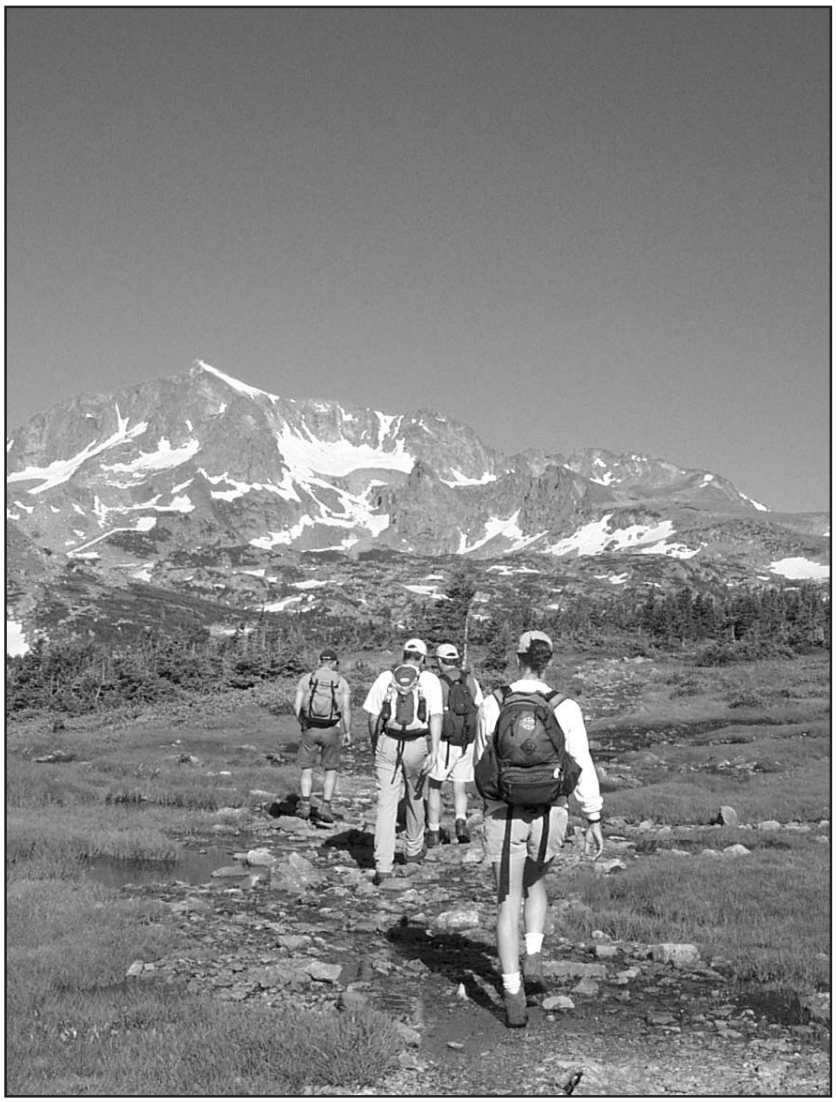
QUATERNARY AUSTRALASIA



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Cover illustration: Hike up Fourth of July Valley toward Arapaho Pass at 3629m (in distance) on the continental divide. From Brent Alloway's pre-INQUA XVI Colorado Front Range field trip report, p. 20. Photo: B.V. Alloway.

Erratum: In Mooney, S.D. and Black, M. 2003. A simple and fast method for calculating the area of macroscopic charcoal isolated from sediments. QA 21(1):18–21, all references to mm should read µm. We apologize for any confusion this may have caused.

EDITORIAL

This issue of *Quaternary Australasia* follows the XVI Congress of the International Union for Quaternary Research in Reno, Nevada, USA, in late July 2003. Two summaries of this meeting have been included here, one by John Dodson, the other by Alan Palmer and Brent Alloway, because the outlooks of the reports differ somewhat, particularly where the latter authors reflect on aspects of their INQUA experience from a New Zealand perspective.

One of the most valuable features of academic conferences lies in the opportunities they provide for meeting colleagues old and new, for matching familiar names with unfamiliar faces, and, especially for young players, in the occasions they provide for hearing presentations by distinguished scholars. In plenary sessions in particular, speakers sometimes take the opportunity to share a view of the science which might remain invisible in their peer reviewed output.

In the context of the very voluminous, and hence ultimately cloying (after three or four days, anyway) international conference diet of hundreds of detailed and rigorous pre-publication oral and poster presentations, this can be quite a relief. Perhaps I lack stamina, but for me the highlight of INQUA XVI was Sir Nick Shackleton's prefacing of his opening plenary address with a clarinet recital of Louis Cahuzac's *Pastorale Cévenole*, in memory of recently deceased colleague, Hugues Faure, head of the Laboratoire de Geologie du Quaternaire at the University of Aix-Marseille, former INQUA president, and pioneering investigator of orbital scale controls on African monsoon circulation and on the glacial/interglacial carbon cycle. Jonathon Adams captures the inspirational verve of Dr Faure in an obituary for his former supervisor (found at http://members.cox.net/quaternary/ObituaryHuguesFaure) in which he recalls 'I spent much of my PhD period living in poverty in a small converted storage cupboard in the lab, but when I complained about the lack of heating, hot water, and the absence of any cooking facilities (the Lab's kitchen area having been dismantled ready for a move), I got no sympathy at all from Hugues. He reminded me that he had lived in the Sahara Desert for months at a time, alternately roasted and frozen, with no access to running water, no bed, dodging scorpions, and surviving on only the simplest of dried foodstuffs. After that I stopped bothering to complain.' Very old school! As for a connection, however ethereal, between Shackleton's Cahuzac and the Quaternary, it came to me, suddenly, only after several months of rumination via this quote from Shackleton et al. 1995 *Palaeoceanography* 10:693–697: 'The process of converting the geological data … to (a timescale) that makes detailed correlations to the astronomically calculated sequence is known as 'tuning' (by analogy with the minor length adjustment that a clarinetist makes to his instrument to move the pitch of his a' [440 Hz] to that given by the oboe player).' In his plenary address, Sir Nick discussed the slightly troubled relationship between the Quaternary marine oxygen isotope record and its terrestrial counterpart, continental glacial stratigraphy, and, after making passing reference to a text concerned with the Quaternary stratigraphy of Great Britain which he described as 'a fascinating book to skim through. It is totally incomprehensible unless you are a Quaternary stratigrapher working in the British Isles', ultimately suggested that European Quaternary local stages be abandoned.

For my part, I was interested to learn that the anomalously odd numbered interstadial isotope stage 3 had its origins in César Emiliani's belief that he was working with regular glacial cycles which had a period of 40,000 years. It is easy to forget (at least for those who, like me, obviously haven't carefully read Emiliani) that the dominant 100,000 year period of glacial cycles was quite an unexpected discovery in the context of Milankovitch theory.

To move on: aside from the INQUA reports, this issue contains a report by Brent Alloway from an INQUA field trip along the Colorado Front Range, a report from Craig Sloss on his attendance of IGCP 437 on Quaternary coastal morphology and sea-level in Puglia, Italy, and a report by Simon Connor on the hazards of palaeoecological fieldwork in Georgia. Reports of recent research activity at two institutions, the University of Adelaide, and Victoria University of Wellington, are provided respectively by John Tibby and David Kennedy. Simon Haberle analyses this year's ARC

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PRESIDENT'S PEN

The last six months have been an eventful period for the Australasian Quaternary community. Securing the next INQUA meeting for Australia was a highlight and signals a major opportunity to showcase the work we do in Australia, New Zealand and the region to the global community. Congratulations to John Dodson who put so much effort into developing the proposal for INQUA 2007 in Cairns. A number of key INQUA executive and commission positions were also filled by AQUA members. Congratulations to Alan Chivas (Treasurer), Colin Murray-Wallace (President of Coastal and Marine Processes commission), Brad Pillans (President of Stratigraphy and Geochronology commission) and Peter Kershaw (Secretary of Palaeoclimate commission).

In October Henk Heijnis and I attended the annual Science Meets Parliament Day. This is a forum organized by the Federation of Australian Scientific and Technological Societies (FASTS, of which AQUA is a member) for working scientists to present their research and discuss with parliamentarians key issues which included; the need to build on the success of Backing Australia's Ability; the introduction of a tapered capital gains tax rate for investment in high technology companies; and adequately fund universities to support the development of science, technology and mathematics disciplines (for details see www.fasts.org/Fsite/SmP/Issuesflyerweb.doc). The announcement of the ARC results on the same day as this meeting was a stroke of genius by the organizers as the chance to demonstrate the state of research funding in Australia was put to the forefront. The article I've included below by Snow Barlow, the new President of FASTS, sums up events of that day and should be read by everyone.

Next year promises to be even more challenging with the launching of the Australasian INTIMATE program in February, PEPII meeting in July, the AQUA biennial conference being held in Tasmania at the end of 2004 and organising for INQUA 2007 to be well underway … hope everyone can manage a quiet break over Christmas!

Simon

Editorial continued on from page 3

funding results, and University of Tasmania (palaeo)botanist Greg Jordan discusses the implications of the concept of glacial plant refugia in eastern Tasmania. Finally, this issue includes an abstract of Tim Cohen's recently completed Wollongong doctoral thesis concerned with late Holocene and post-European dynamics of the Bellinger River, NSW, and peer reviewed research papers by Nunn and Omura concerning sea-level history in northeastern Fiji, and Gayler and Pearson concerning the accurate determination of organic matter in gypsum-rich sediment.

Kale Sniderman
Editor

Reckless squandering of talent hurts the knowledge economy

conScience Column published in *Australasian Science Magazine*, **November/December 2003 (see www.control.com.au)**

The Government must dramatically improve career paths for young scientists, says Snow Barlow.

Securing realistic careers for scientists after graduation is the most challenging and unaddressed issue for Australia's labour force in science, engineering and technology (SET). Currently, markets for jobs in universities and CSIRO are stagnant, forcing postdoctoral scientists into accepting a succession of 1–2 year contract.

Chronic uncertainty regarding employment is devastating for scientists at an age when their peers in other fields are settling down on comfortable salaries, getting married, having children and buying a house.

This situation was poignantly demonstrated at October's Science Meets Parliament Day in Canberra. Two senators learned first-hand about this grim reality when they graciously allowed two young postdoctoral scientists to use their computers to download the list of grants released that day by the Australian Research Council (ARC). The senators were shocked to find themselves thrust into a grief-counselling role with the two unsuccessful applicants.

Bursting into tears in a senator's office registers somewhere between a personal set back and tragedy, but it sure makes a point to those responsible for science funding. (Only about one in five applicants to the ARC was successful.) It underlines Australia's reckless squandering of talented people who collectively hold the answers to our economic and environmental future.

One of the tearful scientists is unable to enter the housing market because bank managers remain unconvinced by two-year contracts. The other is looking at a new city, a new job, and possibly a right-angle change of career — out of science.

A strong corps of creative, passionate and well-trained SET people is a key pillar of Backing Australia's Ability, the government's innovation statement in 2001. Yet, the interim report of the Government's follow-up Science Mapping task force could not hide the fact that, as other OECD nations move more strongly towards knowledge economies, the impact of Australian science is declining just when we needed a boost. We now face intense competition globally for intellectual resources in SET.

Professor Kwong Lee Dow's recent Review of Teaching and Teacher Education has highlighted a decrease in the number of students selecting a second science subject at high school, as well as an acknowledged shortage of teachers with science degrees.

While Education Minister Dr Brendan Nelson's higher education reforms attempt to redress the shortage of teachers through special incentives, they do not address the effect of higher HECS fees on science teachers who will earn exactly the same as their colleagues of similar age and experience who teach other disciplines.

The Nelson reforms also present dilemmas for university science faculties. In the past decade more expensive science courses have fared poorly in increasingly cash-strapped universities where Vice-Chancellors have often preferred the more popular and lucrative business courses. The ability to increase income by raising HECS will help to lift the quality of science education, but higher HECS debts will deter students from enrolling in science.

The Government's Federation Fellowships were launched to attract our best scientists home, but has evolved into a program seeking to stem the flow of our talent out of Australia as well. This year, the scheme did not even fill its quota of 25 Fellowships. Furthermore, some of the eight overseas scientists offered Fellowships are having reservations about accepting them (*Australasian Science Magazine*, October 2003, pp.14–16).

The nation needs a dramatic review of its education development and retention of SET personnel if it is to become competitive in the knowledge economy. This must be a key component of the next phase of Backing Australia's Ability. The provision of career paths for highly trained postdoctoral scientists, in whom the nation has invested heavily, requires urgent attention. Otherwise, they may be lost to science at great personal cost to themselves and the nation.

Professor Snow Barlow is Head of the University of Melbourne's School of Agriculture and Food Systems, and President of the Federation of Australian Scientific and Technological Societies (FASTS). conScience is a column for Australians to express forthright views on national issues. Views expressed are those of the author.

Reconciliation time: resolving the conflicts between paleaoenvironmental science and evolution

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I am faced with a quandary. Many of you will know parts of this story, but perhaps fewer have put the parts together. Although it might seem parochial, I feel that it is an exemplar of a kind of problem that is appearing in many parts of the world.

The problem is with the idea of glacial refugia in eastern Tasmania. This region is botanically diverse, and includes many species that occur nowhere else. This raises the question of what these species did during the last glacial maximum (LGM). Did they survive in isolated pockets of suitable habitat (refugia), did they recolonise from elsewhere after the LGM or have they evolved since the LGM?

Although the question applies to a very wide range of species, most of the arguments have centred on a couple of ecological standbys—*Nothofagus cunninghamii* (the dominant temperate rainforest tree in Tasmania) and eucalypts. *Nothofagus* occurs in north-eastern Tasmania, with a gap of about 60km between the north-east and the nearest suitable habitat in western Tasmania. However, *Nothofagus cunninghamii* is a rainforest tree and its distribution strongly suggests that it requires wet climates (it only occurs in areas with an average rainfall in the wettest month of more than 48mm, and in the drier parts of its range it becomes more and more restricted to wet microsites). There appears to be some interaction between rainfall and temperature (or at least altitude) as it only extends into the alpine zone in the wettest parts of its range. As a result it would, presumably, have been very stressed in north-east Tasmania during the colder and drier LGM. The story for the eucalypts is a little different. South-eastern Tasmania contains a number of species that occur nowhere else, and many of these species appear to be quite constrained by their environment, particularly climates. The distribution of these species forms a mosaic, and the patterning of this mosaic strongly reflects a combination of rainfall, aspect and soil which is essentially consistent with water being a major constraint.

This raises the question of whether these species could have survived *in situ* through the LGM. This question needs to be approached in two complementary ways — firstly to model past distributions based on present distributions and available palaeoclimatic data, and secondly to use molecular genetics. So far the best attempt at the first was by Kirkpatrick and Fowler (1998) who attempted to identify Tasmanian glacial forest refugia. However, to explain the current distribution of *Nothofagus* they had to invoke a special pattern of climate change — that eastern Tasmania was not drier during the LGM than it is now. This contradicts, of course, the impression of drier conditions (at least functionally) generally throughout southern Australia and particularly in western Tasmania. The caveat 'at least functionally' refers to the effects of decreased atmospheric carbon dioxide — the reduced CO_2 concentration of the LGM should have imposed physiological dryness on most plants. In other words, even if rainfall stayed the same, the lower atmospheric CO_2 would have made the climate effectively drier for most plants. Similarly, the survival of eucalypts in the south-east appears to have depended on smaller temperature depression and increased aridity in eastern Tasmania than is seen in the west. The habitats of most of the eucalypt species (as we understand them) would not have existed if the climate was really as dry and cold as one would expect. An earlier presentation of Kirkpatrick and Fowler's models

(Kirkpatrick and Fowler 1996) included alternative scenarios. In these models, no eucalypt forest or *Nothofagus* would have survived in south-east and north-east Tasmania respectively if rainfall was decreased 50% and temperature depression was 5°C in those regions.

