation results from the production or release from storage of fine-textured sediment, large surface area of exposure of those sediments, suitable conditions for deflation and transport, conditions amenable to trapping, and finally, stable receiving land surfaces where the rate of erosion is less than the rate of dust accretion. Climate mediates at every step.

Lower temperatures and glacier growth may be responsible for generating fine-textured sediment by grinding. Widespread loess accumulation in North Island (NI) where mountains were largely free of glaciers indicates this is not a necessary condition. In NI, cold climate is implicated in increasing erosion causing rivers to aggrade, thereby enhancing loess source area. Aeolian deflation of sediment from floodplains requires sparse vegetation, lack of soil structure, dry surfaces and wind. Temperature, precipitation and windiness all contribute, but so also may atmospheric CO2 concentrations and insolation. Aeolian transport depends on windiness and the strength of atmospheric scrubbing by rainfall. Trapping of loess has topographic and vegetation controls. The climate conditions working for deflation and entrainment work against trapping. Lastly, erosion rate may be affected by temperature and precipitation modulated by biota. We consider a number of case studies from NZ across climatically and geomorphically diverse areas in an attempt to disentangle the climate effects on loess accumulation. We conclude that the complex climate interactions make no universal interpretation possible. The best climate proxies may come from pedogenic, paleontological, biological or geochemical properties of loess deposits.

Late Quaternary environmental change at Lake McKenzie, subtropical eastern Australia: evidence from sedimentary carbon, nitrogen and biomarkers [poster]

Pia Atahan[1,2], Henk Heijnis[1], Pierre Le Métayer[1,2], Kliti Grice[2], Kathryn Taffs[3], Sarah Hembrow[3], John Dodson[1]

[1]Institute for Environmental Research, Australian Nuclear Science and Technology Organisation (ANSTO)
[2]West Australia Organic and Isotope Geochemistry Centre, Department of Chemistry, Curtin University of Technology
[3]Centre for Geoarchaeological and Palaeoenvironmental Research, Southern Cross University

Fraser Island's numerous perched, oligotrophic, dune lakes have proven to be important sources for information on Late Quaternary environments in subtropical eastern Australia. Palaeoenvironmental reconstruction work on the island has thus far focused principally on evidence from sedimentary pollen and charcoal. In this study, bulk organic TOC%, N% and $\delta^{13}C$ and $\delta^{15}N$ values, along with biomarker and compound specific carbon isotope information, for a sediment core from Lake McKenzie (Fraser Island) are presented. Eight AMS ^{14}C dates establish chronology for the 46cm deep core, and show a basal date of ca. 37,000 cal. BP. Bulk organic C/N is high, >20 through all but the upper 4 cm of the core, suggesting that terrestrial organic matter is a dominant contributor to the lake sediments. However a supplementary source of unusual hydrocarbons mainly from the B race of *Botryococcus braunii* may also contribute to the high C/N. The appearance of other algal biomarkers throughout the core suggests the presence of either perennial or ephemeral water at the site over the study period.
Two clear shifts in lake conditions are detected at ca. 14,000 and ca. 5500 cal. BP. The former is marked by a reduction in TOC% and N%, lower C/N and elevated $\delta^{13}C$ and $\delta^{15}N$ values, and is suggested to have resulted from a reduced proportion of terrestrial organic matter in the sediments, perhaps as a result of an expanded lake area. The latter shift is marked by an increase in TOC%, N% and sedimentation rate, with C/N remaining relatively constant, and may reflect increased production of autochthonous organic matter. A shift towards higher lake levels and reduced fire activity has been previously noted to occur on the island at ca. 5500 cal. BP.

Keynote

Geological evolution of the Mackenzie basin, central South Island, New Zealand

David J Barrell

GNS Science, Dunedin

The Southern Alps dominate the landscape of the central part of the South Island. This ~60 km-wide northeast-trending mountain chain has a sharp northwest margin, coinciding with the Alpine Fault, which marks the Australia/Pacific plate boundary. Southeast of the Southern Alps is a series of ranges and basins, the largest of which is the Mackenzie basin. Basement rock is Torlesse Supergroup, comprising hard quartzo-feldspathic 'greywacke' sandstones and mudstones of Permian-Triassic age (300 to 200 Ma), with progressively more metamorphosed equivalents, semischist and schist (Haast Schist), particularly west of the Main Divide. A sheet of marine transgressive overlain by terrestrial regressive sediments was deposited over the basement during latest Cretaceous to late Cenozoic time. The present plate boundary developed in earliest Miocene (23 Ma). Increasingly convergent plate motion in Late Miocene-Early Pliocene (10 to 5 Ma), led to uplift and formation of the Southern Alps, and fault- or fold-controlled basins and ranges to the east. The increased convergence is recorded stratigraphically by influx of greywacke and/or schist gravels to sedimentary basins adjacent to the uplift zones. Southern Alps uplift at ~8 mm/yr and surface faulting in parts of the range/basin zone is ongoing.

The highest parts of the Southern Alps support valley glaciers today, but during glaciations, valley glaciers extended out into western parts of the Mackenzie basin, leaving belts of moraines and extensive outwash plains. Lakes Ohau, Pukaki and Tekapo occupy glacial troughs last evacuated by ice at ~18 ka at the end of Last Glaciation. Since that time the lakes have been near-complete traps of sediment delivered from their catchments. Late-glacial moraines formed at ~13 ka in the mid-to upper reaches of the main glacial valleys. Glacier moraines formed since ~6 ka lie in proximity to the modern glacier termini.

Glacial geomorphology of the central South Island, New Zealand

David J. A. Barrell[1], Bjørn G. Andersen[2], George H. Denton[3]

[1]GNS Science, Dunedin
[2]University of Oslo; deceased
[3]University of Maine

Glaciers are expressions of atmospheric climatic conditions, and their advances/retreats provide a measure of climate changes. New Zealand is one of the few landmasses in the Southern Hemisphere with persistent glacierisation, and its glacier record is important for enquiry into the natural behaviour of Earth's climate. The central South Island contains a spectacular array of landforms produced by glacier action, spanning from Middle Pleistocene to present. The central South Island record benefits from modern glaciers, whose historic behaviour provides an analogue for interpretation of the prehistoric record, while the prehistoric record gives context to the widespread retreat of Southern Alps glaciers within the ~100 years or so. The central South Island glacial geomorphologic record is documented on a five-sheet, 1:100,000-scale, geomorphology map (Barrell et al. 2011: GNS Science Monograph 27). Spanning from the west coast to the east coast and including the highest portions of the Southern Alps, the map shows the distributions of glaciers, glacial moraines, outwash plains, and a range of other landforms. The landforms are placed in broad age groups, emphasizing climatic events. Greatest emphasis is placed on the landforms of the Late Otira Glaciation, within the period between about 45,000 and 14,500 years ago, as well as younger landforms of late-glacial age (about 14,500 to 11,700 years ago) and the succeeding Holocene epoch, up to the present day. The historic record of modern glacier fluctuations, and landforms produced, shows considerable variation from valley to valley. This reflects topographic setting and geometry of each glacier, which determine sensitivity and responsiveness to small shifts in climate, as well as whether any landforms produced are in positions likely to survive erosion or burial. Understanding the local and regional landscape context of a glacier greatly aids the interpretation of its prehistoric record of behaviour imprinted in landforms.

Late Pleistocene glacial stratigraphy of the West Coast, New Zealand

Timothy T. Barrows[1], Peter Almond[2], Rob Rose[3], Keith Fifield[4], and Stephen G. Tims[4]

[1]Department of Geography, University of Exeter
[2]Department of Soil and Physical Sciences, Lincoln University
[3]Department of Geological Sciences, University of Canterbury
[4]Department of Nuclear Physics, Australian National University

The central West Coast of New Zealand possesses the classic glacial sequence of the Late Pleistocene of New Zealand, the most recent advances being broadly grouped as the Otira (Last) Glaciation. The current chronostratigraphy of the Otira glaciation is based on radiocarbon dating, and correlation to the marine oxygen isotope record for the oldest (MIS 4) advance. Three main glacier advances occurred during the last 35,000 years with deglaciation at 19,000 cal yr BP or shortly after.
We have reassessed the limits of ice advance in the lower Taramakau and Arnold River catchments and conducted an exposure dating campaign with complementary tephra analysis to place direct age estimates on each of the major glacier limits. We find that mapped limits of the Loopline Formation have ages ranging between 20,000-35,000 years, not ~74,000 years as implied by the correlation with MIS 4 that is currently accepted. Tephra analysis on both the Kumara and Moana lobes of the glacier support this age, with the Kawakawa tephra found just above the till. In this paper we discuss possible ways to revise the existing glacial stratigraphy.

