Volume 27 | Number 2 | December 2010

Quaternary AUSTRALASIA

Quaternary Island - AQUA on Straddy

Welcome the first NZ president

Kershaw Fest: raising a glass to another great palynologist

Quaternarists abroad - AMQUA, Tephrochronology and Sand Sea

Volume 27 | Number 2 | December 2010 | ISSN 0811-0433

Quaternary AUSTRALASIA

COVER: Blue Lake, a window lake located within Blue Lake National Park, North Stradbroke Island, Queensland, Australia. This was visited on the mid-conference field trip, held during the AQUA 2010 meeting. Photo: Steven Phipps, UNSW.

BELOW: Myora Springs, a freshwater spring located on the west coast of North Stradbroke Island, Queensland, Australia. The spring discharges 2.4 million litres per year, and the surrounding vegetation is dominated by mangrove forest. Photo: Steven Phipps, UNSW.

Editorial


Dear Fellow Quaternarists,

This is our final issue of Quaternary Australasia for 2010, and we have well and truly moved into the electronic age with the official online publication of our journal – although the hard copy will still be sent to our members. QA is now available through the Humanities and Social Sciences Collection of InformIT, an Australia-based electronic publisher run through RMIT. We urge you to recommend it (and AQUA membership!) to your colleagues now that we offer wider access.

The Australasian Quaternary research community has been particularly busy with meetings over the past half year. One obvious highlight was the AQUA conference, held on North Stradbroke Island in July. It was a most successful meeting in a stunning location, and the field trip offered a variety of experiences relating to Quaternary studies, not to mention a fine time had in the great outdoors. Australasian Quaternarists have been active at a number of international meetings, including the Global Sand Seas meeting in London, the Tephrochronology meeting in Japan and participation in our sister society meeting of the American Quaternary Association in Wyoming, USA.

Possibilities for advocacy for and integration of Quaternary science with policy in Australia were recently discussed in Canberra with the reconvention of the Australian Academy of Science's National Committee for Quaternary Research for the first time since INQUA in 2007. Allan Chivas and Craig Sloss report on the discussions held at the meeting, including strategies for increasing the visibility of our discipline in the public sphere.

As time passes, our senior colleagues are increasingly winding down their activities and making way for the next generation of Quaternarists. In our previous issue we paid tribute to Professor Geoff Hope on his recent retirement. In this issue Tara Lewis reports on Peter Kershaw's retirement symposium and accompanying events in Melbourne. Despite this official transition we nevertheless hope still to hear from Peter well into the future!

Yours Quaternarily

Kathryn Fitzsimmons and Jessica Reeves
Editors, Quaternary Australasia

President's Pen

Kia Ora, friends and colleagues,

Australasia is a fantastic part of the planet for study of the last 2.6 M years of Earth history. Together New Zealand and Australia capture the subantarctic to tropical- on land and water- and from tectonic mortification to hyperactivity. There are no political barriers to trans-Tasman collegiality, and the cultural ones are generally confined to sporting crowds. I am very pleased to have been elected the first NZ-resident President of the Association that makes Australasian Quaternary science its *raison d'etre.* A key responsibility of the President is to ensure the Biennial conference runs successfully. In that regard I feel reassured having two very able and knowledgeable colleagues, Marcus Vandergoes and David Barrell, on the organising committee with me. That conference will be held in Tekapo in the South Island in February of 2012. Mark your diaries! We also have the INQUA Congress in Bern next year. As always, the AQUA executive is doing its best to encourage participation, especially of students and early career researchers. The abstract submission deadline is fast approaching – do your bit to enlighten the world to the depth and fascination of Australasian Quaternary science.

Kind regards,
Peter Almond

Past President's Pen

Dear Quaternarists,

We saw a changing of the guard at the recent AQUA Annual General Meeting, with the election of a new president (Peter Almond), vice president (Craig Sloss), secretary (Craig Woodward) and treasurer (Steven Phipps). I would like to congratulate the new committee members, and in particular to note that we have our first New Zealand president. It has been an honour and privilege to serve on the committee as president and I would also like to thank the rest of the executive for their assistance over the last two years or so, particularly Sam Marx who has left the committee as the immediate past treasurer.

Exciting times are ahead for Australasian Quaternary Science, with the upcoming INQUA conference in Bern, which looks to have a very strong presence of Australasian Quaternarists, and the next biennial meeting that is being held in New Zealand in early 2012. I strongly encourage all members to remain actively involved in AQUA. Please also suggest to any non-members in Quaternary science (particularly students) that they should consider joining. One of AQUA's unique strengths is the promotion of students in their activities, as highlighted by the awards at the recent biennial meeting.