Now, here's the difficulty. There isn't much solid palaeoclimatic data for eastern Tasmania, but every piece available suggests that the climate did become distinctly cold and dry during the LGM. Several lines of evidence suggest that it was drier than today. Glaciation extended to low altitudes in the west, but glaciation was very, very minor in the east, even though the eastern mountains are as high as those in the west. This implies that the east must have been either drier or warmer than the glaciated west. We can probably discount the lack of cooling alternative. The dribble of pollen evidence suggests cooling, but more importantly the marine record suggests that the cooling offshore from eastern Tasmania was equivalent to cooling elsewhere around Tasmanian (n.b. this is not all published: Will Howard pers. comm.). Periglacial activity, although poorly dated, is very widespread. Further evidence for drying of the east comes from aeolian landforms and a tiny bit of pollen data. Strengthening of the East Australia Current is the only way that I can envisage a lack of cooling and drying in eastern Tasmania during the LGM. However, the marine record also suggests that this did not happen.

Let's consider some alternative explanations of these data:

Solution 1. That the climate really was relatively wet in the east. This is possible, but seems unlikely. Given the potential error in the palaeoclimatic data, it would have been unlikely for the net effect during the eastern Tasmania LGM to have been 'functionally wet' because of universal low atmospheric CO_2. There is nowhere to hide from global changes in CO_2 concentration (barring maybe CO_2 springs).

Solution 2. That the eucalypts and *Nothofagus* did not survive in the east. This would require dispersal from refugia during the Holocene. This could have been from western Tasmania or eastern Victoria for *Nothofagus*. The situation is more complex for the eucalypts because of the larger number of species involved. Dispersal of blue gums and white gums could have been from Victoria, but the endemic species would have either gone extinct in the refugial regions or evolved during the Holocene. Large areas of inhospitable habitat separate eastern Tasmania from most potential refugia. Suitable habitat may have been more continuous during a relatively warm and devegetated early Holocene, with low sea-levels reducing the need for long distance dispersal somewhat, but regardless, this scenario would require very rapid dispersal.

However, the evidence for glacial survival of eucalypts in south-east Tasmania is truly compelling. This evidence shows there is strong geographic patterning in the chloroplast DNA ('haplotypes' in the jargon) of one of the two major groups of eucalypts in the region. The important point to note about haplotypes is that they only transfer from generation to generation by seed (i.e. by mothers not fathers). For eucalypts and *Nothofagus*, dispersal by seed is a notoriously slow process (at current rates, a few kilometres in a thousand years would be considered relatively fast). This would imply that large-scale patterns in haplotypes reflect ancient patterns. In this particular case the best estimate is Early Pleistocene. Two of the haplotypes are closely associated with the south-eastern corner of Tasmania which contains many endemic species of eucalypts, and was modelled by Kirkpatrick and Fowler as a glacial refugium. We have no evidence to date about the survival of *Nothofagus* — no LGM pollen records from eastern Tasmania and no molecular evidence.

Solution 3. That the species did survive in cryptic refugia. This idea suggests that species can survive in localised areas of favourable conditions in otherwise hostile regions. There are numerous modern examples of such microsites (e.g. palms and cycads in Palm Valley in the middle of the Australian desert). There is also some fossil evidence that such things happened in the past (see Stewart and Lister 2001). The implication is that inferences from palaeoclimatic data may be useful on a relatively coarse geographic scale, but significant exceptions can occur on a highly localised geographic scale.

This is probably the solution that would gain most widespread favour, but I believe it should not be accepted blindly. For one thing, the Kirkpatrick and Fowler model (even though it works on a very coarse resolution — a 10km grid) actually makes some allowances for microsites, since it includes all those tiny populations. Also, suitable microsites

may be very hard to find. The wet microsites of eastern Tasmania are steep valleys or south facing slopes on large hills, especially near the coast. These sites also tend to be cold ones (e.g. I have data from a modern *Nothofagus* microsite which shows that the temperature on some warm days was 12–14°C colder than the nearby standard meteorological sites). Palaeoclimate estimates therefore suggest that these sites would mostly have been too cold for *Nothofagus* and eucalypts during the LGM. Warmer, topographically moist microsites near sea-level and the moderating effects of the ocean are likely to have been very rare because most of the coast was coastal plain.

Solution 4. That the species have changed (evolved) since the LGM. For the eucalypts, I would suggest that evolution of sorts is quite plausible. The haplotype data mentioned above implies that some eucalypts survived in south-eastern Tasmania, but does not guarantee that these were the modern species. A useful way to think of haplotypes is that they are not part of the genome of the plant species, but are in fact the genome of a species that always lives within the plant species (this is a widely accepted view of the origin of chloroplasts). So haplotypes evolve independently of the main (nuclear) genome of plants, apart from the constraints caused by always living together. In the eucalypts, several species often share several haplotypes, but bizarre as this sounds, the haplotypes show geographic patterning independent of the species (where species A occurs in south-east Tasmania, it possesses haplotype 1, but in Victoria it possesses haplotype 2; species B and C share this pattern, possessing haplotype 1 in south-east Tasmanian populations, but haplotype 2 in Victorian populations). This suggests that the haplotype distributions pre-date the patterns in the modern species. The most convincing explanation for this pattern is confusing to many (and anathema to some, since it questions the sacrosanct status of species), and this essay is too short to discuss the details, so I will give a very simplistic version. It is called introgressive hybridisation, and can be explained as the invasion of one species by another by repeated pollination of the *in situ* species with pollen from invasive species. This can happen until all trace of the original is lost (except the haplotype). In this context all that is necessary to explain the haplotype patterns is for any suitable species to have survived, then to be overrun genetically by other species. When did this invasion happen? This is not clear, but the Early Holocene seems to be as good a time as any (with Bass Strait exposed as dry land and climates seemingly warmer and possibly wetter than now).

This kind of evolution is at least a possibility for *Nothofagus cunninghamii*, although as yet there is no genetic evidence to back this up. This species is wind pollinated, so there is always the chance of pollen from other areas blowing into the north-east, fertilising the *Nothofagus* there and therefore bringing a whole new suite of genes into the populations. Under strongly changing selective regimes (e.g. the change from glacial to Early Holocene conditions) this kind of introduction of new genes could allow the replacement of glacial adapted forms by Holocene adapted forms.

Solution 5. That the current distributions of species are poor indicators of past climatic ranges of species — something that is a little unpalatable to palaeoclimatologists dependent on fossil pollen data. Of course Solution 4 implies something like Solution 5, but there are also several alternative mechanisms here. One is that realised niche of plants is not the same as its fundamental niche (i.e. that species are eliminated from some parts of their theoretical range by competition with other species). This is certainly sound in theory — competition does certainly restrict the ranges of species, but perhaps its importance in the context of past distribution can be easily exaggerated. To make past climatic ranges different to present ones, it is necessary for the competition in the past to be substantially different. I think that competition was always there — species would always have been present to create the gap between fundamental and realised niches. A second alternative is non-equilibrium distributions. This is where species have not realised their potential ranges for historical reasons — e.g. they have not fully expanded out of glacial refugia. This is an interesting concept, but can be difficult to test.

Overall, reconciling this problem raise challenges to many scientists. Firstly it shows that eastern Tasmania is a key area for research. It begs palaeoclimatologists to seek physical evidence for LGM palaeoclimates in eastern Tasmania. To palynologists it emphasises the (ever-present) problem of developing techniques to cope with the altered niche problem. From ecological modellers, we need models of past and present species distributions that cope with microsites and

include areas that are now submerged. For geneticists, the problem is coming to terms with palaeo-environments, and taking this evidence seriously. Finally, it begs everyone to think about their problems in the broadest context, rather than diving ostrich-like for the sand ('someone else's problem'), or resorting to hubris ('I know my data — they must be wrong').

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Trends in the ARC? 2002–2004

Simon Haberle (AQUA President)

This is the third year of monitoring the success of the Quaternary in the ARC granting process. While obtaining information on the successful grants is relatively straightforward it remains a problematic task to obtain information on all the unsuccessful grant applications (only five people on six unsuccessful grants supplied their information this year which must grossly overestimate the success rate). Its completely understandable that people are reluctant or are simply so unenthused after receiving bad news, to send in this information given the effort that goes into producing a competitive application. The result, however, is that producing any useful statistics on the relative success of total applications submitted is not possible. That being said I've compiled a rough guide to the success of ARC Discovery Grant applications related to the Quaternary over the last three years (Figure 1). This includes archaeology and I focus on this discipline in the second graph. A list of the successful Discovery and Linkage ARC projects for 2004 is also included below.

A number of points are worth making in this data:

- There is a clear commitment to fund Quaternary-related projects from the ARC. Over the last three years there have been 10 to 20 grants awarded per year making up a steady ~2% of the total applications funded by ARC each year.
- $5.18 million was allocated to Quaternary-related Discovery Grants in this year's budget of $198.1 million (= 2.6% of total ARC budget). The average allocation over the last three years is around 2.4% of the total budget, which suggests that Quaternary-related projects receive above average funding given the ~2% success rate.

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- Areas of most interest appear to be associated with aspects of palaeoclimatology and archaeology, particularly those with field areas overseas (only seven of the 16 successful grants this year are based on fieldwork in Australia).
- Grants funding archaeological research are dominated by projects based outside Australia (Mediterranean and Eurasian archaeology), with very few Australian-based projects being funded (only one of the eight grants related to archaeology are based in Australia this year) and those that are funded receive proportionately less than the overseas field-based projects.

The ARC process remains a problematic venture and the outcomes can be devastating for younger researchers' careers (see Snow Barlow's comments under 'President's Pen'). Despite this there is a relatively high level of support being maintained for Quaternary-based projects. The apparent lack of support for projects dealing with Australian field-based research projects remains perplexing in the light of the explicit emphasis on National Priorities in the application process. On such grounds, the assumption that Australian field-based projects will be more likely to succeed appears false. This is particularly evident in the archaeological projects where the 'classics' appear to be doing so much better than their poorer Australian archaeology colleagues. Whether this relates to relative quality/ enthusiasm of researchers, the criticality of assessors, the notion that 'bigger is better', or the relative difficulty of 'sexing up' Australian archaeology may well begin to play on the minds of archaeologists, as perhaps it should for all Quaternarists, working in Australia.

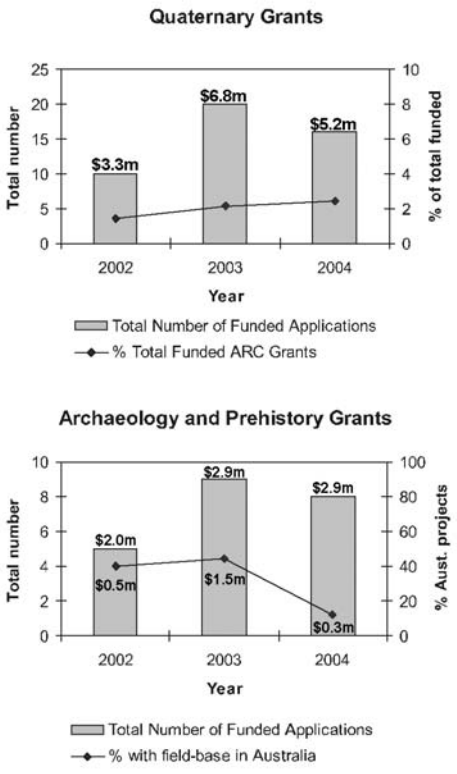


Figure 1. Quaternary-related ARC Discovery Grants 2002–2004. The top graphs shows total number of Quaternary-related grants funded, the % this represents of total grants allocated in that year, and the funding in million dollars allocated to Quaternary-related projects. The lower graph focuses on Archaeology and Prehistory grants and shows the total number of grants funded, the % of these grants with field-bases in Australia, and the comparitive funding in million dollars allocated to the total Archaeology and Prehistory grants and those with field-bases in Australia. Data from the ARC annual reports 2002-2004 (http://www.arc.gov.au/funded_grants/selection.htm).

Successful ARC grants for 2004

Discovery Grants

Macquarie University, Dr S.P. Turner, Prof C.J. Hawkesworth, A/Prof M. Reagan, Dr J.W. Kirchner

The time scales of magmatic and erosional cycles

Precise information on time scales and rates of change is fundamental to understanding natural processes and the development and testing of quantitative physical models in the Earth Sciences. Uranium decay-series isotope studies are revolutionising this field by providing time information in the range 100–100,000 years, similar to that of many important Earth processes. This project will establish a dedicated Uranium-series research laboratory and investigate (1) the processes and time scales of magma formation, transport and differentiation beneath western Pacific island arc volcanoes, (2) the time scales and relative roles of physical and chemical erosion in Australian river basins. Total support = $270,000 over 3 years.

Southern Cross University, Dr R.T. Bush

Contemporary sulfur biomineralisation in acid sulfate soil landscapes

This project aims to generate fundamental knowledge on the processes, kinetics and impacts to water quality of contemporary sulfur biomineralisation in acid sulfate soil landscapes. Extreme concentrations of highly reactive sulfides are forming in the surface sediments of floodplain drains, wetlands and agricultural soils. The newly forming sulfides are linked to severe oxygen depletion and acidification of coastal rivers and the complete failure of floodplain vegetation, leaving soils susceptible to erosion. The proposed study will greatly advance our understanding of how our precious coastal floodplain soil and water resources are being degraded, and will guide better land management. Total support = $225,000 over 3 years.

The University of Sydney, Dr C.A. Petrie (APD)

Key of Anshan, Bolt of Elam: cultural evolution and state formation in the Fahliyan Plain (Fars, Iran), 4000 BC–500 AD

This project will excavate cultural material from the site of Tul-e Spid in the area of Fahliyan in southwest Iran and has been proposed as the location of Huhnuri, the Key of Anshan and the Bolt of Elam. Little is known about Fahliyan, yet it lies on the route between the two ancient capitals of the region. Excavation and analysis of material from Tul-e Spid will provide insight into the evolution of states and empires that developed in southwestern Iran, and the first indication of the changes that occurred in regional areas during their formation. Total support = $382,000 over 4 years.

The University of Sydney, Dr R. Torrence, Dr T.E. Doelman (APD), Mrs N.A. Kononenko

Reconstructing prehistoric exchange of volcanic glasses in Far East Russia

This project examines competing theories to explain the causes for volcanic glass movement up to 700 kilometres from its source, in Far East Russia 18,000 years ago. As the earliest evidence in the world for long distance overland movement of materials, this case represents a significant innovation within human evolution. The project combines studies of production and consumption to test competing theories to explain why and how volcanic glass was transported. Analyses of geological outcrops, quarries/workshops, and locations of artifact use and discard over a large region enable a comprehensive reconstruction of changing patterns of behaviour between 18,000–2500 bp. Total support = $230,000 over 3 years.

University of Wollongong,

Dr C.S. Turney (QEII)

Radiocarbon dating frontiers: testing hypotheses of human evolution and environmental change in Australasia and Southeast Asia (60,000–25,000 years ago)

Radiocarbon (^{14}C) dating has revolutionised our understanding of archaeological events and past environments. However, much of the period

60,000–25,0000 years ago is beyond the traditional limit of the method (40,000 years). This is unfortunate as this period is characterised by rapid, extreme shifts in climate during which the global spread of modern humans took place. This project will utilise the latest developments in ^{14}C dating (allowing ages up to 60,000 years ago) to test hypotheses concerning the timing of human arrival and settlement in Southeast Asia and Australasia, their environmental impact, and the synchroneity of climate change between the hemispheres. Total support = $710,000 over 5 years.

La Trobe University, Dr L. Liu, Prof X. Chen, Dr Y. Lee, Prof H.T. Wright, Dr A.M. Rosen

Settlement patterns, craft production, and the rise of early states in China

This project is an international, multidisciplinary archaeological program focused on monitoring the processes which led to the rise of early states in China, through extensive study of settlement patterns in the Yiluo valley, using regional surveys and geoarchaeological investigations. It will make significant contributions in four aspects: evaluation and reformulation of general theoretical and methodological approaches to the interdisciplinary study of social complexity; enhanced understanding of Chinese cultural history in the light of anthropological theory; articulation of empirical approaches to the study of Chinese civilisation through archaeology; and strengthened collaborative research between archaeologists in Australia and other parts of the world. Total support = $570,400 over 5 years.