A review of the Australian-New Zealand sector of the Southern Ocean over the last 30 ka

Bostock, H.C.[1], Armand, L.K.[2], Barrows, T.T.[3], Carter, L.[4], Chase, Z.[5], Cortese, G.[6], Dunbar, G.B.[4], Ellwood, M.[7], Hayward, B.[8], Howard, W.[7], Neil, H.L.[1], Noble, T. L.[9], Moss, P.T.[10], Moy, A. D.[11, 12], Williams, M. J. M.[1]

[1]National Institute of Water and Atmospheric Research, Wellington
[2]Department of Biological Sciences, Macquarie University
[3]Department of Geography, University of Exeter
[4]Antarctic Research Centre, Victoria University of Wellington
[5]Institute for Marine and Antarctic Studies, University of Tasmania
[6]GNS Science, Lower Hutt
[7]Research School of Earth Sciences, The Australian National University
[8]Geomarine Research, Auckland
[9]School of Earth Sciences, University of Tasmania
[10]School of Geography, Planning and Environmental Management, University of Queensland
[11]Department of the Sustainability, Environment, Water, Population and Communities, Australian Antarctic Division, Kingston
[12]Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart

During the last glacial there was an increased sea-ice extent around Antarctica (as far north as 55°S) and iceberg presence inferred from ice-rafted debris. Evidence from microfossil assemblages suggests that sea surface temperatures (SST) were up to 7°C cooler and the Subtropical Front (STF), Subantarctic Front (SAF) and Polar Front (PF) had migrated north, except where the fronts were controlled by bathymetric highs. Despite potential iron fertilisation by increased dust, there is little evidence for higher total biological productivity in the Pacific sector of the Southern Ocean. The altered oceanic circulation during the glacial also affected the outgassing and decreased nutrients in the surface waters, and contributed to increased storage of CO_2 in the deep waters and lowering of the carbonate lysocline. During the deglaciation sea-ice retreat and SST increased rapidly at ~18 kyr BP, roughly synchronous with the reinvigoration of the intermediate water and deep water circulation in the Southern Ocean and the release of CO_2 stored in the deep waters. The gradient in carbon isotopes ($\delta^{13}C_{benthic}$) between the Antarctic Intermediate Waters (AAIW) and lower Circumpolar Deep Waters (LCDW) was greatest at the start of the deglaciation suggesting that the AAIW ventilation led the LCDW. There was a slight enrichment in $\delta^{18}O_{planktic}$ and decrease in SSTs, and a reduction in intermediate and deep water circulation between ~14-12.5 kyr BP occurred during the Antarctic Cold Reversal (ACR). Following the ACR, there was a second, more minor, release of deepwater CO_2 related to reinvigoration of the North Atlantic Deep Waters. From 10 ka onwards the modern intermediate and deep water circulation was established.
SSTs reached a maximum in the early Holocene, with the STF located at its most southerly position, and there was a rapid retreat of the Ross Ice Sheet. A decline to modern SST in the mid to late Holocene followed. Vegetation on Campbell Island lagged this early Holocene SST maximum by 2 kyrs, possibly in response to changes in the westerly winds affecting the length of the growing season, or succession. Millennial cycles overprinted on the Holocene SST and $\delta^{18}O_{planktic}$ records may also be the result of subtle changes in the position and strength of the westerly winds.

Stable Isotope Dendroclimatology in New Zealand: Palaeoclimatic Potential and Methodological Challenges from a $\delta^{13}C$ and $\delta^{18}O$ Case Study of the Southernmost Stand of Kauri (*Agathis australis*).

Tom Brookman[1], Travis Horton[1], Thomas Whittaker[2], Michael Evans[3], Jonathan Palmer[4] and Andrew Lorrey[5]

[1]Department of Geological Sciences, University of Canterbury
[2]Earth and Planetary Sciences, University of New Mexico
3Department of Geology, University of Maryland
[4]Gondwana Tree-Ring Laboratory, Little River, Canterbury
[5]National Institute of Water and Atmospheric Research, Auckland

New Zealand's extensive forests support long-lived tree species ideal for stable isotope dendroclimatology. The relative novelty of the discipline, however, means that local researchers must confront numerous methodological challenges to set-up research programs. The majority of recent research reporting stable-isotope based dendroclimatic archives has focussed on carbon and/or oxygen stable isotopic ratios ($\delta^{13}C$, $\delta^{18}O$) of the α-cellulose component of wood. α-cellulose is a preferred biological archive because it does not undergo isotopic exchange with xylem water or other wood components and is resistant to diagenesis. The reconstruction of long biochemical records, therefore, depends upon efficient α-cellulose isolation. The modified-Brendel acid digestion is the fastest and easiest for a new laboratory to adopt but has inherent challenges: extraction temperature, reagent amount and extraction time all affect the purity of cellulose produced and vary between tree species.

We present results from Fourier-Transform Infrared Spectroscopy and an experimental design using carbon and oxygen stable isotope analyses to provide a simple means of quantitatively testing α-cellulose purity. We document $\delta^{13}C$ variations of ~3‰, likely due to reagent residues and ~1.5‰ in $\delta^{18}O$ due to insufficient lignin removal, suggesting that procedural changes are capable of obscuring palaeoclimatic signals.

Despite rapid chemical processing major analytical impediments to dendroclimatology remain: time consuming analyses and limited sample material from narrow-rings. Determination of organic $\delta^{13}C$ and $\delta^{18}O$ traditionally requires separate analyses, doubling the required sample mass and making the process time and resource intensive. We have addressed this limitation by configuring an Elemental Analyser (EA) to provide simultaneous analysis of carbon and oxygen through relatively low temperature pyrolisis; the system can provide cheap, efficient and precise data. We will present design details and a preliminary palaeoclimatic reconstruction from a ~60 year old kauri plantation, growing in a marginal environment near Dunedin, approximately 8^{o} (lat) south of its natural range.

A palaeovegetation record from Howard Valley, New Zealand, spanning the period 38-21 cal ka BP

Louise Callard[1], Rewi Newnham[1], Marcus Vandergoes[2], Maureen Marra[3], Brent Alloway[1]

[1]School of Geography, Environment & Earth Sciences; Victoria University of Wellington
[2]GNS Science, Lower Hutt
[3]Waikato Pathways College, University of Waikato, Hamilton

This paper presents a vegetation record and inferred climate reconstruction spanning the period 38-21 cal ka BP from Howard Valley, South Island, New Zealand. During the last glaciation a glacier occupied the upper Howard Valley depositing extensive outwash aggradation surfaces in the lower valley. Episodic periods of aggradation and incision by fluvial activity have produced a sequence of terrace risers flanking the main Howard River and its tributaries. Three terrace risers, consisting of fluvial sand, gravels and cobble deposits interrupted by organic-rich silt horizons, indicative of episodic back-ponding and soil development, were sampled for palynological analysis. Palynology of the organic horizons, combined with existing beetle and plant macrofossil records from the same horizons, has provided an environmental reconstruction. During late MIS3 the site was dominated by marshy shrubland vegetation interspersed with mixed beech forest indicating temperatures ~2-3 ^{o}C cooler than present. A transition to an alpine/sub-alpine grassland, comparable to communities growing near the treeline today, indicates glacial conditions had developed by ~31 cal ka BP. A further decline in beech pollen and increase in alpine grassland and herb taxa suggests further deterioration of conditions and a period of maximum cooling (~4.5 ^{o}C) ca 23-21 cal ka BP. The consistent presence of beech pollen nevertheless suggests small forest refugia persisted in the region throughout. A number of important outcomes have come from this project. The site illustrates the merit of combining pollen and beetle records to reconstruct past vegetation/climate change. The record also points towards and earlier onset of the LGCP and questions the currently accepted age of the Kawakawa Tephra Layer, an important chronostratigraphic marker in New Zealand.

Mid-Pliocene deserts wetter, ice-caps smaller, and CO_2 higher: analogues for future greenhouse earth

John Chappell

Research School of Earth Sciences, Australian National University

The chronology of desert landscapes remained obscure until the rather recent advent of exposure-age dating using cosmogenic nuclides. Results from central Australian deserts show that seasonal fluvial activity, represented by alluvial fans and floodplains, was widespread in mid-Pliocene times but effectively ceased when Quaternary ice-age cycles commenced. Comparable results have been reported from arid regions in Peru, Southern Africa, the Middle East and China. Moreover, recent reports indicate that at this time Greenland and West Antarctica were probably ice-free, there were no significant Laurentide and Fennoscandian ice-sheets, sea-level was 15-20 m higher than today, and atmospheric CO_2 was around 400 ppm. Although some geographic features were different – notably a seaway through Panama - the mid-Pliocene appears a likely analogue for the equilibrium state of the planet if oncoming greenhouse conditions persist, with wetter conditions in central Australian and several other deserts as well as warmer polar regions and significantly higher sea level.