Best Wishes
Patrick Moss

Australasian Quaternary Association Biennial conference

North Stradbroke Island, Queensland 11th-16th July 2010

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Figure 1. The University of Queenland's Moreton Bay Research Station (photo Kirsty Wilkes).

The biennial meeting of the AQUA took place between July 11th and 16th on the idyllic 'sub-tropical' North Stradbroke Island (NSI), located in Moreton Bay, southeast Queensland. The meeting was held at the University of Queenland's Moreton Bay Research Station, located within the small community of Dunwich. The island is the second largest sand island in the world and was formed and shaped during windy, arid phases of the Quaternary making the island an appropriate location for this meeting.

Conference registration opened on Sunday 11th July followed by an introductory talk about the station and the contemporary island environment and, in particular, the safety aspects of our visit. This included an extensive and, for an infrequent visitor to Australia, triflingly unnerving list of potential life-threatening fauna in the immediate vicinity. At 5 pm a BBQ banquet was served, feeding roughly 50 hungry Quaternary scientists from around the world. Fuelled by burgers and beer, conversations soon struck up between both old and new acquaintances about our research interests. The group disbanded with a healthy proportion of the delegates deciding to explore the (somewhat limited) bar scene that Dunwich town has to offer.

The meeting began promptly on Monday morning with an opening speech and welcome from Patrick Moss. This was followed by a day of interesting talks and discussions. The conference sessions were divided into geographical regions and the meeting started with the theme 'Tropical and subtropical regions' that was restricted to Australia-based research. Patrick continued on from his welcome speech to begin the talks with an overview of the Late Quaternary environments of Stradbroke Island. The session theme continued with discussions on OSL dating and sedimentology of rock shelters, Holocene sea-level change, and various studies of the Quaternary history of NSI. The post-lunch session began the theme 'Temperate Australia'. Stephan Phipps started this session with an insightful keynote address discussing the use of modelling techniques on proxy coral data to inform patterns within the El Niño-Southern Oscillation (ENSO). The following talks discussed palaeoceanography and palaeoclimate history in south-eastern Australia. A change in the regional focus to New Zealand led to the final talk of the day by Jamie Schulmeister, who discussed glacial sedimentology from a site in Canterbury. The day finished with the AQUA AGM.

The second day continued the regional theme of 'Temperate Australia' with a keynote address by Jessica Reeves. This talk summarised research at the Barwon Estuary in southern Australia, where modern data on fauna and environment has been combined with analysis of the palaeo-conditions to produce a rigorous reconstruction of environmental change in the Barwon Estuary. Jessica expanded on this work to discuss more recent anthropogenic influences on this environment. Following the morning break John Tibby presented the third keynote address for this regional session. He discussed the reconstruction of waterhole infill and the growing threat to these precious water resources through the projected increase in drought prevalence. The morning talks continued the regional theme and research spanning the breadth of the Quaternary science field was discussed.

Kat Fitzsimmons ended the day's talks by firstly presenting a keynote address for the post-lunch session on 'semi/arid environments'. The talk discussed the reconstruction of hydrological and environmental change at Gregory Lakes in northwestern Australia during the Quaternary, and the use of OSL dating techniques for chronological control. She followed this address with a second talk focusing on

chronostratigraphic studies in the Willandra Lakes World Heritage Area and how this approach can aid insights into indigenous Australian response to long-term landscape and climate change. The afternoon continued with the NZ/OZ-INTIMATE (INTegration of Ice, Marine and TErrestrial records) meeting where discussions concentrated on how to progress the Australian component of the INTIMATE project. The day's events concluded with a well executed Quaternary trivia quiz conducted by Tim Barrows combined with a few alcoholic beverages to stimulate the brain cells.

Wednesday was a talk-free day and instead the time was filled by a field trip of North Stradbroke Island (see report in this issue). Presentations recommenced on Thursday morning with a continuation of the regional theme 'Semi/arid environments', concentrating on research from central and Western Australia. The session started with an interesting discussion on a new cosmogenic nuclide exposure dating method using Manganese-53. This was followed by talks discussing the archaeological evidence from rock shelter sites in the region. After the mid-morning break the focus switched to New Zealand. Peter Almond presented his keynote address on the NZ-INTIMATE findings and how the New Zealand-based group will advance and improve upon this synthesis. In particular he focused upon the Kawakawa tephra time slice and the regional climatic signals from various sites in New Zealand. This talk continued on from the themes recognised in the NZ/OZ-INTIMATE meeting. Subsequent talks covered a broad Quaternary science spectrum from various New Zealand terrestrial and marine sites.