The University of Melbourne,
Dr H.M. Jackson (APD)

House to house enquiries in the Hellenistic Near East

Housing is primary, vivid evidence of domestic life. Its key role in interpreting the social fabric of human settlement is a current international debate. This will be the first study of households in the Near East in the Seleucid period, when Macedonians settled the Levant. Did Greek culture interact with eastern traditions? Only archaeological evidence survives. The project takes a unique, newly-excavated site in Syria as a starting point for a wider investigation of Hellenistic houses in the Near East, using the cross-disciplinary evidence of architecture, ceramics, domestic cult, zooarchaeology, palaeobotany and nuclear analysis of clays to interpret living space. Total support = $212,000 over 4 years.

James Cook University, Dr R.A. Wust, Prof A.P. Kershaw, A/Prof W.T. Anderson

Drought, El Niño and climate change in Queensland over the last 200,000 years: the Lynch's Crater lake record

Lynch's Crater (Queensland) provides the longest, most sensitive terrestrial record of vegetation and climate change in the low altitude tropics. A multidisciplinary approach will exploit the potential of a core collected in 2003 through high-resolution multiproxy (sedimentology, geochemistry, stable and radiogenic isotopes, pollen, charcoal and diatoms) studies. The results will contribute substantially to the resolution of current debates on the role of the tropics in global climate forcing at a variety of temporal scales, including that of the El Niño phenomenon. The reconstruction of temperature and precipitation over the past 200,000 years will improve global climate databases and prediction models. Total support = $245,000 over 3 years.

The University of Queensland, Dr J. Zhao, Prof K.D. Collerson

Chemical and isotopic fingerprinting of ancient porcelains and pottery

This project aims to establish provenance of ancient porcelains and pottery of archaeological or antique collection significance using trace element and lead-strontium-neodymium (Pb-Sr-Nd) isotopic compositions, which serve as fingerprints of porcelains and pottery of different places or ages. High quality multi-element and isotopic data will be obtained using facilities at ACQUIRE's state-of-the-arts geochemistry laboratory. The results will have significant implications for investigation of ancient cultures, technology and trades, artefact authentication and even forensic studies. Established database is potentially patentable for commercialization in the antiquity market. Total support = $140,000 over 3 years.

The Flinders University of South Australia,
Dr C.E. Smith, Dr J.M. Balme, Dr H.D. Burke

Shared and separate histories: landscapes of memory in the Barunga Region, Australia

This research integrates archaeological, documentary and oral evidence to investigate the dynamic relationships between Indigenous people and place over time in the Barunga region, Australia. By mapping the active construction of social

landscapes by different groups in the same place, this project illuminates the webs of attachment between people, place and identity during periods of upheaval and change. It records Indigenous histories being lost on a regular basis, contributes to national reconciliation through enhancing understandings of shared histories and advances international debates about the nature of social significance and how best to assess this for Indigenous places. Total support = $319,000 over 3 years.

The Australian National University,
Dr M.C. Ball
Global change in the sub-antarctic — temperature response of vascular plant species from Macquarie and Heard Islands
The aim is to understand how subantarctic and alpine plant species that have evolved, respectively, in equable and highly variable temperature regimes will respond to increase in temperature resulting from global warming and climate change. The proposed project will identify species that are likely to benefit from, or are vulnerable to, rising temperatures. Processes underlying adaptation and acclimation of plant growth to increasing temperature will also be identified. These results will be significant for conservation of biodiversity and management of Australia's unique subantarctic and alpine flora. Total support = $240,000 over 3 years.

The Australian National University,
Dr P. De Deckker, Dr S.M. Eggins
Uncoupling past salinity and temperature signals in the Indo-Pacific Warm Pool: implications for climate change in the Australian region
The tropical oceans and in particular the Indo-Pacific Warm Pool, immediately to Australia's north, play a key role in modulating global and Australian climate through El Niño and related phenomena. Using a new microanalysis approach to analyse individual foraminifera from deep-sea cores, we will reconstruct past salinity and temperature variability within the Warm Pool, and determine changing rainfall patterns and, ENSO and monsoon behaviour under climate conditions that lie outside modern records. This information is vital for understanding past climate and predicting the future intensity and frequency of El Niño related drought and wet cycles in Australia. Total support = $280,000 over 3 years.

The Australian National University,
Dr S.G. Haberle, Prof A.J. Anderson, Prof H. Heijnis
Stepping-stones or barrier: The movement and impact of people throughout the Far Eastern Pacific
The vast ocean of the far eastern Pacific divides two great migratory peoples, the Amerindians and Polynesians. Whether or not members of either group overcame this barrier remains one of the greatest uncertainties in Pacific prehistory. We focus on the remote islands of the far eastern Pacific Ocean and combine fine-resolution archaeology, palaeoecology, and dating techniques to determine the antiquity and nature of occupation on these islands. Their role as stepping-stones for human migration and material exchange will be determined and the notion of these islands as pristine and unspoilt at the time of European discovery will be challenged. Total support = $312,000 over 4 years.

The Australian National University,
Dr P. Hiscock
A reappraisal of Western European Mousterian tools from Australian perspectives
Intense debates in human evolution surround Neanderthals in France, where archaeological deposits provide abundant evidence of their lives. Were Neanderthals complex cultural beings comparable to our ancestors or did they possess less complex cultures? This question has often been addressed through analysis of Neanderthal, or Mousterian, stone tools. Previous studies follow a tradition of dividing tools into types such as scrapers or points. This study employs non-type-based Australian perspectives, incorporating new analytical techniques, to re-describe Mousterian tools, review what they tell us of Neanderthal capabilities, and evaluate conventional type-based systems of analysis. Significant new information about hominid evolution will result. Total support = $320,500 over 3 years.

The Australian National University,
Prof K. Lambeck
Growth and decay of ice sheets during glacial cycles: the example of Europe
The proposal is to develop a comprehensive model for the growth and decay of the ice sheets of Europe during the last glacial cycle, using a combination of diverse field evidence with geophysical modelling. The outcomes provide

boundary conditions for climate models (times of inception and decay, ice limits, ice thickness) including processes driving climate as well as constraints on the Earth's mantle viscosity. Thus the project contributes to the quantitative characterisation of both climate change and planetary structure. In an Australian context, these outcomes form important elements in the development of predictive models for sea-level change. Total support = $290,000 over 3 years.

The Australian National University,
Dr G.R. Summerhayes, Prof G. Hope,
Dr S.L. O'Connor
The archaeology of northern New Guinea, a cultural corridor between Asia, Island Melanesia and the Pacific
The project seeks to define the chronology, and clarify the dynamics of prehistoric human colonisation, settlement, subsistence and exchange in northern New Guinea. Integrated archaeological and palaeoenvironmental sequences will show settlement, environmental change and development of agriculture across 40,000 years. The significance is in understanding a key area in the settlement of greater Australia and the Pacific. Total support = $435,000 over 3 years.

Linkage Grants

The Australian National University and the National Museum of Australia,
Prof P.S. Bellwood, Ms J.A. Cameron (APDI)
Bronze Age textiles from Dong Son coffins in Vietnam
This multi-disciplinary project breaks new ground in Southeast Asian archaeology by incorporating excavation with the conservation and analysis of a unique assemblage of prehistoric textiles already located in Dong Son coffins in the Red River delta. In recognition of the cultural significance of the archaeological materials to Vietnam, conservators are involved in the excavation process to reduce physical damage and the loss of fragile materials during recovery. The research will also contribute to Southeast Asian (and Vietnamese) archaeology by providing some new insights into the cultural interaction between South China and Vietnam during the late prehistoric period. Total support = $199,300 over 3 years.

Macquarie University and the Australian Museum, Dr L.A. Hughes, Dr G. Cassis
Predicting climate change impacts on the biodiversity of Lord Howe Island: an approach using experimental and historical data
Climate change will have profound impacts on biodiversity. We will investigate both recent and future impacts of climate change on invertebrate and plant assemblages on Lord Howe Island, an important World Heritage Area. We will 1. compare current assemblages with a unique set of historical databases spanning the past 150 years, to investigate whether recent warming has affected community composition and 2. experimentally assess impacts of increasing temperature and CO_2 on Lord Howe's unique flora and fauna. Our assessment of species vulnerability to climate change threats will be used to inform future conservation policy and species management on Lord Howe. Total support = $120,000 over 3 years.

Infrastructure Grants

University of Wollongong and James Cook University, Dr R.G. Roberts, Dr C.V. Murray-Wallace, Prof A.R. Chivas, Dr P.J. Hearty, Dr J.F. Nott
Luminescence stimulation and detection facility for dating of Quaternary geological and archaeological sediments
Reliable ages are required in the Earth and archaeological sciences. Luminescence dating is a flexible geochronological technique for diverse deposits. It exploits the radiation-induced thermally (TL) and optically stimulated luminescence (OSL) emissions from minerals exposed to sunlight before burial. Recent technical developments have made feasible OSL dating of small samples (e.g., individual sand grains) and sediments deposited during the past 0.5–1 million years. We request funds for a Risø TL/OSL system with single-grain attachment to resolve the timing of sea-level, climate and landscape changes, and the chronology of human evolution and dispersal, in Australia and Southeast Asia. Total support = $110,000 over 1 year.

Report on XVI International INQUA Congress, Reno, USA, July 2003

John Dodson
Department of Geography, University of Western Australia

Another INQUA has come and gone, and this one had lots of pluses, especially for Australia. The main news of interest to Australians is that the 2007 Congress has been awarded to Australia. The meeting will be held in Cairns in late July 2007. We were up against pretty stiff opposition from Tokyo and Edinburgh but its nice we came through with a bid that had great scientific benefit and I think better organization. The decision for Cairns seemed pretty popular amongst many delegates, and the help of our New Zealand colleagues was of great assistance. Other 'wins' for Australia include the continuation of Allan Chivas as Treasurer, and the election of Colin Murray-Wallace and Brad Pillans as leaders of new Commissions. It was at this INQUA that the old cumbersome structure of too many commissions was broken, and five new Commissions were created to better serve across all areas of Quaternary research.

The meeting itself had a great program. About 1000 scientists were said to be present, although to my eyes it looked somewhat less than that (since the venue was a huge Hilton Hotel, essentially a gambling palace, perhaps a lot of attendees were busy at the gaming tables, but again this did not appear to be so). Certainly the 20+ Australians present were noticeable. All the main themes of Quaternary research one normally sees at INQUAs were represented, and the run of parallel sessions did not seem to present too many difficulties of clashing themes. Most of the mornings were taken up with talks while afternoons were devoted to poster sessions and plenary talks. Some of the 'big names' gave the plenary talks and these were generally well received, and dealt with some of the new areas such as the role of DNA in biogeography and archaeology. Feedback from trip participants was very warm. The organization of the program was a credit to the Reno and US INQUA team.

The Congress dinner was held at 'The Ponderosa', many sherriff's badges and hats ala Hoss with in evidence. It was a great venue and I am sure the meal of beans and fried chicken were felt in the buses on the way back to Reno. The Aussies and Kiwis teamed up and orders of 20 margaritas at a time were no hassle to the bartenders at the ranch. The noise was so great that the newly elected President (John Clague) joined the crew. It was a pretty happy night especially since we knew we had won the right to host the next INQUA.

It is probably a bit rich to look for negatives about the meeting which was so good in many ways, but if there was one, it was the hotel. It was rated as fairly expensive, both for accommodation and food, and since it was isolated from town (on foot anyway) most people felt trapped inside. One could go for days without stepping outside and with an absence of clocks in the building day and night seemed to merge. The program-free Sunday seemed to be the first opportunity to get outside, and it was eagerly taken by most to escape to the outside world.

The International Council meetings were efficiently run and were rich in the usual political intrigue for which INQUA is famous. There was much jostling for the President and Vice-president positions. The real working positions of Secretary and Treasurer were not contested. Sylvi Haldorsen had done a fine job over the last 8 years as Secretary General and her act will be a hard one to follow. Peter Coxon from Dublin steps into this role. Allan Chivas had done a great job as Treasurer and his presentation was superb. He was able to fend off the tricky questions and the independent auditors praised his efforts. Main items of discussion in order of consideration by the International Council were as follows:

1. Membership

The following national and regional committees were added to the INQUA family: Belarus, Croatia, India, South America, Ukraine and Yugoslavia. Belgium's application for renewed membership was also approved and an application from Egypt was also approved pending ratification by the International Council. This was later granted.

2. Reports of activities of Commissions in the inter-Congress period

Most Commissions were commended for their activities over the last four years. Exceptions noted were Neotectonics and Economic Deposits, where very little evidence of activity was received by Executive Council.

3. Proposals for new scientific Commissions for 2003–2007

In the Berlin INQUA it was foreshadowed that the commission structure was to be modified. Nothing happens too fast in the INQUA structure so it was finally sorted out at Reno, eight years after the initial proposal. As a result the eleven existing Commissions have been discontinued and replaced by five new ones. It is believed that these are broader and better reflect the full range of INQUA activities. The new Commissions and their leaders are: Commission on Coastal and Marine Processes (leader Colin Murray-Wallace, Australia); Commission on Palaeoclimate (leader John Lowe, UK); Commission on Palaeoecology and Human Evolution (leader Gary Haynes, USA); Commission on Stratigraphy and Chronology (leader Brad Pillans, Australia); Commission on Terrestrial processes (leader Jim Tellar, Canada). Each commission will evolve an appropriate sub-structure and has between 10 and 30 full members. Australians are represented as members of all Commissions. The aim of the groups will be to stimulate activity and to be open to support bottom-up suggestions for proposals for activity. With a smaller number of Commissions INQUA feels it can provide a better seeding finance system for activities.

4. ICSU Membership

This is an ongoing process. Several countries have difficulty raising their INQUA subscriptions because INQUA is not recognized by ICSU. The main stumbling block appears to be that the IUGS, so far, does not support the Quaternary being recognized separately from other geological periods. This may change in the next few years.

5. INQUA archives

The International Council agreed to accept an offer from the Royal Geographical Society (London) to house the INQUA archives.

6. Honorary Members of INQUA

Six new Honorary Members of INQUA were approved. These were: Jim Bowler (Australia), Bjorn Berglund (Sweden), Guoyu Ding (China), Minoru Itihara (Japan), Vladimir Sibrava (Czech Republic) and Arata Sugimura (Japan). These memberships acknowledge outstanding contributions to Quaternary research and to the service of INQUA. It is most satisfying to see Jim Bowler's contributions acknowledged internationally.

7. Election of INQUA Executive for 2003–2007

The following were elected: President: John Clague (Canada); Secretary: Peter Coxon (Ireland); Treasurer: Allan Chivas (Australia); Vice-Presidents: An Zhisheng (China), Margaret Avery (South Africa), Jan Pietrowski (Denmark) and Denis-Didier Rosseau (France). Nicholas Shackleton (UK) remains a member of the Executive as Past President.

8. Reports

Secretary and Treasurer reports were presented and accepted. Many of the points raised in the reports are discussed elsewhere in this summary. The main additional item worth mentioning is the agreed changes in membership categories and subscription rates. It was agreed that Associate Members (who have no voting rights) will have free membership from 2004–2007. A new category of 1A was introduced, with an annual fee of 330 Swiss Francs and was introduced for member countries that have a per capita GNP of less than about US$1000. For this they will have voting rights. All other categories will remain the same and subscription rates will increase by 5%, as was the practice in recent inter-Congress periods. Australia is in category 3, and the new annual subscription from 2004 will be 3616 Swiss Francs.

9. Next INQUA Congress

Cairns was selected as the venue for 2007. This is the first time Australia has been invited to host an INQUA and the first time that INQUA has been held in the Tropics. The theme of the Congress will be 'Heat Engines of the Quaternary'.

10. Future of *Quaternary Perspectives*

It was agreed this would continue and the International Council accepted the offer of DEUQUA, the German-Austrian-Swiss Quaternary Association to look after preparing electronic and paper versions. The electronic versions are likely to be available through the DEUQUA and INQUA web pages.

John Dodson, Perth, August 2003.