Keynote

Clumped-Isotope Thermometry

Allan R Chivas, Florian W Dux, Elena Platonova

GeoQuEST Research Centre, School of Earth & Environmental Sciences, University of Wollongong

The interpretation of conventional $\delta^{18}O$ values of carbonate minerals including fossils, in the general case, is made difficult, and is occasionally confounded, because both the temperature and $\delta^{18}O$ value of the host water are unknown but are required, to complete a standard palaeotemperature equation. Accordingly, most applications concentrate on geological or environmental problems where one of these parameters varies little. A recent development, the application of "clumped isotopes", largely solves this difficulty. "Clumped isotope geochemistry is concerned with the state of order of rare isotopes within natural materials. That is, it examines the extent to which heavy isotopes (^{13}C, ^{18}O) bond with or near each other rather than with the sea of light isotopes in which they swim" (Eiler, 2006). The proportions of ^{13}C -^{18}O bonds in carbonate minerals (i.e. mass 47 in CO_2, extracted from $CaCO_3$ with phosphoric acid) are sensitive to their growth temperatures, independent of bulk isotopic composition. Most previously published work on the development and application of the technique emanate from John Eiler's laboratory at Caltech. The methodology requires the simultaneous measurement of all six masses of CO_2 (44, 45, 46, 47, 48, 49). Ultra high-sensitivity gas-source mass spectrometry is required, measuring the equivalent $\delta^{18}O$ (i.e. CO_2 of mass 46/mass 44) to +/- 0.01 per mil. Hydrocarbon and chlorine contaminants (e.g. $^{12}C^{35}Cl$), even at the ppb level, are fatal to the analysis. Accordingly, CO_2 masses 48 and 49 are also measured, and CO_2 'clean-up' by gas chromatography is mandatory. Long analysis times (1h) are required to gain the necessary precision to declare a carbonate growth temperature of +/- 1.5 to 2 deg Celsius. Standardisation by calibrated standard gases, and constant repeat analyses with overlapping unknowns, means that the Caltech lab produces only 15 new results per week per mass spectrometer. The analysis times and temperature stability are crucial. The UoW laboratory achieves air-temperature stability of about 0.1 deg Celsius, utilises an improved gas chromatographic purification step, and matched electropolished nickel capillaries at the dual-inlet of the mass spectrometer.

Clumped isotope measurements are typically expressed in per mil variation of the relative abundance of a specific isotopologue (chiefly $^{47}CO_2$) from the theoretically predicted relative abundance based on a random distribution (Wang et al., 2004; Schauble et al., 2006). The latter standard is provided by CO_2 that has been isotopically homogenised by heating to 1000 deg Celsius. The clumped isotope palaeothermometer has now been calibrated successfully for inorganic calcite, biogenic aragonite (Ghosh et al, 2006a,b), fish otoliths (Ghosh et al., 2007), and some corals, and should be applicable to any carbonate minerals that were formed in the 0-200°C temperature range. Moreover, simultaneous determinations of $^{47}CO_2$ and $\delta^{18}O$ for carbonates will constrain the $\delta^{18}O$ value (to +/- 0.5 per mil) of the water from which they precipitate. Furthermore, initial empirical measurements (Ghosh et al., 2006b) suggest that the $^{47}CO_2$ values of carbonates remain unchanged despite later heating to 150-200 deg C even over geological time scales.

The clumped-isotope technique will revolutionize Earth and environmental sciences, providing quantitative estimates of ocean temperatures and sea water $\delta^{18}O$ values for much of geological time; terrestrial ground temperatures for the Cenozoic and earlier; hydrologic budgets (temperature + water evaporation/balance) for inland water-bodies and semi-enclosed water-bodies (e.g. Black Sea, Gulf of Carpentaria); and details of fluid processes during diagenesis and low-temperature ore deposition. Where carbonate precipitation involves evaporation (a non-equilibrium process) such as in speleothem and pedogenic carbonates, it is noted that the generalised $\Delta^{47}CO_2$ versus temperature equation is offset. More straightforward isotope systematics are evident for environments where the carbonate precipitates or grows in liquid water.

High-resolution Holocene lacustrine records from southern Australia

Patrick De Deckker[1], Chris Gouramanis[1,2], Dan Wilkins[1,3], Shawn Stanley[1,4], Jon Olley[5], Keith Fifield[6], Franz X. Gingele[1], Marc Norman[1]

[1]Research School of Earth Sciences, Australian National University
[2]Earth Observatory of Singapore, Nanyang Technological University
[3]Environmental Change and Conservation, Australian Antarctic Division
[4]Geographic Information Systems, United Nations, New York
[5]Australian Rivers Institute, Griffith University
[6]Department of Nuclear Physics, Research School of Physics and Engineering, Australian National University

I will be presenting, on behalf of my colleagues, several high-resolution records of crater lakes from Victoria and South Australia, as well as one alpine lake in the Snowy Mountains. We have resampled the maar Lake Keilambete that has provided the standard lake level curve for SE Australia. The new data from Keilambete are now based on many AMS ^{14}C dates done on thin layers consisting of ostracods and organic fibres, and are compared with OSL dates from single quartz grains. A reservoir age is now confirmed for the waters of this lake. Another nearby maar Lake Gnotuk has also been extensively studied with similar dating techniques as for Keilambete, but there is no reservoir effect for Gnotuk which is perched over the water table.

Grain size analysis of narrow layers is backed by stable isotopes and trace elements on ostracod valves from the same horizons, now provide a sound combined water level for both lakes. The maximum lake level was short lived and occurred at 7.2ka, followed by a substantive lake level decline after 5 ka. After this period, water levels continued to oscillate, before reaching a late Holocene nadir around 1.8 ka (Keilambete) and 1.3 ka (Gnotuk). Lake levels commenced to drop about 600 years ago. Today, both lakes have low levels similar to those at ~2 ka.

Data will be examined against the records of the crater Blue Lake at Mount Gambier and the alpine Blue Lake in the Snowy Mountains.

Finally, all these records will be compared with our reconstruction of discharges from the Murray-Darling Basin obtained from a deep-sea core offshore the mouth of the River Murray, and it will be shown that after 6 ka, Australia entered a phase of aridity paralleled with a progressive drop of sea-surface temperature at the core site. This coincides with a strengthening of ENSO over the entire Australian region and is backed by data from a deep-sea core from offshore Northwest Cape in NW Western Australia.

High-resolution record of environmental changes recorded in a deep-sea core offshore Kangaroo Island and comparison with continental records over the last 35ka

Patrick De Deckker[1], Matthias Moros[2], Kerstin Perner[2], Timothy Barrows[3]

[1]Research School of Earth Sciences, Australian National University
[2]Baltic Sea Research Institute, Rostock, Germany
[3]Department of Geography, University of Exeter

Core MD03-2611 is located at 2,420 m water depth on a platform in the Murray Canyons Group offshore the mouth of the River Murray. It occurs under the pathway of the Leeuwin Current which flows over the site in winter during la Niña events. This current is an offshoot of the Indonesian Throughflow that traverses the Indo Pacific Warm Pool.
We studied in great detail the 35 kyears record of this core. We used a variety of techniques: $\delta^{18}O$ analyses of 2 planktonic foraminifers species [*G. ruber* and G. *bulloides*], ample AMS 14C dates on the same foraminifers, planktonic foraminifer assemblages counts and calculated SST using the modern analogue technique, in conjunction with the AUSMAT-F4 database, as well from $U^{K'}_{37}$, clays and their trace elemental composition, including Sr and Nd isotopes. In addition, XRF scanning on the entire core was done and XRD analyses at high resolution.
The record of this core clearly indicates significant changes during the period of 35 to 10ka that are the opposite to those found in the Northern Hemisphere [cold phase in one hemisphere matched by warm conditions in the other, and vice versa], thus confirming the polar inter-hemispheric asymmetry already recognised in polar ice cores. New information on the driving force of the polar see-saw will be presented.
We will discuss some of the pertinent changes recognised in the core and these will be compared with arid phases in Australia [recognised by aeolian material in the core], glaciated events in the Snowy Mountains and Tasmania [recognised by SST drops in the core] and Murray River discharges [recognised by clay species and their trace elemental composition]. Finally, the Holocene record will also be discussed in detail and will be compared against the lacustrine records from southern Australia also to be presented at this conference.

Late-glacial climate in the Southern Alps of New Zealand inferred from glacier modelling

Alice Doughty[1], Brian Anderson[1], Andrew Mackintosh[1], Michael Kaplan[2], Marcus Vandergoes[3], Trevor Chinn[4], David Barrell[5], George Denton[6], Joerg Schaefer[2]

[1]Victoria University of Wellington
[2]Lamont-Doherty Earth Observatory, Palisades
[3]GNS Sciences, Wellington
[4]Lake Hawea Institute of Cryodynamics
[5]GNS Sciences, Dunedin
[6]University of Maine

Climate proxy records indicate that a late-glacial climatic reversal interrupted a warming trend after the last glacial period. In New Zealand, some palaeoclimate records indicate cooling and/or precipitation increase during the Antarctic Cold Reversal (ACR, 14000 to 12500 years ago), while others show no change in climate. Recently published glacial records (moraine maps and ages) present an opportunity to improve the palaeoclimate interpretation through numerical modelling to precise locations during a specific time period. One strength of this modelling approach is to assess the temperature and precipitation changes independently within a coupled energy-balance and 2-D ice-flow model. We reconstruct past glacier extent to infer past climate constrained by mapped and dated moraines in the Irishman basin, a high-elevation catchment in the Southern Alps. First, a suite of steady-state model runs are used to identify the temperature and precipitation forcing required to fit moraine positions dated to the late-glacial period. Second, a time-dependent glacier simulation forced by a chironomid-based temperature reconstruction from nearby Boundary Stream Tarn between 15000 and 11000 years ago is used to facilitate a comparison between the chironomid record and the glacial geomorphic record. Steady-state experiments using the optimal parameter set demonstrate that the climate around 13000 years ago in the central Southern Alps was 3.1 to 2.4°C colder than present with the range corresponding to a ±15% change in precipitation. Our results, together with similar climate reconstructions from speleothems, sensitive pollen records and marine sediment cores, support the notion that a significant cooling occurred in New Zealand during the ACR.