Reno, Nevada, July 23–30, 2003

New Zealand perspectives of the XVI INQUA Congress

Alan Palmer

Soil & Earth Sciences, Massey University, Palmerston North, New Zealand (a.s.palmer@massey.ac.nz)

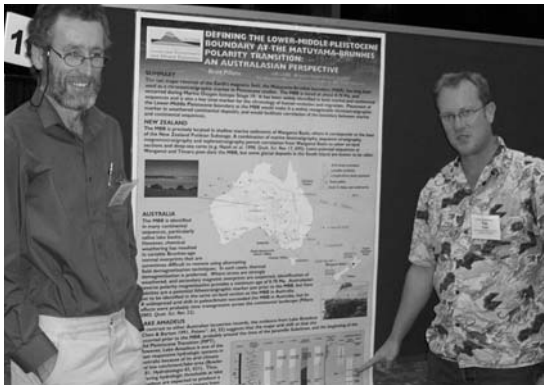
Brent Alloway

Institute of Geological & Nuclear Sciences (GNS), Wairakei Research Centre, Taupo, New Zealand (b.alloway@gns.cri.nz)

The XVI INQUA Congress was held in Reno, Nevada from 23–30 July at the Hilton Hotel. Alan Palmer was the official New Zealand INQUA representative and in that capacity attended the International Council business meetings. To attend the Congress, Alan received some financial support from the Royal Society of New Zealand, which he gratefully acknowledges. The Congress, convened every four years, was hosted by the Desert Research Institute also located in Reno. The organisers took a considerable financial risk in underwriting the Congress, given the potential for terrorist activities to adversely affect registrations.

The Conference venue, the Hilton Hotel is located on the fringe of Reno and is a self-contained city of 20 floors of rooms, six restaurants, and a sizeable, glittering, all-in-the-best-possible-taste casino — that essentially sustains the whole facility. The spacious conference facilities consisted of two main auditoriums (one of which was used for poster sessions), and at least 20 smaller rooms seating capable of between from 30 and 200 people. The main plenary venue could have seated 1500–2000 people. Security people checked that registrants wore their identity badges at all times (and that the Kiwis playing chair-dodgems in the bar after the conference dinner didn't get out of control). The conference facilities were very good, but the casino provided a surreal atmosphere. Registrants were encouraged to stay at the Hilton for $US82 per night, and a search on the INQUA web site did not reveal many alternatives. In reality there was plenty of cheaper accommodation available within a 30 minute walk of the Congress venue that was not listed prominently on either the INQUA or Reno web sites.

The attendance figure was 1100, approximately 350 more than at Durban in 1999. 1185 abstracts were evenly distributed between oral and poster presentations. Large poster boards, approx. measuring 2.5m × 1m, provided ample space on which to display posters, the majority of which contained more information than the 20-minute oral presentations (see photo). Too many speakers used their full 20 minutes allowing no time for questions. Delegates came from 56 countries, and 56% were from outside the USA. One significant issue was that up to thirty scientists failed to be granted US visas and were consequently excluded from entry into the US. Eleven New Zealand scientists were present although not all are employed in New Zealand. New Zealand participants included: Brent Alloway (GNS-Wairakei), Warren Dickinson (Victoria), Richard Holdaway (paleoecology consultant, Christchurch), Rob Langridge (GNS-Gracefield), Nicola Litchfield (GNS-Gracefield), Vern Manville (GNS-Wairakei), Tim Naish (GNS-Gracefield), Rewi Newnham (based in Plymouth, UK), Alan Palmer (Massey), Jamie Shulmeister (Canterbury) and Marcus Vangergoes (based in Maine, US).



Couple of ANZAC's in action during Session 95 — Quaternary Divisions and the Boundary between the Tertiary and Quaternary. Brad Pillans, ANU (left) and Tim Naish, GNS (right). Photo: B.V. Alloway

The standard of talks and posters was very high. The science therein also appeared to be of high quality. It is clear that most Quaternary scientists overseas are much better funded than us in New Zealand. A large array of expensive scientific

equipment, not available in New Zealand, is being applied to Quaternary problems. It is clear that a mechanism similar to the old University Grants Committee system of administering research capital expenditure funds to allow for the purchase of centralised modern equipment. Money for dating sediments and events, for example using ^{14}C, OSL and isotopic techniques is also more readily obtained by scientists overseas.

Another key issue is that the types of studies being undertaken at present, would in many cases, not be funded in New Zealand by either FRST or Marsden funds. It is amazing how many teams of overseas scientists are now working in New Zealand. Some of these projects involve collaboration with New Zealand scientists.

New INQUA Commissions

The Executive had expressed disquiet with the structure of INQUA Commissions for several years. While some Commissions worked very well, and were run democratically, there was a feeling that others were little more than personal fiefdoms. There was also concern for Quaternary scientists whose interests lay outside the commission structure. The Executive proposed five new Commissions, concerned with: Coastal and Marine Processes; Palaeoclimate, Palaeoecology and Human Evolution; Stratigraphy and Chronology; and Terrestrial Deposits, Processes and History [for a list of the presidents of these new commissions, see John Dodson's INQUA report].

The Commissions were chosen by the Executive to be all encompassing and for all Quaternary scientists to be able to find a home in one of them. They chose new Presidents to head them. Some Council delegates were outraged by the arbitrary nature of the new omissions and the way the Executive chose the Presidents (all white English speaking). However the Commissions were approved on vote provided elections were held for the Executive of each. It was envisioned that each Commission would have a President, up to three Vice-Presidents, a Secretary, 10–12 full Commission members and any number of corresponding members.

The nominees were elected, except that Margaret Avery stood down having been elected as a Vice President of the Executive. Her replacement as President of the Paleoecology Commission is Gary Haynes of USA. Several European delegates expressed disquiet at the heavily male, western, English speaking bias of these Office holders.

Each Commission duly elected 2–4 Vice Presidents, a Secretary and a Treasurer, as well as approximately 10 other full Commission members.

There was considerable consultation between the NZ INQUA rep. and NZ delegates to ensure that kiwis were nominated for positions in all of the new Commissions.

ICSU Membership

Full membership of ICSU is a major and pressing objective for INQUA. At present INQUA is an associate member. As we have seen here in New Zealand, there are implications for the ability and willingness of Science Academies and the like to pay membership fees. Belgium did stop paying for two Congress periods (8 years) but have now applied to re-join. The Executive began working in earnest eight years ago to gain full membership. The main objection appears to come from IUGS, which sees the Quaternary and INQUA as coming under their auspices. Their stated fear is that other 'interest groups' such as those working on the Neogene or Permian for example may also then wish to gain their own membership. The difference is that INQUA is very broad, involving a number of other disciplines besides geologists. Delegates were urged to lobby their own IUGS committee to gain acceptance for INQUA. ICSU have invited INQUA to reapply for full membership.

The 2007 INQUA Congress

Three countries offered to host the next Congress in 2007. They were: Cairns, Australia; Tokyo, Japan; and Edinburgh, Scotland. Delegates from each country lobbied strongly throughout the conference for the International Council votes. Japan lobbied, pointing out that they are the only membership category six (the highest category), yet to host a Congress. They might have lost a few potential votes by suggesting Tokyo would be cheap. Edinburgh appealed to the European vote pointing out that their travel costs would be lower. Australia offered a tropical theme focusing on rainforests and the Great Barrier Reef. Lobbying in some quarters was very intense.

Following from proposal presentations and votes from member country representatives as well as

INQUA executive — it was announced that the next (XVII) Conference would be held in Australia at the Cairns Conference Centre July 29th to August 6th, 2007. New Zealand participants at INQUA unanimously supported Australia's bid.

Australia has never hosted an INQUA meeting and indeed INQUA has only been held in the Southern Hemisphere on two occasions in the past (New Zealand in 1973 and South Africa in 1999). Australia is ideally suited as a venue since it has a diversity of world-class Quaternary research sites across its tropical, temperate, arid and alpine zones. Within these zones there is a rich biological and landscape diversity, and an impressive archaeological heritage that will be of interest to the international Quaternary community.

The main focus of the 2007 XVII INQUA Congress will be on 'Heat engines and teleconnections' with other parts of the world's environmental systems, a series of subthemes has been devised to support the work of the commissions and working groups of INQUA. There will also be an attractive package of excursions throughout Australia, New Guinea, Indonesia and New Zealand. For New Zealand —three pre and/or post Congress Field-trips are already in the process of being planned. These are as follows:

1. **Stratigraphy and depositional paleoenvironments of Plio-Pleistocene marine sequences in Wanganui and Hawkes Bay Basins (Central North Island, New Zealand) and global correlations**

Leaders: Peter Kamp (Waikato), Cam Nelson (Waikato) and Tim Naish (GNS). Possible other participants — Brent Alloway, Alan Beu, Bob Carter, and Brad Pillans. Duration — 6 days.

2. **Quaternary tephrostratigraphy, paleopedology and landscape evolution: North Island, New Zealand**

Leaders: Vern Manville (GNS) and Brent Alloway (GNS). Possible other contributors: Roger Briggs, Jim Cole, Shane Cronin, David Lowe, Ian Nairn, Tim Naish, Vince Neall, Brad Pillans, Phil Shane and Colin Wilson. Duration — 10 days.

3. **Quaternary Glacial sequences of the Southern Alps, South Island, New Zealand.**

Leaders: Peter Almond (Lincoln) and Chris Hendy (Waikato). Possible other contributors: David Barrell, Trevor Chinn, George Denton, Sean Fitzsimmons, Tom Lowell, Rewi Newnham, Jamie Shulmeister, Pat Suggate, Phil Tonkin and Marcus Vandergoes. Duration — 6 days.

Special mention deserves to be made of those who put the Australian proposal together. This was done under the auspices of the Australian Academy of Science through the National Committee for Quaternary Research. Those responsible for producing the proposal include: John Dodson (University of Western Australia), John Chappell and Simon Haberle (Australian National University), Peter Gell (University of Adelaide), Henk Heijnis (ANSTO), Paul Hess (Macquarie University), John Nott (James Cook University), Annie Ross (University of Queensland), Ian Simmonds (University of Melbourne) and Brent Alloway (as NZ representative). This group will be responsible for planning the details of the meeting. A great number of Quaternary scientists outside this group have also pledged strong and active support.

Final Words

The Desert Research Institute is to be congratulated for their organisation of this conference. They took a considerable financial risk in hosting the event, given the world political scene. While the Hilton Hotel was not my cup of tea, we thought the talks and posters were excellent. Of course the social side of a conference is equally important. Friendships, networks and collaborations are forged. The venue did allow this to happen. The Congress dinner was held at the Ponderosa Ranch near Lake Tahoe in the Sierra Nevadas. It was a memorable event even despite the vast quantities of free Margaritas that were consumed.

One thing that really stood out about the recent INQUA Congress at Reno was the extent that New Zealand was referred to in presentations especially in terms of being ideally situated for retaining high-quality paleoenvironmental records, assessing rates of change and interpreting climate drivers. I'm sure you all will agree that the 2007 INQUA Congress to be held in Australia represents an exciting opportunity for the New Zealand Quaternary community to really showcase the breadth and quality of our research as well as demonstrate the benefits of living and working in our dynamic natural laboratory we call New Zealand/Aotearoa.

Pre-XVII INQUA Congress Excursion, 18–22 July, 2003

Quaternary stratigraphy, geomorphology, soils and alpine archaeology in an alpine-to-plains transect, Colorado Front Range

Brent Alloway

Institute of Geological & Nuclear Sciences (GNS), Wairakei Research Centre, Taupo, New Zealand (b.alloway@gns.cri.nz)

This field trip held over five days introduced the geomorphology and soils of the Front Range on a transect from the piedmont near Boulder, Colorado to the summit of the Indian Peaks Wilderness Area along the Continental Divide some 40 km to the west. This trip was organised by Peter Birkeland (Department of Geosciences, University of Colorado, Boulder), David Dethier (Department of Geosciences, Williams College, Williamstown, MA) and Ralph Shroba (USGS, Denver). Participants came from a variety of countries including: Brazil (1), Canada (2), Croatia (1), Germany (8), Italy (1), New Zealand (1), Norway (1), South Africa (1) and United States (9).

We examined Late Pleistocene glaciogenic and colluvial deposits downstream of deep canyons (Days 1 and 2), the classic early to late Pleistocene alluvial sequences of the Colorado piedmont (Day 3), and glacial and periglacial deposits, geomorphology and archaeology of the Niwot Ridge/Arapaho Pass area on day hikes (Days 4 and 5). Soil development and the most recent age estimates for deposits and associated surfaces were discussed at many of the stops.

Most Colorado Front Range glaciers originated in cirques on the Continental Divide and flowed down deep, narrow valleys that were cut primarily by streams in late Miocene and Pliocene time. Valley deepening during the Pleistocene by both glacial and fluvial processes was probably not much more than 100 m. Most Front Range glaciers were between 12 and 20 km long and 180 to 350 m thick. None of the glaciers reached east as far as the mountain front and most terminated at elevations between 2,700 and 2,450 m. Glacial till of at least three ages are recognised near the lower limit of glaciation. From youngest to oldest, the deposits are referred to as Pinedale (30,000 to 12,000 ^{14}C yrs), Bull Lake (^{10}Be age of 121.9 ± 25.8 ka) and pre-Bull Lake. Deposits of different ages are distinguished and correlated primarily on the basis of differences in (1) areal and stratigraphic position, (2) topographic expression, and (3) degree of soil development and weathering. Down valley from terminal moraines, minor amounts of glaciofluvial sediment are preserved in small, narrow highly discontinuous terrace deposits on the flatter reaches of the canyon floors. During glaciation, the deep canyons between the glaciated areas and the Great Plains acted more as conduits than as depositories for glaciofluvial sediment. Most glaciofluvial sediment apparently was flushed through the canyons and deposited at the western edge of the Colorado piedmont.

My personal highlights (of a field trip dominated by highlights) were Days 4 and 5 when we ventured to the Continental Divide, firstly to Niwot Ridge (Figure 1) and the following day

Figure 1. View of the glaciated Continental Divide from near the timber-line above Long Lake. Niwot Ridge can be seen on the left extending to the summit of Navajo Peak (3744 m). Navajo and Isabelle glaciers are visible in the distance. These small glaciers survive in this relatively warm, dry environment due to topographic shading and the four-to-eight-fold concentration of snow by wind in east and north-east facing cirques.

along Fourth of July Valley then onward and upward to Arapaho Pass at 3629 m (Figure 2, see front cover). I remember thinking as we hiked through the forest-tundra ecotone *'Geez … I hope we don't stumble upon a bear'* (very much top of the food chain in this wilderness domain and very different from little old NZ where the only native land mammals are 2 species of bat!). While venturing the wilderness we did see some evidence of pocket gophers (no — its not some sort of lurid reference) which are major geomorphic agents that speed up normal wind and water erosion on the alpine tundra (Figure 3). However we were accompanied by a couple of dubious looking characters — which probably played an important role in scaring any curious bears away (Figure 4).

*Figure 3. Evidence of Pocket Gophers (*Thomomys talpoides*) on the downwind slopes of upper Niwot Ridge. Volume analyses of gopher 'eskers' (casts) gave an average annual production per animal of 100,940 cm^3. Studies of these excavation deposits revealed a net erosion loss of approx. 35% from each site. Calculations show an average surface lowering of 0.0037 cm/yr compared to surface lowering values for the same alpine area for nivation processes of 0.009 cm/yr, and normal wind and water processes of 0.0001 cm/yr.*

Niwot Ridge extends eastward from the summit of Navajo Peak (3744 m) for about 9 km before reaching the forest margin. Its crest is unglaciated and its bedrock is obscured by periglacial colluvium. Ecological studies of this ridge began in 1951 following the establishment of the Institute of Artic and Alpine Research. Apparently no landscape in North America has a greater diversity of solifluction and pattern-ground features. Indeed the active sorted stripes, stone-banked terraces with fronts 2.7 m high (Figure 5) and sorted nets (Figure 6) 1.5 to 4.3 m in maximum dimension, all in close proximity, were spectacular — as was the scenery. Isn't life marvellous — imagine … being paid a salary to see and experience this?!!

Figure 4. Two suspicious looking characters. On the left is Peter Birkeland (Department of Geosciences, University of Colorado, Boulder) — the co-organiser of the field trip and Scott Burns on the right (Portland State University, OR) — one of Peter's former PhD students and research partner in crime.

Figure 5. Some of the best developed stone-banked terraces in the world occur on Niwot Ridge. With fronts as high as 2.7 m, the terraces are draped like strands in a necklace across an east-to-south-east-facing, early melting, snow accumulation slopes.

Figure 6. A fine example of a sorted net on Niwot Ridge. The centres of the nets are vegetated and the stones in their borders are heavily lichen covered, suggesting that they are fossil forms. Existing theories of patterned ground formation are inadequate to explain these sorted nets.

Arapaho Pass (3629 m) is one of a handful of easy travel routes between the eastern slope of the Front Range and Middle Park, a resource-rich basin west of the Continental Divide. As herds of elk and bands of bighorn sheep crested the Pass during the seasonal migration, hunters waited in ambush. Rock walls and cairn lines with aggregate length of 1.2 km were used in conjunction with topographic barriers and twenty circular and semi-circular blinds to drive and kill the animals (Figure 7). The oldest walls predate an episode of lichen snow-kill that ended 1050–1040 ^{14}C yrs BP. The youngest walls were built between 850 and 780 ^{14}C yrs B.P. Immediately west of Arapaho Pass an important paleoindian campsite was found located on the Satanta Peak moraine that impounds Caribou Lake. Excavations produced paleoindian artefacts and dates between 7940 ±70 and 9080 ±75 ^{14}C yrs BP. These dates provided evidence that Front Range moraines previously thought to have formed about 2800 ^{14}C yrs BP might in fact be of late Pleistocene age.

On the Continental Divide, Lake Dorothy (3676m) occupies a bedrock and moraine-dammed basin in a cirque at the base of Mount Neva. Lacking a surface outlet, this lake drains to both sides of the Divide through subsurface channels. Well … the sun was shining, the last remnants of ice were almost gone from the lake margins and the opportunity for a quick dip in a lake almost as high as the highest point in New Zealand (Mt Cook/Aorangi, 3764 m) seemed almost too irresistible an opportunity to miss. Refreshing was certainly an under-statement … the impromptu skinny-dip was a gender-changing experience — it was that cold! Thank goodness for body-fat!

Figure 7. An example of a game drive rock wall on Arapaho Pass which was used in conjunction with topographic barriers and circular to semi-circular blinds to drive and kill the animals. Similar systems were used in hunting caribou in the Canadian Artic as recently as the 1920s.

Later, while recovering from the trauma of this quick dip and examining valley-wall rock glaciers in Fourth of July Valley — our guide James Benedict reaches into a rock glacier cavity and pulls out a large cache of ice-cold beverages (Figure 8). Clearly I wasn't all that disposed towards anything too cold but … I reluctantly forced myself. It was clear that all the time James spent in the wilderness — he obviously learnt a trick or two from the squirrels — much to the obvious delight of us all.

The trip was extremely informative and held in a breathtakingly beautiful part of the United States. What really impressed me was the tenacity of researchers to glean as much information as possible from the landscape, and embrace/utilise any tool possible that might provide a means for directly (cosmogenic, ^{14}C, tephrochronology) or indirectly (soil attributes — horizonation, clay content, colour, clast weathering rinds) providing age control. This field trip was also a very fine example of how the Quaternary record could be better understood by using a multidisciplinary and multitool approach. Much has been accomplished but there's still a lot of outstanding questions to be resolved, but hey, that the nature of the science we engage AND its what we love to do — right?!

Anyway, this trip was a real tribute to the organisers, Peter Birkeland, David Dethier, and Ralph Shroba but also to a slew of other contributors who very generously shared their research experience and insights. These supporting contributors included: James Benedict (Centre of

Figure 8. The field team enjoying an ice-cold beverage unexpectedly extracted from a rock glacier cache, Fourth of July Valley.

Mountain Archaeology, Ward), Nel Caine (Department of Geography, University of Colorado, Boulder, CO), Richard Madole (USGS, Denver, CO), Penny Patterson (Exxon Production Research, Houston, TX), Alan Price (Natural Resources Conservation Service, Lakewood, CO) and Taylor Schildgen (Massachusetts Institute of Technology, Cambridge, MA). So to all those involved, thanks for a thoroughly interesting, inspiring AND fun field trip.

For further information see

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All photos by B.V. Alloway.

Conference Report for Project IGCP 437, Coastal Environmental Change during Sea-Level Highstands: A Global Synthesis with implications for management of future coastal change. Otranto/Taranto — Puglia (Italy) 22–28 September 2003

Puglia 2003 — Final Conference: Quaternary coastal morphology and sea-level changes

Craig Sloss

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Last September I had the opportunity to attend, and present at, the final conference for the 'IGCP 437, Coastal Environmental Change during Sea-Level Highstands: A Global Synthesis with implications for management of future coastal change'. The conference was centered at Otranto, in the Puglia region which is the south-easternmost region of Italy and stretches between the Adriatic and the Ionian Seas. The region has a rich and diverse history and is a cornerstone for studies on the more recent paleolithic Mediterranean and European civilizations. Otranto is a coastal village placed in a small bay along the Adriatic coast and was for many centuries the political, cultural and commercial centre of the southern Puglia.

The conference was held in the Aragon Castle, built in 1481, which provided an excellent conference venue. The conference was a wonderful opportunity to hear from participants from around the world reporting on significant sites that were being investigated to improve our overall knowledge on coastal environment modifications in response to sea-level change during the late Quaternary. The conference abstracts contained over 80 scientific communications which reported on a range of study sites from salt marshes in Greenland to estuarine environments on the south-east coast of Australia. It was a great time of learning, exchanging ideas and great Italian food (and wine).

The field trips were equally as informative with over 20 years of research packed into five days. The focus of the field trips was on long-term coastal landscape change, the investigation of raised marine terraces and wave notches, and the description of Last Interglacial and Holocene landforms, which mark the southern Adriatic coastal.

Another focus of the field trips was boulder accumulations along the Ionian coasts of southern Apulia. Investigation into these deposits has related them to the effect of a tsunami, most likely related to an earthquake that occurred on December 1456. The large boulder accumulations in southern Apulia share features with boulder deposits in other coastal regions of the world that have been related to catastrophic waves. However, it was interesting to see that the controversy about making the distinction between the action of storms waves and that of tsunami is alive and well in the northern hemisphere.

One of the more interesting aspects of sea-level research was undoubtedly the use of archaeological sites for the reconstruction of historical sea-level change. Archaeological data collected along the Adriatic coast of southern Puglia has allowed the reconstruction of relative sea-level during the last interglacial/glacial cycle. For example, submerged structures, features belonging to ancient Roman times such as quarries, drainage canals and cisterns which were made above present sea-level are today partly or completely submerged up to 1 m in depth.

Overall, this was a wonderful chance to learn of new advances in the research of Late Quaternary sea-level change and an excellent chance to share my PhD research. I thank the Australasian Quaternary Association for their financial support with the Postgraduate Travel Award that made it possible for me to attend this conference.

Michael Fletcher and Simon Connor coring on Cherepanovis Lake.

Postcard from Tbilisi

Simon Connor

On the map, the Lake of the Cross, perched in the oak-clad mountains beside the oldest monastery in the country, seemed like an attractive enough spot. But when squelching waist-deep through foul-smelling, sticky, black, sulphurous mud to the centre of this small salt lake near the ancient capital of Georgia, its gloss rapidly wore off. Once all the heavy equipment was in position, though, and a rusty car door emplaced as our makeshift coring platform, work began and hours passed when everything seemed to be running smoothly. That was, until the police arrived …

For the past three years, I have been attempting to do fieldwork in Georgia, in the former Soviet Union. It's a small, mountainous country wedged in between the Black Sea, Turkey, Russia, Armenia and Azerbaijan. The Caucasus mountains run along Georgia's northern border, rising to an elevation of over 5,600 metres.

It's a country with a long and turbulent history, a sitting duck at the crossroads of Europe, Asia and the Middle East. Yet in spite of having been invaded by almost everyone, the Georgian people are renowned for their extraordinary hospitality, which they lavish upon the guest with unremitting zeal. The most important word for any visitor to Georgia to learn is *sakmarisia*, meaning, 'That's enough. I can't eat any more!'

My collaborators here are the Georgian Institute of Paleobiology, in the Georgian capital of Tbilisi. I must confess a great deal of admiration for these researchers who face working conditions the likes of which I have never seen. They inhabit an earthquake-battered, nineteenth-century

edifice that regularly drops chunks of masonry on the street below. Their laboratory equipment burns out continually from the daily water and electricity cuts in Tbilisi, and last month the resident cat sparked a flea infestation.

Last year they had a refugee crisis. People left homeless after the recent Georgian civil war laid siege to the Institute, taking up residence in the library, director's office, laboratory and hallways. The police did nothing, so the Institute workers took it upon themselves to evict their new tenants. Armed with whatever they could find, the lab-coated army ousted the impostors and barricaded the door with desks, chairs and geological specimens to prevent their return.

After that they staged a sit-in for several weeks to prove that the institute was still open for business. You see, the Georgian government pays Institute workers the paltry sum of US$40 per month whether they are working or not. Many of the Institute workers had simply retired to their homes after the economic collapse that followed Georgia's secession from the USSR in 1991. One of the empty rooms had been taken over by a scientist as his private flat. There he lives, works and cooks, watched by the vacant eyes of fossil animal skulls peering down from the shelves above his bed.

Two of the researchers, Dr Genia Avakov, palaeobotanist and Dr Oleg Bendukidze, palaeo-zoologist, always accompanied me on little excursions to lakes around Tbilisi. These two were among the friendliest and funniest field assistants one could ask for. They told me that every man from the Caucasus is just like that most famous Georgian, Jospeh Stalin. True to their word, they ordered each other hither and thither, arguing incessantly about whether to go left, right, up or down. As a result we spent most of the time utterly lost. Genia was always prepared for these moments, fortunately, whipping out a small bottle of homemade vodka. Somehow he seemed to think that a little nip would help us with our navigational embarrassment … I can't say that it did, but at least we didn't notice that we were lost any more!

Back at the Lake of the Cross, the police shouted angrily from the lakeshore, insisting that we cease work immediately. I scuttled over the mud surface on all fours to find out what was the matter. The matter with the Georgian police is always money, and this was no exception, reinforced by the police officer's first question of me: 'How much do you earn?'

Houses in old Tbilisi.

Of course, they had invented an official offence: according to them, we were conducting an illegal archaeological excavation on the land of the Georgian Patriarch without a permit. We were, they said, digging for gold, silver and other treasures … in the middle of the blackest, smelliest, muddiest lake in Georgia! One might wonder why the Patriarch would keep his chalices and crosiers there. Still, they insisted on taking us back to the police station for an extended grilling, and finding no fault with our 'archaeological excavation', meticulously checked our passports and let us go, frustrated that they had failed to extract from us a single cent.

The Lake of the Cross had the last laugh, though. When we arrived home and washed away the caked-on mud, Michael, who had stood in that offensive ooze for several hours, discovered sulphuric acid burns all the way up his legs. Cross indeed!

Lake of the Cross, where we were arrested.

Quaternary News from Victoria University of Wellington

David M. Kennedy

Quaternary activities are very much alive and well at Vic with a wide range of projects being undertaken from the tropics to Antractica covering the whole span of the Quaternary. As those who have visited New Zealand would know, the last 2 Ma is quite a significant part of NZ's history; even hard core petrologists are often working on materials formed during the Quaternary!

In the coastal sphere there are a number of projects working at the younger end of the Quaternary looking at sea-level and vegetation histories in the north-west Nelson area. Rachel Armour (MSc. student) is increasing the resolution of the Whanganui Inlet pollen sequence, some of which was presented in Westport. Mike Millar (MSc. student) has also joined the project investigating recent sea-level change using foraminifera. Glen Hughes (MSc. student) has also just started looking at the long-term evolution of the prograding gravel and sand coast of the Kapiti region, just north of Wellington over the last few sea-level cycles. My interest in coral reef sedimentation also continues focusing on carbonate production across environmental boundaries.

In the microscopic world there is a strong interest in phytolith research. Vanessa Thorn (Post-doc) has been looking at lake and soil materials from north-east Queensland and the subantarctic Campbell Island. These studies have been looking at the Pleistocene/Holocene boundary Queensland and preservation of contemporary material at high latitudes (Campbell Island). John Carters's (Technician/PhD student) project on carbon inclusions in phytoliths is progressing well with material successfully extracted from many different species of varying ages. Margaret Harper (Research Associate) is continuing her diatom work on the Auckland maar lakes. She is particularly interested in the distribution of diatoms in the microlaminations seen in thin sections. She has also been busy with new grandchildren (congratulations!!) and reviewing Tertiary diatoms. Bill Mclea (Research Associate) is also maintaining his interest in palynology being involved in almost all the pollen projects here to some degree.

The Antarctic group, lead by Peter Barrett (Professor of Geology) is currently focusing on the role of Quaternary climatic change in the Ross Sea region. Water flow and sediment samples were recently collected in 900 m water depth below the McMurdo Ice Shelf south of Ross Island. This work forms part of a larger project to reconstruct Quaternary climates in that region through drilling. Andrew Macintosh (Lecturer) is also conducting ice work on the East Antarctic ice sheet as well as modelling glacial flux on the West Coast of New Zealand.

The Luminescence Dating Laboratory run by Uwe Reiser (Senior Research Associate) is currently involved in more than two dozen projects in New Zealand and overseas. Aeolian, fluvial, colluvial and lacustrine sediments of about 200–200,000 years age are being dated by OSL for projects which include climate studies, hazards like landslides and tsunamis, palaeoearthquakes and uplift and erosion rates.

Wellington, New Zealand

Quaternary Research at Geography and Environmental Studies, University of Adelaide

John Tibby

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General news

This year has seen the arrival of Jennie Fluin (ex Monash University), Aline Philibert (ex University of Quebec, Montreal) and John Tibby (ex Monash University) into both the Department and DIATOMA (research-based consultancy) this year.

Peter Gell presented a new interpretation of the classic Lashmar's Lagoon charcoal/fire history to the Limnogeology Meeting in Tuscon (Cameron Barr and Jan Skjemstad, CSIRO Land and Water are co-authors). Here he was asked by Sheri Fritz (University of Nebraska) to join her as co-convenor of the IGBP PAGES LIMPACS (Human impact on lakes) salinisation working group. Jennie Fluin 'bravely' decided to suggest to the Palaeolimnology Symposium in Helsinki that diatom transfer functions had been overused, only to find that many keynote speakers had reached the same conclusion. Peter Gell, Angus MacGregor and John Tibby presented respectively, an overview, Snowy River and Torrens 'River' palaeo studies to the mainly non-palaeo audience at the Ninth International Symposium on River Research and Applications. The highlight was surely Gus's midnight open mike session at a local pub.

Peter Gell has obtained seed funding to develop an Austral Environmental Change Research Centre, based at the University of Adelaide, with links in particular to the Environmental Change Research Centre at University College London. Peter also has seed funding to conduct the inaugural LIMPACS salinisation workshop, entitled 'Understanding climatic and human forces driving lake salinity change'. This will be held in Mildura, 30 Sept–3 October, 2004. Jennie Fluin and John Tibby are also on the organising committee. Details from: jennie.fluin@adelaide.edu.au.

DIATOMA, the consultancy, in which all but N. Harvey and M. Williams participate has been active in a number of consultancies. These include ecological assessment of the effect of riverine salinity on the diatom composition of a number of south-east Australian streams, pre-development bioassessment of the Daly River system (Northern Territory) and evaluation of the influence of the Lower Molonglo Water Quality Control Centre (read: 'sewage treatment plant'). We are currently in the midst of preparing for a week-long diatom short course. The course provides a thorough grounding in diatom taxonomy, analysis and its applications and assumes no prior knowledge of diatoms. The next course will be 17–20 February, 2004, details: jennie.fluin@adelaide.edu.au.