The chemical signature of loess deposition and concomitant pedogenesis in soils

Andre Eger, Peter Almond, Leo Condron

Lincoln University

In Quaternary Sciences, loess is often used as a proxy for reconstructing plaeo-environments. Its widespread occurrence is usually associated with glacial periods featuring cool and dry conditions. Loess deposition under temperate-humid, Holocene climate conditions is less recognised and its effect on soil formation largely unknown. We studied the implications of a Holocene dust flux sourced from the braided Haast River (West Coast, South Island, New Zealand) and deposited along a 6500 y old sand dune ridge in a podocarp-hardwood rainforest on soil properties. Along the gradient we dug 7 soil pits and quantified grain size distribution, pedogenic oxides (Fe_o, Al_o, Fe_d) and phosphorus fractions (total P, organic P, apatite P, occluded P, non-occluded P).
Closest to the river, deposition rates using the soil silt content are estimated to about 28 g m^{-2} y^{-1} decreasing with distance reaching detection limit at ~1000 m river distance. From no to maximal loess influence, pedogenic oxides Fe_o, Fe_d and Al_o gradually increase each by 50% and soil organic carbon by 60%. Concentrations with depth are more uniform (i.e. soils maintain elevated concentrations in a broader zone) than in loess-unaffected soils, which instead show a discrete profile peak. Also towards the river, apatite P declines (~50 to 3 g m^{-2} 50 cm^{-1}) and organic P increases by 50% with a depth distribution pattern similar to that of pedogenic oxides and distinct from the topsoil peaks in loess-free soils.
The dust deposition rate at Haast is equivalent to lower estimates for the Pleistocene. We interpret the pedogenic oxides and phosphorus data as consistent with upbuilding pedogenesis, the concomitance of dust deposition and soil development reflecting loess deposition in a temperate-humid climate. It creates characteristic properties of pedogenically more progressed soils.

Quaternary paleoenvironment and loess mollusks of the Carpathian Basin, Central Europe

Pál Sümegi, Sándor Gulyás*

*presenting author

University of Szeged, Department of Geology and Paleontology, Szeged, Hungary

The Carpathian Basin is situated in the southeastern part of Central Europe, or at the boundary between Central Europe, Eastern Europe and Southeastern Europe (Balkans). It forms a topographically discrete unit set in the European landscape, surrounded by imposing geographic boundaries - the Carpathian Mts., the Alps, the Dinarides and the Balkan Mts. The rivers Danube and Tisza divide the basin roughly in half. The modern climate of the basin is the outcome of the interplay of four major overlapping climatic influences (Atlantic, Continental, Submediterranean, Montane) with spatially and temporally varying extent and strength, overprinted on the special so-called basin effect attributable to the unique location and geomorphological endowments of the area. As a result a three-level mosaicity of the environment emerged. The coexistence and temporal fluctuations of these environmental mosaics fundamentally influenced the trajectory of vegetation and faunal evolution during the Quaternary. According to the available Quaternary malacological data, the main drivers of this mosaic-patterning; i.e. the referred climatic influences have been continuously present in the area since the second half of the Middle Pleistocene; i.e for ca. the past 300-350 kys. The southern areas of the basin are of special importance thanks to the location of an outstanding faunal corridor here, which hosted numerous faunal migrations between the Balkan peninsula and the Carpathian Basin. Another peculiarity of the area is that the evolutionary path which the mollusk faunas followed here are at odds with the one observed and documented in Central Europe and the northern and western parts of the basin. This special character of the faunal evolution must be attributed to the firm presence of the Submediterranean Climatic Influence in the area, which triggered different mesoclimatic conditions creating a special trajectory of environmental evolution both during the warmer and cooler periods. This is seen in the overwhelming dominance of dry, loess and sandy grassland species besides the numerous continental, montane and tundraic Carpathian-Central European elements in the Pleistocene mollusk fauna of the region implying the presence of multiple refugees for species of contrasting ecologies. Funding of grants TÁMOP-4.2.2/B-10/1-2010-0012 and TÉT_10-1-2011-0039 acknowledged.

New paleoenvironmental data for the Middle and Late Pleistocene of the Carpathian Basin: preliminary results to the „longest" Danubian loess/paleosol sequence of modern Hungary: Udvari-2A [poster]

Sándor Gulyás, Pál Sümegi, Gergő Persaits, Bálint Csökmei

University of Szeged, Department of Geology and Paleontology, Szeged, Hungary

Predicting climate and environmental changes is one of the most significant challenges of current research in earth sciences. Long-term climatic changes at a resolution of several kys can be assessed by the careful investigation of various paleoarchives including terrestrial archives. Among terrestrial paleoarchives loess/paleosol sequences tend to be the most common and most prominent type of deposits of the Quaternary covering about 10-15% of the area of modern Hungary. A careful multiproxy analysis of loess/paleosol sequences yields us information about not only the fluctuations in past environmental components but a feedback of the local biota as well. Extensive loess sheets and loess plateus of several meters thickness accumulated in the Pannonian Basin, especially in its southern part, which present ideal archives of long-term macro and meso-scale fluctuations of the climate and environment for the Middle and Late Pleistocene. A recently published site of Udvari-2A located in the Tolna-Hegyhát (Tolna Hills) area of the Transdanubian Hills in SW Hungary is outstanding from this point as the borehole deepened in 1996 and originally described by Koloszár (1997) represents the thickest and probably most complete loess/paleosol sequence of Danubian loess from Hungary covering the past 1100 kys. According to the preliminary clay and carbonate mineral analysis of selected loess and paleosol samples by Földváry & Kovács-Pálffy (2002), the sequence seems to be less weathered than other LP sequences studied from nearby Danubian sites of Hungary. In order to assess the degree of weathering for different sedimentary components marking fluctuations in the temperature and humidity and to shed light onto the nature of the paleosols and pedogenesis identified on the basis of macroscopic lithological description of the profile detailed geophysical (MS), geochemical, phytolith and malacological analyses of selected loess-paleosol samples of the sequence roughly corresponding to a period from MIS1 to MIS23 was carried out. This paper presents the initial results of this work. Funding of grants TÁMOP-4.2.2/B-10/1-2010-0012 and TÉT_10-1-2011-0039 acknowledged.

Insights into the Australian desert dunefields from a database of luminescence ages

Paul Hesse

Department of Geography and Environment, Macquarie University, Sydney

The database of luminescence ages of Australian desert sand dunes (all non-coastal, non-lunette dunes) is investigated for insights into the development of dunefields and aridity in the late Quaternary. The database includes 582 individual age determinations (at the time of writing) covering much of the Australian continent (18-43 degrees S latitude) but is unequally distributed. Most research has been concentrated in the southern and eastern sectors, including accessible parts of the Simpson, Strzelecki and Mallee dunefields. The unique dataset gives some insights into the geographic distribution of annual radiation dose rates (average 0.001 Gy/yr), related to local geology. Soil moisture content has been assumed for more than half of all age determinations at either 3% or 5% by weight. However the combined data set shows that measured values (for areas outside the humid southeast) have a modal value of 2 +/- 2 %. It is argued that this value is certainly approaching a long-term average under present climatic conditions. Re-calculation of ages using this value should see a reduction of around 3% in nearly a third of all ages.
The oldest luminescence age determination made is 380 ka, although older estimates from cosmogenic burial ages have been made. Many dunes record multiple episodes of growth, preserving several units of sand sometimes separated by palaeosols. In addition, the surface form of most Australian dunes shows little evidence of substantial post-formation alteration. This conservative behaviour makes Australian longitudinal dunes excellent (if episodic) recorders of past aeolian activity and environments. The full compilation of ages has been used in several ways to deduce a ‘continent-wide’ picture (usually on the assumption that climatic changes are or should be synchronous at that scale). Here frequency distribution of age determinations is compared with analysis of the distribution and range of sedimentation rates. Some findings (increase in activity around 40 ka; LGM peak) are consistent across these different approaches but some features are quite different. One of the sources of uncertainty in all approaches is the treatment of errors which grow with sample age (while time windows are usually held constant). An apparent late Holocene peak in dune activity may purely be a product of the time window considered.

Long-term climatic and short-term volcanic responses of vegetation in western Patagonia

Ignacio Jara[1], Patricio I. Moreno[2], Rewi Newnham[1]

[1]Victoria University of Wellington
[2]Universidad de Chile

The distribution and composition of vegetation on the Andean slopes of Patagonia (38-53°S) are regionally controlled by strong climatic gradients and locally influenced by catastrophic disturbances such as volcanic eruptions. Although, paleoclimatic and geochronologic records have independently evidenced millennial-scale climatic variation and frequent volcanic eruptions during the last 15 ka (ka=1000 calendar years before the present), there is not yet any paleoecological record that documents the combined effects of these agents on the vegetation dynamics of Patagonia.
A ^{14}C-dated sediment record from a small closed-basin lake in the Andean foothills (40°S) of western Patagonia is presented. High-resolution pollen and charcoal analyses, as well as the presence of more than 30 tephra layers during the last 15 ka allow us to evaluate the effects of climate change and individual volcanic eruptions on vegetation composition and fire-activity.
Between 15-7 ka, vegetation and fire activity show a pattern of change analogous to sites located away from the Andes with low volcanic activity, suggesting that long-term climate changes widely controlled the distribution and dynamics of vegetation. Between 7-3 ka, vegetation and fire activity experienced several short-term divergences from extra-Andean sites. Some of these divergences are stratigraphically associated with tephra layers, indicating an increased volcanic influence. From 3 ka to the present, climatic variation controlled the long-term pattern of vegetation change apart from isolated responses associated with particular eruptions.
Our results show, for the first time, climate and volcanic responses of vegetation at different time-scales integrated in one paleo-ecologic record in western Patagonia. Climate variation at millennial and multi-millennial time-scales seems to be the prime controller of the regional vegetation distribution, especially during the glacial-interglacial transition. During periods with high volcanic recurrence, tephra fallouts can generate short-term local divergences from regional patterns of vegetation change. This work has important implications for other regions where volcanism and climate may exert varying controls on vegetation dynamics.

Using tephra beds to assess the age uncertainty of 14C-dated Holocene lake cores

Darrell Kaufman

Northern Arizona University

Lakes are useful repositories for distal tephra deposits because their sediment accumulates nearly continuously. Tephra beds, in turn, are useful chronostratigraphic markers for evaluating the reliability of the age-depth models of lake cores. In this study, I use correlated tephra beds as maker horizons to assess the accuracy of radiocarbon-based age models of Holocene sediment cores taken from six lakes in the Ahklun Mountains, southwestern Alaska. The lakes are located downwind of the Aleutian Arc volcanoes in the northern Bristol Bay area between 159° and 161°W longitude at around 60°N latitude. A radiocarbon-based age model was constructed for each lake using a published spline-fit procedure (the R-code, “clam” Blaauw 2010, Quaternary Geochronology 5: 512), which uses Monte Carlo simulation of the probability density function of the calendar-year calibration of each radiocarbon age to find the most likely model fit, and to assess the age-model uncertainty. Because some tephra beds were dated in more than one lake, their ages can be determined as the average of the multiple occurrences, and their age uncertainties can be estimated by the standard errors of their means. The 1SE for the seven tephra beds that were dated at more than one site averages ± 115 yr. In nearly all cases, the confidence intervals derived from the age-depth model overlap with the mean age of the tephra within 1SE. This indicates that the confidence intervals associated with the age-depth models by the ‘clam’ routine are reliable indicators of the actual reproducibility of the specific event ages as dated at different sites.

The limited impact of Quaternary sea level rise on the Shoalhaven River, south-eastern Australia

Stephanie Kermode[1], Martin Gibling[2], Brian Jones[1], Timothy Cohen[1], James Daley[1]

[1]GeoQuEST Research Centre, University of Wollongong
[2]Dalhousie University, Halifax, Nova Scotia

A sedimentological and geochronological approach is taken to determine the impact of the Holocene sea level rise on the Shoalhaven River, southeastern New South Wales. Sea level peaked at + 1 to 1.5 m by ~7.8 ka, before declining slowly to present elevation at 2 ka. Whilst the coastal response to these fluctuations is well established, the question remains as to how far upstream these influences are recorded in the sedimentary record. Empirical evidence of fluvial impact of sea level rise lags behind well constrained information about the magnitude and timing of these events. Southeastern Australia, being tectonically stable and lacking glaciation throughout the Quaternary, is an ideal location to obtain evidence for fluvial responses to sea level rise.

Base level is a key parameter to which the fluvial system adjusts, thus relative changes in sea level force a response from river systems. In order to maintain equilibrium, channels adjust their planform in response to base level change. However planform adjustment is restricted by the confinement of many coastal rivers in southeastern Australia. Whilst estuarine facies were identified at Wogomia, 35km from the current mouth of the Shoalhaven River, they appear to be reworked deposits from higher in the system, although they have not been identified beyond the bedrock confines immediately upstream. Shell fragments, dated at 7.38 ± 0.045 kcal yr BP, were retrieved from ~2 m below the current low flow water level with at least 4 m of similar sediment above, and 8 m below, overlying Pleistocene basement. Rapid accretion associated with delta progradation in this confined setting is suggested as the mechanism for the deposition of thick beds (> 12.5 m) of estuarine material at Wogomia.

The Mid-Holocene circulation transition in New Zealand

Andrew M. Lorrey[1], Paul Williams[2], Marcus Vandergoes[3], Helen Bostock[4], Duncan Ackerley[5], Andrew Mackintosh[6], Darren King[1], Sharleen Harper[1], James Renwick[4], Anthony Fowler[2], Helen Neil[4], Lionel Carter[7], Gavin Dunbar[7], Julene Marr[7], Giuseppe Cortese[3]

[1]National Institute of Water and Atmospheric Research, Auckland
[2]University of Auckland
[3]GNS Science
[4]National Institute of Water and Atmospheric Research, Wellington
[5]Monash University
[6]Victoria University of Wellington
[7]Antarctic Research Centre, Victoria University of Wellington

Previous work has suggested there was a major climate shift during the middle of the Holocene in New Zealand. However, the timing of the changes observed in many proxies, especially those derived from sedimentary archives, appear asynchronous across the country and a coherent response between archives within individual climate districts are obscure. The lack of clarity for a mid-Holocene event, or whether there was more than one significant change, is a result of insufficient dating control, low archive sampling resolution, and different dating techniques applied to the array of archives. This short-coming inhibits intra- and inter-hemispheric connections between circulation-based reconstructions, and thwarts the comparison of local proxy archive signals to palaeoclimate model results for a crucial time period.

Five speleothem archives were used to identify the timing of a mid-Holocene climate change in New Zealand. All of the speleothems were dated using thermal ionisation mass spectrometry (TIMS). Age models and errors (multi-decadal to centennial) for individual isotope points between TIMS dates were determined using a piecewise cubic Hermite (PCH) polynomial interpolation, which is a new approach for New Zealand speleothem-based palaeoclimate research. The consensus from these age models for each of the speleothem records indicate the timing of a largely synchronous mid-Holocene change for New Zealand as having occurred between ~6.4-5.7 ka.

The speleothem signals and supporting multi-proxy data were also integrated into millennial-resolution past circulation time slices for both sides of the mid-Holocene transition using a new synoptic calibration approach based on a virtual climate station network (VCSN). An ensemble mean synoptic pressure anomaly pattern derived for both sides of the transition suggests regional circulation was characterised by more blocking prior to the mid-Holocene shift (~7-6 ka), with less frequent cold air masses, more easterly flow, and diminished south westerly winds. The time slice following the mid-Holocene transition (~6-5 ka) indicates a zonal regime brought increased precipitation to western and southern regions, more southerly fronts, cooler temperatures, increased incidents of frost, and drier conditions to eastern regions. The timing of the change to a zonal regime corresponds well to surface exposure age dates on neoglacial (mid-Holocene) moraines reported for the Southern Alps that indicate glacier advances. Palaeoclimate model simulations from GCM and RCM also correspond well to the parts of the reconstructed circulation patterns, but illustrate a difficulty for climate model outputs to be verified during regional climate transitions.

Using radiocarbon to date young speleothems and assessment of the Suess effect recorded in speleothems

Janece McDonald[1], Quan Hua[2], Ed Hodge[2], Russell Drysdale[3], Stewart Fallon[4] and John Hellstrom[5]

[1]University of Newcastle, Environmental and Climate Change Research Group
[2]Australian Nuclear Science and Technology Organisation (ANSTO)
[3]Department of Resource Management and Geography, University of Melbourne
[4]Research School of Earth Sciences, Australian National University
[5]School of Earth Sciences, University of Melbourne

Commonly, speleothems are largely and successfully dated using uranium-series techniques since uranium is incorporated during deposition, they tend to behave as closed systems, and there is very little detrital contamination. However, in SE Australia U concentrations in speleothems are often of the order of 10 ppb and in young samples Th/U ages can be very imprecise due to insufficient ingrowth of ^{230}Th. The bomb pulse has been used successfully as a chronological tool in several young Australian speleothems and the challenge has been to extend the use of radiocarbon to construct a chronology extending back to ~ 5ka. Dead carbon fraction (DCF) values for the pre-bomb period were estimated based on the timing of ^{14}C dates for the bomb pulse period determined by high resolution ^{13}C analyses. Bayesian (Bacon and P Sequence of OxCal) methods were used to construct age models. Good agreement between the models suggests that the priors for these models were defined correctly and that the top 50 mm of WM7 grew over the last 1400-1650 years.
Over the last 200 years, anthropogenically produced carbon dioxide released into the atmosphere (particularly the burning of fossil fuels) is equivalent to the magnitude of natural changes observed during glacial-interglacial transitions (~ 100 ppm). Given that fossil fuels are strongly depleted in ^{13}C, their release has diluted the ^{13}C/^{12}C of atmospheric CO_2 over time, resulting in a steady decline in δ^{13}C, known as the Suess Effect. This phenomenon has been recorded in natural archives such as ice cores, tree rings, speleothems and corals. The high resolution ^{13}C record contained in WM7 shows this depletion of $\delta^{13}C_{atm}$ and is used as an additional chronological tool.

Using the past to plan for the future: sea-level rise in Hexham Swamp, NSW Australia

Sarah McGowan, Robert Baker

University of New England

Climate change and associated sea-level rise are an increasing concern for coastal communities. One of the greatest challenges lies in predicting future rates of sea-level rise and climate change. This study outlines how the understanding of past episodes of sea-level variation enables a better understanding of present sea-level and assists with better predictions of future sea levels.