Researcher profiles

After a year of employment at DIATOMA, in which he was part of numerous water quality monitoring projects, Cameron Barr has commenced his PhD and is attempting to conclude some unfinished business. During his Honours project, based in the south-east of South Australia, his diatom analysis inferred the occurrence of a major drought in the area around 300 years ago. With so few short-term fine-resolution studies to refer to, Cameron has decided to undertake a very fine-resolution study of the climatic fluctuations of the last 2000 years in south-eastern Australia. Ideally he is hoping to identify the impacts of the Medieval Warm Period and the Little Ice Age, which will be the first such study to do so from a mainland site.

Sorell Bulpin is continuing her PhD research based on her Honours site, Tareena Billabong (lower River Murray). Earlier this year she and Peter Gell obtained an AINSE grant for ^{210}Pb, ^{137}Cs and AMS ^{14}C dating. She spent a week at Lucas Heights, NSW, preparing the samples to be dated. Sorell has recently been awarded a River Basin Management Society grant, which she will also put towards further dating. Currently, Sorell is busy in the lab conducting sediment analyses, preparing and counting diatoms. She aims to submit her thesis on 1 March 2005 and has a very busy time ahead of her!

Jennie Fluin has had a busy year presenting at conferences, working in DIATOMA, and also organising various meetings (including the LIMPACS salinisation meeting). Jennie attended the International Palaeolimnology Symposium in Helsinki in August 2003, and as the sole Australian representative, presented her PhD work on palaeolimnology in the lower Murray River. The

general theme of the symposium was the emerging shift in the discipline from reconstructions based on a single parameter to more multiproxy approaches. To this end, Jennie is attending a macrofossil course, held by Hilary Birks, in London in December 2003. Jennie will then be partly grounded again for a couple of years as she and John expect their third child in April 2004.

Nick Harvey is involved in a number of projects including: synthesis of global change coastal research in the Asia–Pacific region (to be published as a book in 2005); Holocene sea-level change in Australia (with Bob Bourman, University of South Australia and Tony Belperio of Minotaur Resources); decadal to centennial climate-induced sea-level change and coastal response in the South West Pacific Region (with Ian Goodwin, University of Newcastle); Holocene sea-level change and management implications in the Pacific (with Roger McLean, ADFA, Canberra and Paul Kench, Auckland University); monitoring atoll coastal change in the Pacific (with Paul Kench and Komeri Onorio of Kiribati) and evolution of and human impact on the Younghusband Peninsula, South Australia (with Bob Bourman).

Gus MacGregor, continuing his Honours research, has identified additional wetland sites and continues to quantitatively and independently reconstruct the environmental history of the Lower Snowy River Floodplain region of east Gippsland with respect to its climate, flow regime, water quality and vegetation. This will aid in determining what proportion of changes in the natural archives are due to human activity and climate variability. Aside from constituting the only direct means of gauging the magnitude of impact, or ecological opportunity costs, of changing land-use and the inter-basin water diversions from, and subsequent riparian ecosystem degradation of, one of Australia's hallmark river systems, it will assist in forming a prescriptive basis for rehabilitation.

Gus has commenced a three-year AINSE Postgraduate Research Award to analyse his sediment cores in conjunction with ANSTO Environment, and was more recently awarded a D.R. Stranks Travelling Fellowship to support two months research at the Environmental Change Research Centre, University College London (mid-2004).

At the end of 2002, PhD researcher Craig McVeigh returned from six months of field work in Bahia, north-eastern Brazil. This marked the completion of the field work component to Craig's research, which is to reconstruct the pollution histories of three acid, oligodystrophic freshwater coastal lakes, using a diatom-based calibration data set which he has developed. The rest of the year has been taken up on a variety of tasks related to completing his PhD including, extensive Light and Scanning Electron Microscopy (SEM), ^{210}Pb and AMS dating of the sediment cores aided by an AINSE Grant gained with Dr P. Gell and making use of the increased depth of research experience now found within DIATOMA with the arrival of Drs Aline Philibert, John Tibby and Jennie Fluin.

Aline Philibert's research has focussed on three main topics. Firstly, generation of diatom-based water quality diagnostic tools for eastern and southern Australian streams. The project entails complex model development and the generation of water quality indices for modern diatoms (with P. Gell). Secondly, reconstruction of a 20,000 year diatom-based water quality and climate history from Lake Surprise (with Peter Kershaw, Monash University). The work forms part of a cultural and scientific program supported by the traditional owners. Thirdly, reconstruction of climate change and/or disturbances (volcanic eruption) in Sudan from diatomite remains (with Martin Williams).

John Tibby is an ARC Research Associate supervised by Peter Gell working on tracing sediment sources in the Torrens River catchment (with Peter Wallbrink, CSIRO Land and Water). Diatom analysis is being implemented to reconstruct the nutrient histories of four sites in the catchment. John is also evaluating causes of cyanobacterial blooms at Lake Ainsworth northern New South Wales (with Peter Leavitt, University of Regina, Carl Sayer University College London and Henk Heijnis, ANSTO). Additionally, he has a small grant to attempt development of a salinity transfer function using the mid-infared spectroscopic signature of surface sediments (with Jan Skjemstad, CSIRO Land and Water). Cameron Barr will undertake much of this research. Work carried over from Monash includes diatom histories from Lake Euramoo (late Pleistocene to present with Simon Haberle, ANU), Lake Purrumbete (8 ka BP to present with Dan Penny, University of Sydney) and Tower Hill North West Crater (Younger Dryas Chronozone with Rochelle Johnstone and Peter Kershaw, Monash University). His most important achievement has been to establish a strong early

lead in the soccer tipping competition.

Martin Williams is working on five main projects: the Quaternary history of the Blue and White Nile; Middle to Late Stone Age environments in the Kenya Rift (with Stan Ambrose, University of Illinois); Miocene fossil-bearing sediments in the Siwaliks of northern India (with Brad Pillans, ANU and David Cameron, University of Sydney); Quaternary environments in the Flinders Ranges with Peter Glasby (PhD student); and Holocene sapropels in the Coorong Lakes of South Australia with David McKirdy (Geology, University of Adelaide) and Aija Mee (PhD student). He is also involved in several CRC LEME projects on landscape evolution and mineral exploration.

Publications of group members

(*indicates undertaken in institutions other than University of Adelaide)

Ahmmed, A and Harvey, N. (in press). Evaluation of EIA Procedures and Practice in Bangladesh. *Impact Assessment and Project Appraisal*.

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*Tibby, J. (in press). Development of a diatom-based model for inferring total phosphorus in south-eastern Australian storages. *Journal of Paleolimnology*.

*Tibby, J. (2003). Explaining lake and catchment change using sediment derived and written histories: an Australian perspective. *The Science of the Total Environment*, 310: 61–71.

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Preparation of gypsum-rich sediments for determining organic matter content using loss on ignition

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Introduction

One of the most important measurements used to describe unconsolidated sediments is the organic content and several different methods have been developed to measure the total organic matter or organic carbon content (Metson et al., 1979; Rayment and Higginson, 1992; Skjemstad et al., 1998; Leong and Tanner, 1999). While some of those methods provide very precise measures, they remain subject to errors and many involve complicated procedures or require highly specialised equipment. Many authors favour the 'loss in mass' techniques as the simplest, cheapest, and fastest and are satisfied that the results are sufficiently accurate for most purposes (Schollenberger, 1945; Dean, 1974; Gale and Hoare, 1991; Ben-Dor and Banin, 1989; Maher, 1998). Of those, the low-temperature ignition methods (Ball 1964; Davies 1974) are often considered preferable and appear in standard references and laboratory protocols (e.g. Gale and Hoare, 1991; University of Newcastle, Australia, standard laboratory procedures prepared by Mr Chris Dever, unpublished). This is further evidenced by a ISI Web of Knowledge (http://www.isiwebofknowledge.com) citation database search according to which 260 journal papers cited Ball (1964) and 161 cited Davies (1974).

The aim of the low-temperature loss on ignition protocols is to remove hygroscopic water by drying samples at 105°C and then record the loss of mass caused by ashing of organic material without crossing the threshold temperature at which inorganic mineral modification confounds the measurement. The protocols are used widely because they eliminate the errors caused by decomposition of carbonates, which typically occur at higher temperatures (Davies, 1974). Although Ben-Dor and Banin (1989) suggest three possible losses of mass due to dehydration — at 100–200°C for phyllosilicates and gypsum, at 200–300°C for palygorskite and halloysite, and at 250–300°C for hydrated iron-oxides — they considered the errors to be small compared to other assumptions and errors related to the control method: the dichromate wet oxidation. Other low temperature mass loss has been reported in marine sediments where gibbsite is present (Davies, 1974; Gale and Hoare, 1991).

During routine measurement of organic matter in lake and dune sediments from the semi-arid Paroo River region, Australia, we discovered anomalously high organic results from the loss on ignition method. For site and project details see Pearson et al., (2001). According to University of Newcastle standard procedures, the samples were first dried in 40°C oven, then ground and transferred to a 105°C oven to dry overnight. A batch of eight samples, which was accidentally left in the oven for a longer time (approx. 24 hours), had consistently lower estimates after combustion. It was noticed before the combustion that the extended drying of these samples had altered the appearance of gypsum crystals from clear to 'milky white'. Suspecting that water locked in the gypsum crystal lattice may have been responsible for some of the mass loss during combustion, we used a simple experiment to check this hypothesis.

Method

The experiment was designed to:

a) compare the loss of moisture from sediment samples free from gypsum and containing various crystal sizes and amounts of gypsum,

b) determine the 105°C drying time necessary for gypsum-rich sediments to minimize the effect of dehydration of gypsum crystals distorting weight changes.

Ten standard sized samples (approx. 10 ml): eight from the Paroo region (Palaeolake) and two from Hunter Valley were selected to represent six different sediment/soil types with respect to gypsum crystal content and texture (Table 1). The Hunter Valley samples were used to provide samples with confirmed absence of gypsum. We were unable to measure gypsum quantity so we cannot relate drying time to the precise gypsum content. Instead, a sample taken from a band of selenite (sample H — Table 1) was chosen to represent the highest (close to 100%) gypsum content at the same time representing large crystal size.

All samples were initially dried at 40°C and then ground to pass through a 2 mm sieve (standard size for LOI). After weighing on a screened electronic balance with a measurement accuracy of 0.0001 g, the samples were dried in a 105°C oven for one hour, transferred into a desiccator for half-an-hour to cool, and then weighed again. The procedure was repeated until the weight of all samples stabilised. The time in the oven was extended to two, and later to four hours, as the relative weight loss started to decrease.

During the 105°C drying, five of the samples (A, B, C, I, J — Figure 1) lost less then 3% of their initial weight (Table 1). Most of the weight was lost in the first 14–18 hours after which the weight became stable (Figure 1). The remaining samples (D, E, F, G, H — Figure 2) lost between 8 and 15% of their initial weight (Table 1). It took around 80 hours of drying for the weight of the samples to stabilize (Figure 2). The experiment ended after 88 hours of drying when no further weight was loss was recorded.

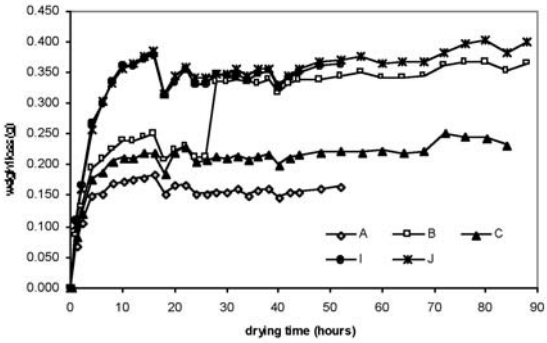

Figure 1. Weight loss during drying at 105°C for samples with little/very fine or no gypsum.

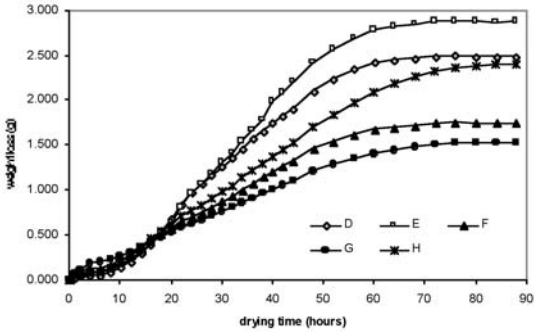

Figure 2. Weight loss during drying at 105°C for samples with gypsum crystals.

Table 1. Summary of samples used in the 105°C drying experiment

Sample ID	Location	Soil/sediment type	Gypsum (classification by crystal size after Warren, 1982)	Initial sample weight (g)	% of total mass loss on drying after 88 hours
A	Hunter Valley	clay	not detected	17.60	1.65
B	Hunter Valley	loam	not detected	18.90	1.94
C	Paroo (sand dune)	sandy red-brown soil	very fine gypsite	20.93	1.20
D	Paroo (Palaeolake)	sandy clay	gypsarenite	17.68	14.90
E	Paroo (Palaeolake)	silty clay	very fine and fine gypsarenite	21.44	13.41
F	Paroo (Palaeolake)	silty clay	fine and coarse gypsarenite	17.43	10.02
G	Paroo (Palaeolake)	sandy clay	gypsarenite	18.30	8.37
H	Paroo (Palaeolake)	–	selenite band	18.95	12.68
I	Paroo (Palaeolake)	medium clay	not detected	17.50	2.16
J	Paroo (Palaeolake)	heavy clay	not detected	15.28	2.63

Discussion

The patterns in Figures 1 and 2 show that the differences in weight loss between samples differ dramatically in relation to their gypsum content. Samples with little or no gypsum dehydrated rapidly within a few hours and their weights stabilised within 24 hours. In contrast, gypsum-rich sample weights declined more gradually. However, it is worth noting that where gypsum was present in gypsite (powder-like) form (Sample C — Figure 1) the loss in weight was similar to the samples with no gypsum content, suggesting water held within lattice of very fine crystals will dehydrate rapidly and within the current protocol. The dip in weight loss at 18 hours (clearly visible on Figure 1) is related to a week of break in measurements when samples were stored in the dessicator. Possibly the samples absorbed atmospheric moisture during the pause, however, we do not believe that anomaly affects the overall conclusion.

The process responsible for the described loss of weight has been identified as the conversion of gypsum ($CaSO_4.2H_2O$) into bassanite ($CaSO_4.1/2H_2O$ – Plaster of Paris). During the dessication, the bassanite crystals usually grow parallel to the cleavage direction of the pre-existing gypsum as micro-crystallites. The rapidity of the process is a complex function of temperature, time, and morphology. The 'milky white' colour is probably caused by a combination of extremely fine crystal size and parallel orientation. The change of the visible gypsum crystals from transparent to white provides a good visual check that the conversion took place.

The experiment has identified the need to extend the standard protocol's drying time for samples containing either large gypsum crystals or high concentrations of gypsum. It clearly shows that the ~12 hours of drying at 105°C recommended by Ball (1964) and Rowell (1994) and the 24 hours recommended by Ben-Dor and Banin (1989) and Gale and Hoare (1991) are inadequate (Figure 2). In fact, drying samples for longer than 12 hours gives a substantial improvement in organic content estimates of gypsum-rich sediments by removing the considerable contribution of crystal-derived mass loss that confounded the standard protocol. Based on the presented results we have extended the time for drying gypsum-rich samples at 105°C to 85 hours. While 85 hours is probably an overestimate, it leaves a margin for samples with higher gypsum content and characteristics not explicitly tested in this experiment. The experiment does not allow the regression of gypsum content or crystal size against time taken to desiccate the sample; that would be a very useful relationship to explore. It was also suggested to us that marginal increase in temperature (e.g. to 125°C) might increase the rapidity of the reaction (gypsum to bassanite) and consequently considerably reduce the required drying time. Further experimental investigation is, however, necessary to define the new parameters.

Acknowledgements

We would like to thank Robert Loughran and an anonymous referee for valuable comments on this paper, including additional information (incorporated into this paper) about the changes occurring in gypsum at the discussed temperature as well as recommendations as to possible further improvement of the method. Mr Chris Dever, laboratory manager, University of Newcastle, Australia, is gratefully recognised for his preparation of the standard laboratory procedures manual.