This study undertakes a somewhat controversial approach to predicting future sea-levels. Evidence from past episodes of higher sea-levels during the Holocene and Pleistocene from the south-eastern Australian coast are used to develop estimates of future rates of sea-level rise. A rule of thumb calculated from ice cores and other palaeo-proxies is applied. For every 1°C increase in temperature, on average, there would be a 0.8m positive response in mean sea-levels in south-eastern Australia. Although this approach is controversial it is relevant as correlations between past sea-level heights and temperatures have been reported. Palaeo data can therefore be used to test the validity of models predicting the response of coastlines to sea-level rise.

The developing methodology is then applied to a case study of Hexham (near Newcastle, New South Wales). Biological proxies from the estuary are calibrated to a Holocene sea-level curve from rocky shore relic fixed intertidal species. GIS mapping completed illustrates the extent of inundation and the urban infrastructure inundated by each of the various sea-level scenarios (0.9m, 2.6m and 5m).

Investigating a new modern coral proxy for the tropical southwest Pacific

Louise Moody[1], Mark Quigley[1], Helen Neil[2], Travis Horton[1], Peter Marriot[2], Brendan Duffy[1]

[1]University of Canterbury
[2]National Institute of Water and Atmospheric Research, Wellington

Modern and fossil corals from the tropical southwest Pacific have become highly valuable climate proxy tools, providing unprecedented insights into palaeoclimate fluctuations. Corals located within the Western Pacific Warm Pool (WPWP) are especially sensitive to climate changes and can yield detailed stable isotopic histories from this dynamic region, where the interactions of El Niño Southern Oscillation (ENSO), Asian- Australian monsoon and Indian Ocean Dipole (IOD) influence rainfall and temperature variability. This study is a preliminary investigation using a modern *Goniastrea retiformis* coral from East Timor to determine the suitability of this species as a palaeoclimate proxy. Although abundant throughout the Pacific and Indian Oceans, the *Goniastrea* genus has not been previously studied in this context, and its prevalence in the southwest Pacific since the Plio-Pleistocene means that the use of this species could increase the ability to capture important palaeoclimate data. With developments in the field of coral sclerochronology, *Porites* corals have been the key genus used in modern and palaeoclimate reconstructions from tropical regions around the globe, allowing estimates of sea surface temperature (SST) and sea surface salinity (SSS) using coral $\delta^{18}O$ and Sr/Ca. This study compares preliminary stable isotopic data from the *G. retiformis* with a modern *Porites* coral from West Timor, enabling comparison of this initial data with a calibrated modern coral from the same region. The strong correlation between the two coral $\delta^{18}O$ data sets provides exciting results, suggesting that with further investigation this species may indeed provide a new source of modern climate and palaeoclimate SST and SSS data for this region.

Reconstruction of past trophic states using diatoms: a case study from of Lake Spectacle, northern New Zealand

Helen Munro[1], Paul Augustinus[1], Michael Reid[2]

[1]School of Environment, University of Auckland
[2]School of Behavioural, Cognitive and Social Sciences, University of New England

Nutrient enrichment of lakes, especially shallow lakes, is a significant environmental problem globally, as well as in New Zealand. However, it is unknown whether shallow New Zealand lakes naturally have high nutrient levels or this has arisen as a consequence of land clearance and agriculture. In order to develop effective management programs to reduce nutrient levels of lakes, the background state of the lake needs to be understood, as well as an evaluation of when and why enrichment has occurred. To date few paleolimnological studies on New Zealand lake sediment records have addressed these important questions. This study describes the changes in trophic status inferred through diatom analysis of two sediment cores from Lake Spectacle, northern New Zealand, covering the period ca. 6000 cal yr BP to present. Lake Spectacle has been hypertrophic since regular monitoring commenced in 1993. 21 samples from two cores were taken and processed using standard procedures. At least 300 valves per sample were identified and counted. Past trophic levels were determined utilising a transfer function developed by Reid (2005) and equations from Burns et al (2000). Diatom analysis was supported by pollen and geochemical data. Lake Spectacle was mesotrophic during the majority of the pre-human history of the lake. Polynesian habitation of the catchment was not associated with any significant change in lake trophic status. A significant increase in the trophic level of the lake occurred with European settlement of the catchment, with the lake switching to a eutrophic system. Lake trophic status has continued to become more eutrophic since 1860 with the introduction of agriculture and draining of the surrounding wetland. The insights gained through diatom analysis of Lake Spectacle have provided essential information for the development of a successful management plan to return the lake to its pre-human impact state.

Keynote

Should there be formal subdivision of the Holocene?

Rewi Newnham

Victoria University of Wellington

A Working Group of INTIMATE (Integration of ice-core, marine and terrestrial records) and the Subcommision on Quaternary Stratigraphy (SQS) of the International Commission on Stratigraphy (ICS), has been established to consider the prospects for a formal subdivision of the Holocene Series/Epoch. Although previous attempts to subdivide the Holocene have proved inconclusive, recent developments in Quaternary stratigraphy, notably the definition of the Pleistocene-Holocene boundary and the emergence of formal subdivisions of the Pleistocene Series/Epoch, mean that it may be timely to revisit this matter. The Quaternary literature reveals a widespread informal but variable usage of a tripartite division of the Holocene ('early', 'middle' or 'mid', and 'late'), and the working group argue that this *de facto* subdivision should now be formalised to ensure consistency in stratigraphic terminology. They are proposing an Early-Middle Holocene Boundary at 8.2 ka BP and a Middle-Late Holocene Boundary at 4.2 ka BP, each of which is linked to a Global Stratotype Section and Point (GSSP). Should the proposal find a broad measure of support from the Quaternary community, a submission will be made to the International Union of Geological Sciences (IUGS), via the SQS and the ICS, for formal ratification of this subdivision of the Holocene Series/Epoch. A discussion paper that concerns this proposal will appear in the coming months (early 2012).

At the AQUA meeting I will outline the proposal and seek the views of Quaternary workers in Australasia which can be conveyed to the working group. Time permitting, this may also be an opportunity to discuss what registration, if any, of the proposed boundary 'events' are found in Holocene records of Australasia.

The termination of the Last Glacial Stage in eastern Australia: multi-proxy, high resolution reconstructions from lake sediment cores on North Stradbroke Island

Lynda M Petherick[1], Hamish A McGowan[2], Patrick T Moss[2]

[1]Queensland University of Technology
[2]The University of Queensland

Two continuous, high resolution records encompassing the LGM have been developed using multiple proxies (aeolian sediment flux, grain size, pollen and charcoal) in lake sediment from North Stradbroke Island (NSI), Australia. These records are unique in that they are the only continuous records extending into the LGM from the lowland subtropics of the Southern Hemisphere (SH). As such, they make a valuable contribution to enhancing our understanding of climatic variability in the region.
The presence of Asteraceae (Tubilifloreae) and spineless Asteraceae (common indicators of glacial conditions in Australia) indicate significantly cooler temperatures (≥6^{o}C lower than today) in the subtropics during the LGM. Similarities between the vegetation at NSI and other temperate sites e.g. Caledonia Fen, Redhead Lagoon and Barrington Tops suggests that the NSI records reflect regional conditions across eastern Australia. The NSI records also suggest that the LGM was an extended period ca. 8 – 10 kyr, containing 2 arid phases (ca. 30 – 26.5 kyr & 21 – 19.5 kyr) separated by an interstadial. A growing number of records from across the SH also show evidence for an extended LGM that was not uniformly cool and dry.

Keynote

OZ-INTIMATE: a climate event stratigraphy for the Australian region, 0-35 ka

Jessica Reeves[1], Tim Cohen[2] and OZ-INTIMATE members

[1]University of Ballarat
[2]University of Wollongong

Over the past 2.5 years, the OZ-INTIMATE group has been working together to determine a climate event stratigraphy (CES) for the Australian region. To approach the >60 degrees latitude, we initially divided the region into four broad climatic zones: tropical, temperate, arid interior and Southern Ocean.
From the regional syntheses, it is clear that the drivers of the tropics (insolation, exposure of the Sunda shelf, ITCZ position) are distinct from those of the temperate region (mid-latitude Westerly location, extent of Antarctic Winter sea ice), where clearer comparisons can be drawn with New Zealand. The arid interior is plagued by the paucity of continuous records, which is forcing a re-interpretation of proxy responses. For example, dunes and dust – are these a result of increased source or preservation of record under more humid conditions?
The Australian CES looks to compare the responses of the regions to the major drivers of insolation, sea level, atmospheric and oceanic circulation and greenhouse gases. A key time period of the Australian CES is ~14 ka, which is coincident with the Antarctic Cold Reversal and the re-establishment of the Indonesian throughflow and expansion of the IPWP, causing a steep temperature gradient across the continent and an invigoration of the Austro-Indonesian Summer Monsoon, with wetter conditions in all excepting the Eastern seaboard.
The CES provides a framework for palaeoclimatic change over the past 35 ka in the Australian region. However, in doing so, the project has also highlighted the key temporal and spatial gaps in the Australian palaeoclimate records. These will form targets for future research by the group.

Keynote

Integrated Ocean Drilling Program Expedition 339 Mediterranean Outflow: Pliocene – Pleistocene mid-slope deposits in the Gulf of Cádiz.

Craig R. Sloss[1], F Javier Hernandez-Molina[2], Dorrik Stow[3], Carlos Alvarez-Zarikian[4], Expedition IODP339 Scientists[5]

[1]School of Earth and Environmental Science, Queensland University of Technology
[2]Departmento Geociencias Marinas Universidad de Vigo, Facultad de Cinencias Del Mar, Vigo, Spain
[3]Institute of Petroleum Engineering, Heriot-Watt University, Edinburgh
[4]Integrated Ocean Drilling Program, Texas A&M University, College Station
[5]IODP Expedition 339 Scientists: Acton, G., Bahr, A., Balestra, B., Ducassou. E., Flood, R., Flores, J-A., Furota, S., Grunert, P., Hodell, D., Jimenez-Espejo, F., Kim, J. K., Krissek, L., Kuroda, J., Li, B., Llave, E., Lofi, J., Lourens, L., Miller, M., Nanayama, F., Nishida, N., Richter, C., Pereira, H., Sanchez Goni, M., Sierro Sanchez, F., Singh, A., Takashimizu, Y., Tzanova, A., Voelker, A., Williams, T., Xuan, C.

The Pliocene – Pleistocene sedimentary history of the Gulf of Cádiz, in the south-western margin of the Iberian Peninsula, at the eastern end of the Azores-Gibraltar zone, is significantly influenced by the opening of the Strait of Gibraltar 5.3Ma. This opening initiated the Mediterranean Outflow Water (MOW) and along slope currents (contour currents) which played a major role in depositional processes and the preservation sedimentary successions along the middle slope (500 to >1200 mbls). IODP Expedition 339 drilled 5 sites in the Gulf of Cadiz and 2 off the west Iberian margin, from November 2011 to January 2012 to investigate the influence climate change, neotectonics and changes in the MOW on sedimentation within the Gulf of Cádiz. The total length of core recovered was 5447 m; with an average recovery of 86.4%. Preliminary work has shown that sedimentary successions include down slope processes such as turbidity currents and mass movement. However, the depositional environment is dominated by along slope processes which has resulted in one of the most extensive contourite depositional systems (CDS) ever described. The high sedimentation rates and expanded sedimentary records of CDS permit high-resolution examination of the influence of the opening of the Gibraltar Gateway, the MOW and the interaction of a variety of down slope processes on Quaternary sedimentary successions preserved on the mid-slope. Preliminary results also show a remarkable record of orbital-scale variation in bulk sediment properties of contourites at several of the drift sites and a good correlation between all sites. The climate control on contourite sedimentation is clearly significant at this scale; further work will determine the nature of controls at the millennial scale.

An alternative mechanism for polygon evolution on hillslopes in Taylor Valley, McMurdo Dry Valleys, Antarctica: implications for surface exposure dating?

Carol Smith[1], Peter Almond[1] , Fiona Shanhun[1], Rachel Downward[1], Victoria Nall[1], Andre Eger[1], Jim Bockheim[2]

[1]Lincoln University
[2]University of Wisconsin, Madison

Patterned ground landscapes in Taylor Valley consist of polygons comprising soils with ice-cemented permafrost. Polygons are defined by linear troughs (tension cracks) in the underlying ice-cement. Sletten et al. (2003) proposed a mechanism for the development of patterned ground on flat surfaces in these landscapes, based on a rotating motion ("convection cell") driven by thermal ice expansion during summer. This returns some surface material to the polygon troughs, by forcing the sand away from the cracks towards the polygon centre. We aimed to test the general applicability of Sletten's mechanism to hillslopes (which dominate the landscape) and to examine the influence of cryoturbation on soil transport and properties, desert pavement dynamics and hence the effect on the surface age of the patterned ground.

Along a surveyed transect aligned downslope on Taylor III drift (208-335 ky) we recorded clast size, logged the exposed stratigraphy and sampled for chemical analysis and micromorphology. The stratigraphy showed that sand, emerging from the ice cement near the uphill trough, moves downslope, in *en echelon* layers, rather than a polygon-centreward movement of sand at depth. These layers outcrop at the soil surface at different points along the transect, producing a crusted soil surface and concentrations of overturned clasts; they also carry a raft of gravelly desert pavement.

We conclude that different mechanisms maintain patterned ground on hillslopes compared to flat land. The surfaces of polygons are dynamic zones characterised by a downslope flux of desert pavement and cryoturbated soil. In the absence of numerical ages, we use salt accumulation in soils to estimate the residence time of soils along the transect. We also use soil chemistry and microfabric analysis to further inform our polygon evolution model and to further consider the implications on the use of surface exposure dating for chronostratigraphic interpretation in this landscape.

Sletten RS, Hallet B, Fletcher RC (2003). Resurfacing time of terrestrial surfaces by the formation and maturation of polygonal patterned ground. *Journal of Geophysical Research-Planets* 108.

Preliminary results of relative dating of fluvial terraces and outwash plains using a Schmidt Hammer

Tim Stahl, Stefan Winkler, Mark Quigley

Department of Geological Sciences, University of Canterbury

Schmidt-hammer exposure-age dating (SHD), a combination of the Schmidt-hammer relative-age dating method with numerical age dating techniques like e.g. terrestrial cosmogenic nuclide dating (TCND), has shown its high potential for the investigation of Holocene/Late-Glacial moraines and glacially sculptured bedrock surfaces during the past decade in Norway and New Zealand. Until now, SHD has rarely been used on boulders or bedrock surfaces of non-glacial origin. Additionally, only a few pilot tests have been conducted on landforms of an older age (e.g. past the LGM). Ambiguity on the mechanical limits of the Schmidt-hammer that determine its possible resolution, a missing control over possible removal of superficially weathered detritus, and especially uncertainties about the shape of the essential age-calibration curves are responsible for the lack of results in such instances. The latter has been confirmed as a linear trend/graph over the past c. 13 - 12,000 years.
In this study, we examine the usefulness of the Schmidt Hammer in locally correlating fluvial terraces and outwash surfaces in inland Canterbury. We find that for its ease of use, low cost, and quick sampling method, the Schmidt Hammer provides good results when applied to fluvial terraces- outside its usual realm of landslide and glacial features- and with resolution comparable to that of weathering rind data. Our preliminary results show an R-value/age curve that maxes out near 100ka and the possibility, on a local scale, of high resolution dating. In the Mackenzie basin, we show how age correlations of outwash surfaces and terraces can be accurately made to within a few thousand years, with implications for regional active tectonics studies.

Lacustrine sediments in Lake Ohau, central South Island, New Zealand – An archive of erosion, earthquakes and paleoclimate since the Late Glacial

Phaedra Upton[1], Marcus J Vandergoes[1], Jamie Howarth[2], Richard H Levy[1], Albert Kettner[3], Andrew Gorman[2]

[1]GNS Science
[2]University of Otago
[3]CSDMS University of Colorado at Boulder

Located east of the main divide in the central Southern Alps, the Mackenzie Lakes, Ohau, Pukaki and Tekapo, occupy fault controlled glacial valleys and contain a high resolution sedimentary record of the last ~17 ka. Recorded in these sediments are climatic events, earthquakes along the Alpine Fault to the northwest, the landscape response following Alpine Fault earthquakes and land use changes. We focus this study on Lake Ohau, the smallest and shallowest of the three lakes. A 5 m core collected from the distal end of Lake Ohau at a depth of 60 m comprises finely laminated, light and dark sediment couplets. Preliminary estimates of sedimentation rate = c. 5 mm/yr suggest that the core contains a record of approximately the last 1000 years. We use HydroTrend, a climate-driven hydrological model, coupled to Sedflux, a basin filling stratigraphic model, to simulate sediment deposition within the lake basin. A high resolution simulation, run at daily timesteps over the last 60 years and constrained by measured climate parameters, is compared to the top 30cm of the core which has been dated to this time interval. Much of the catchment of Lake Ohau is located within 30-50 km of the Alpine Fault, within the region expected to experience shaking strong enough to generate significant landsliding (≥MM8 shaking intensity) and thus create a wealth of sediment available to be transported through the sedimentary system. Following an earthquake, the next major rain event will transport the first pulse of that sediment into Lake Ohau. Subsequent storms will transport much of the landslide generated material (Dadson et al., 2005). Our Sedflux models show how these sediments will distribute through the lake basin.