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Quaternary shorelines of Kaibu Island, southwest Pacific Ocean:
implications for Last Interglacial sea-level history and uplift of the Lau-Colville Ridge

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Abstract

The island Kaibu in north-east Fiji exhibits a series of three limestone terraces (5.0–5.5 m, 8.0–9.2 m and 12–14 m) arranged around a volcanic core. Each terrace comprises a fossil coral reef along its seaward side and an erosional platform and notch along its landward side. Where the lowest terrace is locally absent, it is marked by an emerged notch (5.1–5.2 m above the modern notch) cut into the cliff.

Ages of fossil corals from the forereef zone of the lowest emerged reef all indicate that it was living during the Last Interglacial (oxygen-isotope Stage 5e). A plausible interpretation is that the ages represent a double sea-level maximum with peaks around 133–130 kyr and 123–120 kyr. The earlier maximum was some 2 m lower than the later and marked by the growth of a surface reef. The later maximum appears to have involved only cutting of erosional shorelines at the 5.0–5.5 m level.

Since there are no ages for the two higher terraces, various scenarios can be envisaged. The one favoured is that both terraces formed during Stage 7 sea-level maxima.

Key Words
coral reef, limestone, uplift, sea-level, Last Interglacial, Pacific Islands.

Introduction

The island Kaibu is located in the north-east Fiji group, south-west Pacific and is enclosed within the same barrier reef as the larger nearby island Yacata (Figure 1). The islands represent the emerged reef cover of a largely-submerged volcanic edifice similar to others rising from the north–south trending Lau-Colville Ridge (Nunn, 1996, 1998a); volcanic rocks are exposed only in the interior of Kaibu (see Figure 2).

Kaibu and Yacata were two targets of a research team investigating both environmental and human history in this part of the Pacific. The present account is confined to Kaibu as this was the only island in the study area from which fossil corals were successfully dated. The study aimed to understand the late Quaternary interaction between tectonic and sea-level changes.

Geology and geomorphology of Kaibu

Kaibu is 1.5 km^2 in area and reaches a little over 40 m above sea-level in its south–central part. Middle Miocene andesite lavas and breccias belonging to the Yacata Andesite group (Fiji Mineral Resources Department, 1984) are exposed in the centre of the island and are surrounded by a series of three reef-limestone terraces of variable width (Figure 2). The seaward parts of these terraces are interpreted as former fringing reefs which grew out from the ocean-facing (rather than the lagoon-facing) shores of Kaibu at various times in the past. In places at the back of the two lower terraces is found a conspicuous erosional notch, regarded as analogous in origin to that forming along the modern shoreline. The terraces therefore represent reef–shoreline complexes which have emerged since they formed at sea-level.

The highest terrace (12–14 m above the modern shoreline) is least continuous and least well-exposed. It onlaps the volcanic rocks in the centre of the island and, because of the variable elevation of this onlap, is thought to have covered them once. The middle terrace (8.0–9.2 m above the modern shoreline) is more widely exposed and actually comprises the coastline along the island's central north-eastern coast. The lowest terrace along this coast occurs as a veneer of younger reef

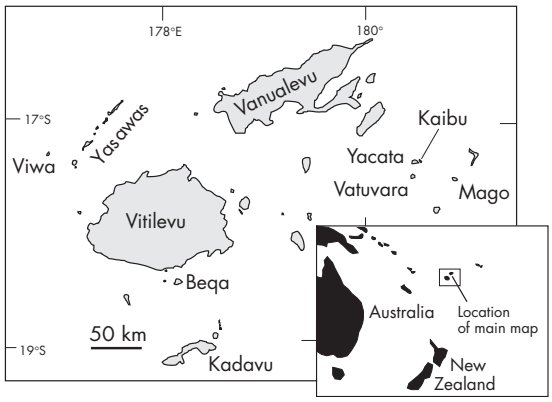

Figure 1. Location of Kaibu within the Fiji Islands. Inset locates the main map within the Southwest Pacific.

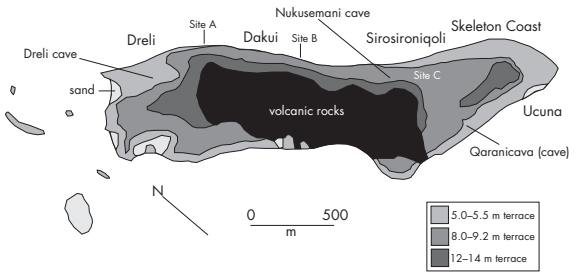

Figure 2. Geology of Kaibu Island (after Fiji Mineral Resources Department, 1984) showing the three reef-shoreline complexes mapped and the location of study sites.

on the cliff face beneath an emerged notch 5.1–5.2 m above the modern notch. The 5.0–5.5 m terrace is best exposed around the extremities of the island where it forms a broad level surface in which various divisions, corresponding to ecotones on modern reefs in this area, could be recognized.

The surfaces of the reef terraces usually exhibit around 0.5 m of relative relief although sinkholes occur occasionally — such as at Dreli and Nukusemani caves (see Figure 2). The boundary between adjacent terraces is generally marked by steep cliffs along the base of which are found emerged erosional notches and caves such as that at Qaranicava.

The first report of the Kaibu Island terraces was made by Derek Woodhall as part of his survey of Lau Island geology which has as yet been reported only in a series of geological maps by the Fiji Mineral Resources Department (1984). The Department granted the authors access to

Woodhall's unpublished notes and reports and these provided significant insights. For this study, detailed investigations of emerged reef terraces on Kaibu were made along the entire north-east coast of the island where they were well-exposed and most conspicuously fossiliferous.

Detailed investigations

The bedrock limestone at the northern end of Dakui Beach can be clearly distinguished from a younger fossil reef by the large numbers of visible fossils, mostly corals in their growth positions, crowded into the latter at this location (Figure 3). Farther south, the younger reef is less prominent but can be recognised as a veneer on the cliff face. Two samples taken from this reef at Dakui (samples D4 and D5) imply that this younger reef is of Last Interglacial age (Table 1).

The younger reef is regarded as contemporaneous in age with the 5.1–5.2 m emerged notch, which forms a conspicuous feature along this cliffed coast (Figure 4). Although well beyond the reach of modern coastal erosion, this notch is smooth-walled and smooth-floored and has well-developed speleothem pillars at one place. At this site, two higher emerged notches were surveyed, one emerged 8.9 m above the modern notch, the other (which was inaccessible) emerged about 11.3 m.

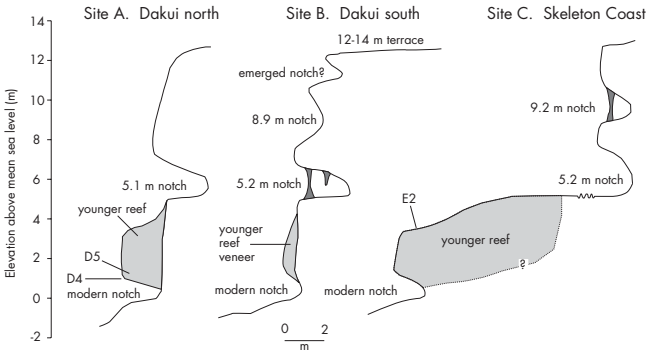

Figure 3. Coastal sections showing locations of samples D4, D5 and E2.

The 12–14 m terrace forms the flat surface at the top of the cliffs all along Dakui Beach.

The younger reef is better preserved to the south at Sirosironiqoli and what we named Skeleton Coast. At the latter, the younger reef and the associated shore platform and notch are 30–40 m broad in places. Fossil corals were abundant throughout the seaward 10–15 m of this feature but were exposed best along the coast where they were sampled. A single date from this location gave a Last Interglacial age for the coral sample E2 (Figure 5).

Table 1. Ages of emerged corals from Kaibu

The sole ^{14}C age was determined at the University of Waikato, New Zealand, and is considered to be a minimum age for what is likely to be a Last Interglacial coral. The $^{230}Th/^{234}U$ ages were determined by Akio Omura, Kanazawa University, Japan. Only the three acceptable ages are given; to be acceptable, the $^{234}U/^{238}U$ activity ratio should be between 1.13 and 1.16.

Laboratory number	Location	Coral genus	Elevation above modern reef (m)	Conventional ^{14}C age (BP)
WK-5418	Sample D4 from notch overhang, northern end of Dakui Beach	*Favites* sp.	1.40	33,150 ± 350

Laboratory number	Location	Coral genus	Elevation above modern reef (m)	Age (kyr)	$(^{234}U/^{238}U)_0$ (activity ratio)
443	Sample E6 from emerged reef platform at edge of 5-m terrace, northern end of Ucuna Beach	Platygyra sp.	3.85	131.1±2.4	1.149±0.011
A0454	Sample E2 from platform at front of 5-m terrace, Skeleton Coast	Platygyra lamellina	3.60	132.8±2.3	1.159±0.010
A0455	Sample D5 from cliff at front of young reef outcrop,	Porites sp.	1.45	126.8±2.1	1.155±0.010

Figure 4. View north-west along the coast at Dakui from inside the 5.2 m emerged notch. The line of this notch is visible along the cliff face as far as Dakui north, where it was measured at 5.1 m above the modern notch.

Figure 5. The 9.2 m notch about 80 m inland of the modern shoreline at Skeleton Coast. The staff is 5 m long.

At the back of the Last Interglacial shoreline along the Skeleton Coast, there is commonly a cliff in which what we regard as the Last Interglacial notch (emerged 5.2 m) is preserved. There is a higher notch (Figure 5), with considerable speleothem development locally, emerged 9.2 m above the modern notch. This notch, in which were found numerous human burials, appears older than the 5.2 m notch on account of the degree of weathering of the exposed surface. This was true especially of the notch floor in which fossil corals (*Porites* sp) were upstanding relative to their weathered matrix. No ages could be obtained for samples within this notch because they were recrystallised.

A sample from the front of a 5.0–5.2 m platform at Ucuna (not shown in Figure 3) was also dated to the Last Interglacial and confirms the age of the 5.0–5.5 m shoreline.

Chronology

Four ages (Table 1) suggest that the 5.0–5.5 reef–shoreline is of Last Interglacial age. Assuming that the three securely-dated corals all grew close to the mean low-tide level (MLT), as is plausible if not demonstrable, then two scenarios can be envisaged (Figure 6).

The first and simplest is one involving a single sea-level maximum perhaps about 124 kyr as Chappell and Shackleton (1986) proposed, although AO455 would then have to have been growing more than 3.5 m below MLT (Figure 6)

The second scenario is one involving a double sea-level maximum, as inferred originally by Chappell (1974) from his recognition of a disconformity between emerged Reef VIIa and Reef VIIb on the Huon Peninsula in Papua New Guinea. Evidence for a Last Interglacial double sea-level maximum has since been found elsewhere (Ku et al., 1974, Sherman et al., 1993, Montaggioni and Hoang, 1988). As shown in Figure 6, either scenario is possible; the critical factor is whether the Porites coral dated by sample AO455 grew at the ocean surface or 3.5 m or so below the ocean surface (MLT). If this coral grew at MLT, then we envisage a scenario, shown in Figure 6, in which Last Interglacial sea-level rose to a maximum around 133–130,000 years ago. This transgression must have been sufficiently slow for coral reef to 'keep up' or at least 'catch up' with sea-level rise (to use the terms of Neumann and MacIntyre, 1985). Following this maximum, the sea level fell by around 2 m before rising again to a maximum around 123–120,000 years ago. We infer this sea-level rise to have been comparatively rapid, sufficiently so that coral reefs 'gave up' trying to grow upwards at the same rate. The result was that when the sea-level maximum was reached, a largely erosional shoreline (that at 5.0–5.5 m) was cut. This scenario explains the observed form of the Last Interglacial shoreline on Kaibu marginally better than one involving a single sea-level maximum.

A Last Interglacial shoreline at 5.0–5.5 m is close to the +6 m palaeosea-level occurring at

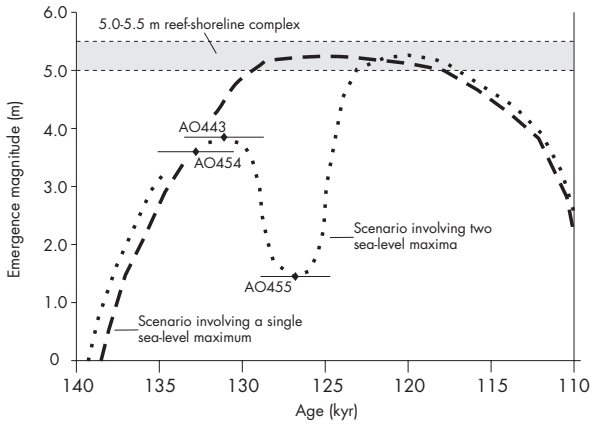

Figure 6. Plot of $^{230}Th/^{234}U$ ages against sample elevation showing the various possible Last Interglacial sea-level reconstructions.

approximately 124 kyr. This is derived from comparison of the record from the emerged reef staircase on the Huon Peninsula in Papua New Guinea with the deep-sea oxygen-isotope record (Chappell and Shackleton, 1986). Analogues from elsewhere in the region include the Last Interglacial reefs dated on Viwa Island in the Yasawa Group of western Fiji (see Figure 1) and those on the islands 'Eua and Tongatapu in Tonga by Taylor (1978).

The higher terraces on Kaibu have not been dated directly and, from what is now known about pre-Last Interglacial sea-levels, it is not a simple matter of assigning them to successive earlier interglacial stages. That said, there is evidence from throughout the islands of the Lau Ridge that uplift was the norm for much of the Quaternary but that, at least in parts of the group, this uplift effectively ceased during the late Quaternary around 150 kyr (Nunn, 1996, 1998a, Nunn et al., 2002). Unless a scenario involving intermittent uplift is invoked, the most plausible explanation is that both higher terraces formed during Stage 7 (Penultimate Interglacial) sea-level highstands and were uplifted at rates of between 0.30 mm a^{-1} and 0.43 mm a^{-1} before uplift ceased around 150 kyr.

Conclusions

This study is significant because it provides a detailed chronology of late Quaternary reefs in north-east Fiji where no comparable studies have been carried out. As such it has implications not only for the various chronologies of (reef-) terraces mapped on nearby islands (Nunn, 1996, 1998a) but also for an understanding of the age of the low-lying Ucuna Limestone which is ubiquitous in the Fiji archipelago (Rodda, 1994).

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THESIS ABSTRACT

Late Holocene floodplain processes and post-European channel dynamics in a partly confined valley of New South Wales, Australia

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The partly confined valleys of south-eastern Australia provide suitable conditions for the formation of vertically accreted floodplains with laterally stable channels. Three reaches in the Bellinger catchment in the New England Fold

Belt on the mid-north coast of New South Wales (NSW) provide sites to assess the attributes of confined floodplains and the impact of European settlement on otherwise highly stable systems. The nature of Late Quaternary floodplain processes in a bedrock-dominated landscape is investigated, providing an evolutionary context for the study of contemporary channel processes.

The Bellinger catchment is characterised by an assemblage of stepped Late Quaternary alluvial units. Late Pleistocene terraces represent large more competent rivers that reworked almost entire valley floors, however, a progressive decline in discharge since the Last Glacial Maximum has resulted in the abandonment of these deposits as elevated terraces or residual alluvium onlapped by contemporary floodplains. The Bellinger catchment exhibits evidence of intrinsic controls on floodplain formation superimposed over an early-mid Holocene climatic signature. A fluvially active period from 12–3 ka reworked Late Pleistocene terraces and is termed the *Nambucca Phase*. In the Bellinger catchment, two floodplain surfaces, one higher than the other, both started to vertically accrete from 4 ka onwards, but with some valley locations remaining vulnerable to episodes of reworking resulting in substantial units of even younger basal alluvium. The high floodplain is dominated by horizontally laminated, vertically accreted sequences, while the low floodplain is characterised by pronounced cut-and-fill stratigraphy. In both instances, vertical processes are the dominant mode of floodplain construction. However, an extensive AMS radiocarbon chronology supplemented with a limited OSL investigation suggests that these two surfaces are not chronologically distinct. In contrast, polycyclic terraces and floodplains can share much the same elevation but be very different in age. The assumption that the continuity of terrace or floodplain profiles along a valley represents coeval formation is shown to be frequently invalid for such confined landscapes.