Keynote

Mackenzie Basin Lakes Project: Understanding sub decadal to annual climate variability in the mid-latitude SW Pacific over the last 15 kyrs

Marcus Vandergoes[1], Richard Levy[1], Sean Fitzsimons[2], Jamie Howarth[2], Gavin Dunbar[3], Lionel Carter[3], Bob Ditchburn[1], Gary Wilson[2], Andrew Gorman[2], Phaedra Upton[1], Alexander Forrest[4], Paul Stumpner[4], Jen Purdie[5]

[1]GNS Sciecne
[2]University of Otago
[3]Victoria University of Wellington
[4]UC Davis
[5]Meridian Energy

Highly resolved geological archives that define precise timing and magnitude of climate change in Southern Hemisphere mid-latitudes extend our knowledge beyond the instrumental record and are required to determine natural spatial variability in the global climate system. However, relevant paleoclimate records remain scarce due to a paucity of accessible sedimentary archives. Glacial lakes located in the Mackenzie Basin of New Zealand's South Island lie at the northern boundary of the westerly winds in a region that is highly sensitive to shifts in polar and equatorial climate modes and resultant changes in temperature and precipitation. The Makenzie Basin Lakes (MBL) contain thick (up to 300 m) sequences of fine scale sedimentary couplets that provide a unique means to resolve changes in precipitation, storm frequency, and wind regimes over the past 15 kyrs at inter-annual resolution. Records derived from these lakes can provide insight into climate change in the southern mid-latitudes, the relative influence of different principal climate modes (e.g. ENSO, SAM,) on the region, and regional response to global climatic events including the Antarctic Cold Reversal, mid-Holocene warming, Little Ice Age and Medieval Climate Anomaly.
Here we present preliminary results from: (1) studies on modern sedimentary processes, (2) seismic surveys, and (3) examination of short cores (1-5.5m) with a focus on data from Lake Ohau. Results suggest that sediment flux within Lake Ohau is sensitive to changes in inflow, which decreases to a minimum amount in winter (August-September). These changes in lake inflow are sensitive to changes in regional precipitation. We therefore infer that sedimentary sequences contained within the MBL provide an annually resolvable archive of precipitation. These results form the basis for a proposed initiative to recover a complete sequence from one (or more) of the MBL and establish a high-resolution paleoclimate record for the past 15 kyrs.

Bedrock geology, landscape evolution and aboriginal usage of the Western Desert and Murchison Basin

R. Esmée Webb

School of Natural Sciences, Edith Cowan University

Courtesy of CSIRO and the Geological Survey of Western Australia, on 11-22 September 2011, I visited a number of Aboriginal sites and geological exposures (a) between Esperance and Kalgoorlie and (b) on AngloGold Ashanti's mining tenements at Tropicana, and surrounding country, approximately 400 km northeast of Kalgoorlie.
I will describe the sites I visited, principally rock art and water sources, but also artefact scatters and quarries for raw material, discuss why they are where they are in the landscape and how the antiquity of the landscape affects how and whether the archaeological record is preserved, in Western Australia.
The country I visited is underlain either by the Late Archaean shield rocks of the Yilgarn Craton or lies on the extreme western edge of the Eucla Basin, which is filled with much younger sedimentary rocks. These differences in basement crucially affect the availability of potable water and the presence/absence of flakeable rock suitable for making artefacts. These factors constrain human usage of this part of the arid zone which will be compared with the Aboriginal
archaeological record for the Murchison Basin where potable water and raw material is much more freely available.

GRACE satellite data and late Quaternary ice loss in coastal East Antarctica: How accurate are our estimates of modern day ice loss?

Duanne White[1], David Fink[2]

[1]Institute of Applied Ecology, University of Canberra
[2]Australian Nuclear Science and Technology Organisation

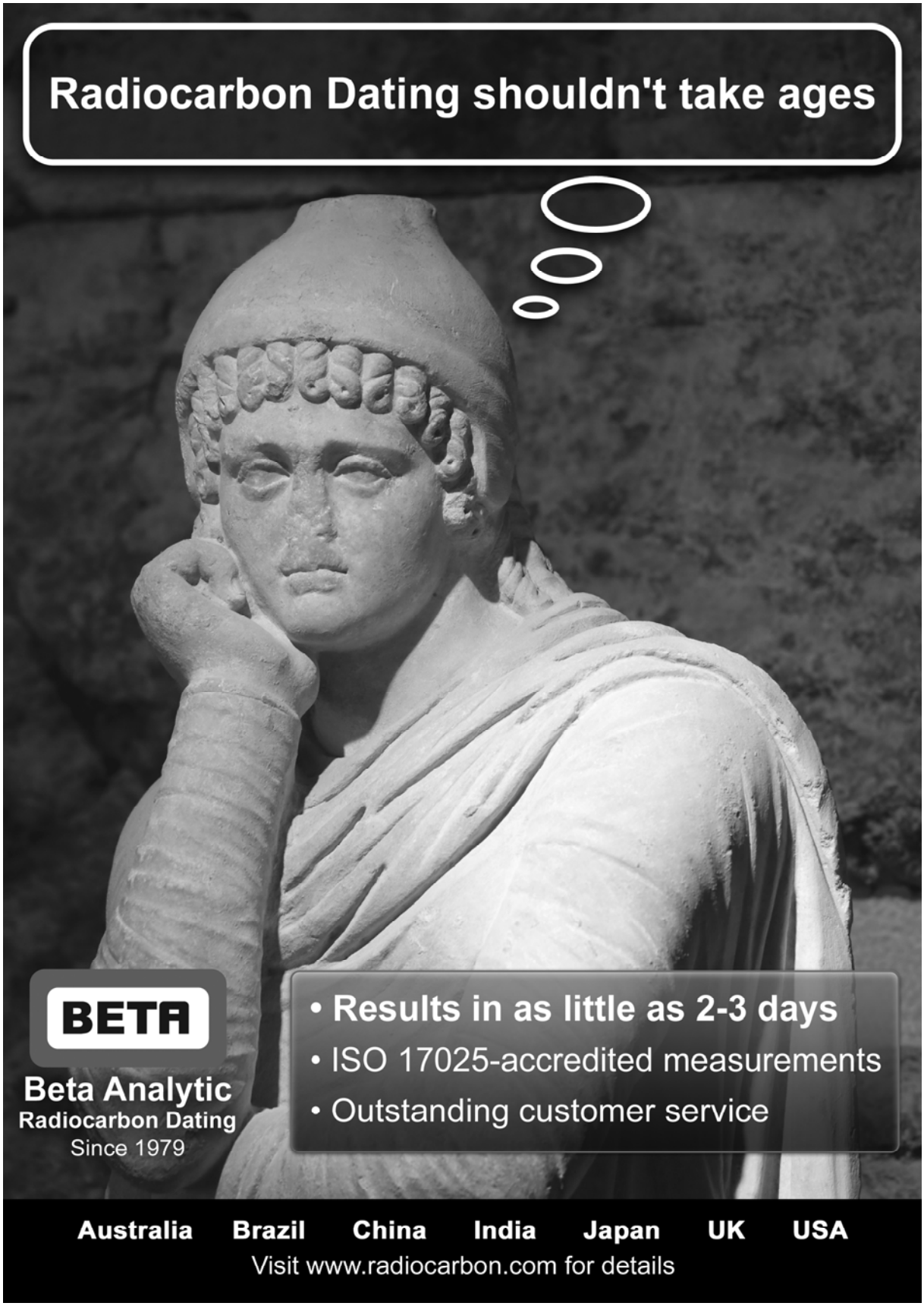
Measuring present day changes in the volume of the Antarctic ice sheet has traditionally been difficult, due to its remote nature and vast size. Over the past decade, the GRACE (Gravity Recovery and Climate Experiment) and ICEsat (Ice, Cloud and land Elevation) satellite systems have vastly improved these measurements by accurately measuring changes in the gravity exerted by the ice sheet, and the ice sheet surface height respectively. However, data sets from both these systems require various corrections related to an understanding of the rate of post-glacial rebound across the continent in order to make accurate measurements of ice loss or gain.
This presentation summarises the implications of observations of late Quaternary ice loss in East Antarctica for likely rates of Post-Glacial Rebound in this region. It includes new cosmogenic exposure data from the Enderby Land region, where GRACE observations have intermittently indicated substantial apparent mass gain. The compilation suggests that while the overall amount of late Quaternary ice loss assumed by the post-glacial rebound models is similar to that observed by field evidence, the spatial pattern is not consistent. Thus, GRACE observations that use these models appear to provide reasonably accurate estimates of total ice loss, but the spatial assessment of modern ice loss may be misleading.

Speleothem-based high-resolution reconstruction of New Zealand palaeo-temperatures during the last 2700 years

Paul W Williams[1], Sharleen Harper[2], Helen Neil[3], Jian-xin Zhao[4]

[1]University of Auckland
[2]National Institute of Water and Atmospheric Research, Auckland
[3]National Institute of Water and Atmospheric Research, Wellington
[4]University of Queensland

We present the first high resolution record of mean annual temperatures for a mid-latitude terrestrial site in the Southern Hemisphere. Data are obtained from a stalagmite that was deposited in isotopic equilibrium in a cave in western North Island. It was sampled by micromilling at 40μm intervals to determine O-C stable isotope values. The chronology is based on a combination of U-series dates and two tie points (date of sampling and date of Taupo eruption). Errors bands were determined by Monte Carlo simulation. The series extends from the present to 2700 year BP at an average resolution of 5 years. Statistical comparisons between detrended $\delta^{18}O_c$ and $\delta^{13}C_c$ values and historical temperature data from nearby meteorological sites yield high positive correlations, and because there was no significant correlation between paired O-C values both were used in a multiple correlation model to estimate past temperatures. The resulting palaeo-temperature curve permits clarification of the thermal nature of the Little Ice Age and Medieval Warm Period in New Zealand and enables comparison of mid-latitude Southern and Northern Hemisphere palaeo-temperature reconstructions. The stable isotope record also provides an insight into the duration of the effects of the Taupo eruption.


Radiocarbon Dating shouldn't take ages
BETA
Beta Analytic
Radiocarbon Dating
Since 1979
• Results in as little as 2-3 days
• ISO 17025-accredited measurements
• Outstanding customer service
Australia Brazil China India Japan UK USA
Visit www.radiocarbon.com for details