European settlement from c.1840 transformed the fluvial environment, initiating phases of channel metamorphosis that do not correspond to a previously accepted model of channel change based on proposed cyclical changes in flood activity termed flood- and drought-dominated regimes. Largely in response to deforestation, the Bellinger River has undergone rapid adjustment to changing boundary conditions, including measurable channel straightening, a three-fold increase in width, a five-fold increase in channel capacity, bed level incision and a re-configuration of riffle-pool units. These changes have occurred in periods of above- and below-average flood activity and are a direct result of landscape clearance for agriculture, compounded by activities such as within-channel aggregate extraction. In the latter part of the 20th century, channel capacity has continued to increase despite recent increases in riparian vegetation and a climatically-driven decline in flood frequency.

Wide-scale post-settlement entrenchment has produced a diverse range of in-channel depositional and erosional landforms that are not the product of particular discharge return-periods. Deposited over gravel-bar platforms, a variety of cut-and-fill benches have developed and their stratigraphy and form are controlled by their position within the channel, local sediment supply and local energy conditions. Bench processes, along with continued channel expansion, are attributes of a highly disturbed post-European system that currently displays non-equilibrium characteristics.

This significant revision of our understanding of the controlling processes and changing environment in the partly confined coastal rivers of northern NSW has important implications for the management and future rehabilitation of these disturbed systems. The future success of river management in these valleys requires a reach-scale assessment of post-European channel responses, but framed within the context of the longer-term channel and floodplain formation processes.

Announcement of a new palaeoclimate science project for Australia, New Zealand and the Southern Ocean:

The Australasian INTIMATE project

At the recent International Quaternary Association Congress (INQUA) in Reno there was very significant interest in the chronology and nature of the deglaciation in the Australasia/Southern Ocean region. As a result a proposal was made that a group be formed to examine the extent to which regionally coherent climatic changes can be used to determine an event stratigraphy for Australasia and the Southern Ocean. A primary objective of the group will be to attempt to establish an event stratigraphy for the period spanning from the Last Glacial Maximum (c.21,000 years ago) to the start of the Holocene (c.11,500 years ago) and to examine its applicability across the Australasian region. We are forming a regional Australasian sub-project within the very successful INTIMATE (Integration of Ice Core, Marine and Terrestrial Records) programme which is a core project of the INQUA Palaeoclimate Commission. The purpose of INTIMATE is to integrate data sets from ice core, marine and land records to produce a series of palaeoenvironmental maps of the Atlantic Region (and now Australasia) for the interval between the Last Glacial Maximum and the Early Holocene and to study the ice–sea–atmosphere interactions and feedbacks during the last Glacial–Interglacial transition. Participation in the work of INTIMATE is open to any scientist with interests in, and/or data pertinent to, the aims of INTIMATE.

The interest ultimately focuses on global scale questions on the nature and timing of links between climate events in the Northern Hemisphere, Antarctica and Australasia as a means of improving our understanding of global climatic teleconnections and systems responses to climate change. It follows on from the recognition that records from this part of the world are critical for testing the global applicability of climate change scenarios. In order to actually derive useful answers we need very high resolution climate change records. The decision to focus initially on the Australasian region was taken at the Reno meeting essentially for reasons of pragmatism. Nevertheless we recognise the importance of ultimately extending the coverage to other regions of the Southern Hemisphere and would strongly welcome parallel or collaborative initiatives from workers in those regions, especially South America.

About 30 participants were signed up at INQUA in August with numerous additions since then. Dr Rewi Newnham (R.Newnham@plymouth.ac.uk) is acting as the link person to the main INTIMATE project, Dr Jamie Shulmeister (James.Shulmeister@canterbury.ac.nz) is the NZ local co-ordinator [and email list operator] and Dr Simon Haberle (simon.haberle@anu.edu.au) is the Australian co-ordinator. The regional project is intended to run until at least 2007 when results will be presented at the next INQUA congress in Cairns (and a journal issue and/or summary paper/s will be derived).

The project will be kicked off with a demonstration workshop at the New Zealand Geological Society Conference in Dunedin in early December. A discussion session/report of progress will be given at Southern Connections in Cape Town in January. The first Australian meeting will be a workshop at the Australia New Zealand Geomorphology Group Conference at Mount Buffalo, Victoria, 15–20 February 2004. The first full meeting of the Australasian INTIMATE group will be at the Australasian Quaternary Association Biennial Conference in Tasmania in December 2004.

The ANZGG meeting will take a draft protocol from the New Zealand meeting and try to develop a 'final' protocol for running the project along with the basic scientific framework — e.g. initial working 'events', age conventions and a 'rating' of proxy data. The INTIMATE session is provisionally set down for the afternoon of 19 February. The Second Circular for the Australian and New Zealand Geomorphology Group conference at Mt Buffalo Chalet, Victoria, 15–20 February 2004, is now available from the ANZGG website: www.anzgg.org. Full information on the meeting and how to get and stay there is available from that web site.

The way INTIMATE works is to have a series of warts and all presentations on critical data sets for erecting the stratigraphy followed up by work shopping the paper(s) to identify key findings and identify where the holes are. Critical issues that need to be resolved include 1) the establishment of universally applied procedures for establishing chronological control (e.g. how should C-14 ages be presented, which calibration will be used, how reliable are key markers like tephras (a major issue in NZ)?), 2) linking marine to terrestrial records, 3) distinguishing local site, ecological or hydrological effects from climate responses and 4) defining which Northern Hemisphere/Antarctic/ South American climate events (if any) actually show up in the regional record. The idea is that the presentations are informal and that the workshops are supportive.

Want to know more? Either contact any of the co-ordinators listed above or, for background, have a look at what has been done for the North Atlantic region by the original INTIMATE group in Europe and check out the European web site at http://www.geog.uu.nl/fg/INTIMATE/ and links therein. Please also respond if you are likely to attend the Dunedin workshop, Southern Connections or ANZGG.

Want to sign up — drop an email to either James.Shulmeister@canterbury.ac.nz or simon.haberle@anu.edu.au

Hope to see you at the ANZGG or at AQUA.
Simon Haberle, James Shulmeister and Rewi Newnham

Inaugural LIMPACS salinisation meeting 'Understanding climatic and human forces driving lake salinity change'

30 September–3 October 2004, Mildura
A meeting aimed at building the bridges between hindcasting, monitoring and modelling salinity change. International keynote speakers, including Professor Rick Battarbee from the ECRC.

Further details to follow, enquiries to Jennie Fluin jennie.fluin@adelaide.edu.au

Diatom Course

17–20 February 2004, University of Adelaide
This four day course is designed for ecologists, palaeoecologists and archaeologists. It provides a thorough grounding in diatom taxonomy, analysis and its applications. The course assumes no prior knowledge of diatoms and consists of lectures and practical classes. Cost $600.

Further details contact Jennie Fluin jennie.fluin@adelaide.edu.au

CAVEPS meeting: CAVEPS 2005 and Quaternary Extinction symposium

10th Conference on Vertebrate Evolution Palaeontology and Systematics, Naracoorte Caves World Heritage Area, Naracoorte, South Australia, AUSTRALIA
29 March to 2 April 2005
CAVEPS is a biennial meeting of vertebrate palaeontologists from around Australia and overseas. CAVEPS 2005 will consist of 3 days of general sessions including papers on all aspects of vertebrate palaeontology, culminating in a 2 day symposium which will focus on Quaternary extinctions and dating applications. In addition to the main sessions, a student forum is also proposed where students can present their project proposals or work in progress and benefit from professional input.

Expressions of interest are sought for CAVEPS 2005

Conference convenors:
Liz Reed, liz.reed@flinders.edu.au
Steven Bourne, Bourne.Steven@saugov.sa.gov.au
Postal address:
CAVEPS 2005, c/- Naracoorte Caves National Park, PO Box 134, Naracoorte South Australia 5271, AUSTRALIA

Soil micromorphology meeting:

The 12th International Meeting on Soil Micromorphology will be held at the University of Cukurova in Turkey during 20-26 September 2004. The meeting is being organized by the Department of Soil Science and the Department of Archaeometry, Ceramics and Geological Engineering. Quaternary interests will be strongly represented especially in terms of archaeological site investigation and paleosols. Indeed the use of soil micromorphology in archaeology is a growth industry and an annual meeting on this theme has been held in Europe over the past few years. Further details can be found on: http://ziraat.cu.edu.tr/imm/html/meet.html or by contacting

Professor Selim Kapur at kapur@mail.cu.edu.tr or Geoff Humphreys at ghumphre@laurel.ocs.mq.edu.au

Paleosols meeting, Italy: International Union of Soil Sciences

International Union for Quaternary Research, Working groups and commissions, Paleopedology, World Reference Base for Soil Resources, Soil Genesis, Soil Science Society of Italy, Paleosols: memory of ancient landscapes and living bodies of present ecosystems

Florence, 7–11 June 2004
more information: paleosolstoscana@issds.it

Rapid and catastrophic changes… Rapid and Catastrophic Environmental Changes during the last 10,000 years.

Nature is not always the benign provider of shelter and the carer to all needs. Nature has a dark side, capable of extreme and sudden geological violence. The International Council of Scientific Unions (ICSU) and the International Geological Correlation Programme of IUGS and UNESCO have recognised this by funding two new projects.

- ICSU Grant, category I, on 'Dark nature: rapid natural change and human response', from 2004 to 2005
- UNESCO-IGCP 490 project grant on 'The role of Holocene environmental catastrophes in human history', from 2003 to 2007.

Indicators of these changes are available. We should watch them carefully!

The two first meetings are currently being organised.

The first one will be in Mauritania in January 2004 where scientists will forget about electricity and venture into the Saharan desert either on camels or in four-wheel-drives (http://www.brunel.ac.uk/depts/ges/igcp490/maur2004.htm). Out in the desert, under the shelter of an acacia tree, presentations and discussions will be held on desertification, coastal wetland protection, ground water, dust, upwelling strength, tsunami, health and the collapse of past civilisations. Contact: Suzanne.Leroy@brunel.ac.uk.

The second one will be held in Turkey in June 2004 and will bring earth scientists, archaeologists and anthropologists together to examine human responses to past rapid environmental change in the ancient world. After the three-day discussion meeting, a field trip will take participants around some of the spectacular cultural and geological sites of western Turkey. Contact: Iain.stewart@brunel.ac.uk.

The other meetings are planned for Mozambique in Autumn 2004. Contact: (sylvi.haldorsen@ijvf.nlh.no), Argentina (Eduardo Piovano, epiovano@efn.uncor.edu and Jose Sayago, sayagojm@infovia.com.ar), and the Canadian Arctic in spring 2005 (Tony Berger aberger@uvic.ca). Finally, a wrap-up symposium will take place in Como, Italy, in Autumn 2005 (Alessandro Michetti, michetti@fis.unico.it). The IGCP 490 programme, which is for five years, will have additional meetings in Papua New Guinea in 2006 (Hugh Davies, hdavies@upng.ac.pg and Ted Bryant, ebryant@uow.edu.au) and Egypt in 2007 (fekrihassan@hotmail.com).

The outcomes of these multidisciplinary meetings will be a series of conference proceedings, many of them in the Geological Society of London and a contribution to the webcyclopedia of IUGG.

For IGCP 490 see: http://www.brunel.ac.uk/depts/geo/igcp490/igcp490home.html

For ICSU-DN see: http://www.brunel.ac.uk/depts/ges/ICSU-DN/ICSU-DN.htm

Sponsors: IUGS, IGU, IUGG, INQUA, IUGSGeoind, UNESCO, WAC, IAG

The Second Circular for the Australian and New Zealand Geomorphology Group conference

Mt Buffalo Chalet, Victoria, Australia, 15–20 February 2004, is now available from the ANZGG website: www.anzgg.org.

Papers are invited on all aspects of geomorphology. Special sessions will be held on 'mountain geomorphology' and 'geomorphology and society'.

Pre-conference, post-conference and mid-conference field trips are being offered in conjunction with the conference. The pre-conference field trip will travel from Sydney to Mt Buffalo via the Snowy Mountains. Three post-conference field trips are offered: Mt Buffalo to Sydney via the Riverine Plains, Mt Buffalo to Melbourne via Gippsland, and King Island.

PEP2 Session at the Asia–Oceania Geoscience Society (AOGS) Conference, 'Low-latitude and high-latitude climates and linkages in the Asia Oceania sector in the late Quaternary'

Singapore 5–9 July 2004

The Asia–Oceania region is host to the Indo–Pacific Warm Pool and the tropical monsoon systems associated with it which have a wide impact on regional and global climate, climate variability and ocean circulation. The effects of this tropical climate system are also felt in mid and high latitudes of both hemispheres, which are also impacted by polar weather systems. We invite original research papers dealing with palaeoclimatic reconstructions of the tropical (monsoonal) climate system and the warm pool, high latitude climate systems or their interaction in the mid-latitudes of the Asia–Oceania region. Papers may include proxy evidence, modelling results or model validation using proxy data. This session is an activity of the Austral–Asia Pole Equator Pole (PEP 2) Transect project. (Session OA18)

The conference will include several sessions of interest to PEP2 participants including South China Seas and Indonesian Throughflow, Asian Dust, Typhoons and Mesoscale Weather, Land–Ocean Atmosphere Interactions, Climate Change.

Find conference information, session titles and register at www.asiaoceania.org, Conference registration is US$270/S$450 by 10 May 2004; US$320/S$550 after 10 May 2004.

We hope to be able to offer financial assistance to presenters from developing countries. The 'Call for Abstracts' follows and we invite you to take the next big step. Submit your abstract online and invite your associates, friends and colleagues to follow suit. Abstract submission deadline is 14 Febuary, 2004. Submit abstracts online at http://www.asiaoceania.org/submitabstract/

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FIRST ANNOUNCEMENT

AUSTRALASIAN QUATERNARY ASSOCIATION

BIENNIAL CONFERENCE

6–10 DECEMBER 2004

CRADLE MOUNTAIN, TASMANIA

The next AQUA Biennial conference is proposed for the 6th-10th December 2004 at Cradle Mountain National Park, Tasmania. The conference will be held in the Doherty Hotel Conference Lodge, which is 10 min drive to the park entrance.

There is backpacker style accommodation 10 min walk from the conference centre that will accommodate up to 80 people in cabins (approx. $25/night). There are kitchen facilities and there is ample camping facilities. Hotel and Lodge accommodation is also available. The pre-Christmas/pre-school holidays timing will allow maximum access to the park. Travel to the park in your own vehicle or take the shuttle buses that leave daily from the airports and ferry terminals.

The program will include plenary talks by leading Quaternary researchers who have worked in Tasmania. The oral and poster sessions will cover all aspects of the Quaternary, though there will be a focus on the glacial, geomorphological and vegetation history of the southern temperate latitudes.

Possible Conference Fieldtrips

3-4 day post conference fieldtrip in central and western Tasmania to view key glacial and vegetation history sites. Mid-conference ½ to full day walking trips around key Quaternary sites of Cradle Mountain or a scenic flight over this outstanding landscape.

For more information or to help out please contact:

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QUATERNARY AUSTRALASIA

Quaternary Australasia publishes news, commentary, notices of upcoming events, travel, conference and research reports, thesis abstracts and peer-reviewed research papers, of interest to the Australasian Quaternary community. Non-referreed material for the next issue should reach the Editor by 1 May 2004. Please ensure that citations, in both refereed and non-refereed manuscripts, are formatted to conform to *Quaternary Australasia* style.

The Australasian Quaternary Association (AQUA) is an informal group of people interested in the manifold phenomena of the Quaternary. It seeks to encourage research by younger workers in particular, to promote scientific communication between Australia and New Zealand, and to inform members of current research and publications. It holds biennial meetings and publishes the journal *Quaternary Australasia* twice a year. *Quaternary Australasia* is edited by Kale Sniderman. The annual subscription is A$25 or A$15 for students, unemployed or retired persons. To apply for membership please contact Janelle Stevenson (address below). Members joining after September gain membership for the following year. Existing members will be sent a reminder in December.

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Stage 5 shore platforms at Perpendicular Point viewed from Irimahuwheri Lookout; see Peter Almond's Quaternary Geology of the North Westland Coast, last issue.