Talks on the final day of the conference focused on areas outside Australasia including research from Africa, China and the Tibetan Plateau. The conference concluded after the mid-morning break with the poster presentations which covered a diverse array of topics within Quaternary Science. The meeting came to a close after lunch with newly appointed AQUA president, Peter Almond, leading our thanks and appreciation to Patrick Moss, Lynda Petherick and the rest of the Queensland University team for such a well organised and successful conference. Thanks were also directed to the talented cooking team that produced splendid food and kept the Quaternary hoard well fed throughout the week. Having said our goodbyes, we went our separate ways whilst a lucky few remained for a further night at the station to enjoy the (now) tranquil environment.

Figure 2. Sunset from Cylinder headland (photo Kirsty Wilkes).

Australasian Quaternary Association Conference Field Trip

North Stradbroke Island, Queensland, Australia

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On the third day of the AQUA conference in July on North Stradbroke Island (NSI) the group abandoned the darkened lecture studio and powerpoint slides in favour of an escapade in the field. Vivid panoramas of an evolving landscape unrolled around the bevy of Quaternary enthusiasts as we traversed the length and breadth of NSI. Island regulars Lynda Petherick and Dr. Patrick Moss were our guides and delighted us with their collective treasury of geographic facts and research anecdotes.

Our first stop landed us on the eastern edge of the island in 18 Mile Swamp – an expanse of wind-swept, razor-edged sedge and rush communities lying atop a series of sand swales undulating toward the adjacent beach. West of the swamp, tall and densely vegetated dunes stood in shadowy sentinel over some coring sites for Patrick Moss and John Tibby's research. Along the face of these dunes evidence of previous high stands marked times when the spot had been inundated by the sea.

Figure 1. Patrick Moss briefing the troops at 18 Mile Swamp (photo Kirsty Wilkes).

From here, we passed over the dunes to blustery Main Beach. Here we heard about the pulses of sand sourced from the Hawkesbury Sandstone region that pass periodically along the coast with the longshore current. It is this migrating sand that provides source materials for the island's formation. Standing within what felt like a gathering of unprecedented size for this long and desolate beach, Patrick brought us back from our imaginings of ancient sand deposition to explain the present day environmental significance of sand extraction to the island. Over the howl of the onshore winds he told us about the current sand mining lease which occupies approximately two thirds of the island, and how this status is set to change in the coming years. Sand mining is being phased out. By 2027, it is proposed that 80% of North Stradbroke Island will be protected by National Park.

Our beach vantage point was ideal for further discussion on the effect of changing climate on the coastline dynamics of southeast Queensland, and the potential issues this brings to coastal infrastructure and communities. The dry conditions which have prevailed since the 1970s have provided the setting for intense development along the fragile coast. However, recent wetter conditions will increase cyclone activity and associated coastal erosion. Craig Sloss both entertained and disturbed us with anecdotes of sinking canal estates, litigation by developers against councils who veto development plans, and the requirement for all new structures built within a certain distance of the shore to include a boat ramp on both the first and second floors.

Back on the bus and heading inland, the third stop brought the group to Tortoise Lagoon. As Lynda's PhD site, she described evidence for regional climate change preserved in the lake sediments. She described the layers of dust preserved in the record, indicating the increased influence of drier westerly winds during the LGM over the prevailing south-easterlies. The lagoon is also an Aboriginal sacred site and the only current National Park on the island.

Blue Lake and Brown Lake, named for their differences in colour and clarity, were visited next. While Blue Lake's crystal clear water (you can see clearly to

Figure 2 (TOP). View of Main Beach from Point Lookout (photo Kirsty Wilkes). Figure 3 (ABOVE). The aptly named Brown Lake (photo Kirsty Wilkes).

Figure 4. Point Look out headland (photo Kirsty Wilkes).

depths of 11 m) is the result of filtering and flushing made possible by the system's connection to both the underlying watertable and an outflow point, Brown Lake's waters resemble muddy coca-cola. The latter sits perched above the watertable and hence retains suspended sediments and tannins leached from leaf litter.

In contrast to our first stop at high-energy Main Beach, Amity Point allowed us a look at what's happening on the mainland side of the island, overlooking the calm waters of Moreton Bay. As benign as these waters look on the surface, their power to shape the island is evident. Erosion here is a significant issue, with installed rock groynes and replenished beaches showing our attempts to control it. Swimming nets provide shelter from passing Bull Sharks on their way up the Brisbane River, and a meander down the rickety jetty provides views of some of the other, less vicious inhabitants of Moreton Bay's aquatic realm.

Just before lunch the bus pulled to the side of the road and Patrick lead us to the hidden nook that is Myora Springs. This is the only pocket of rainforest remaining on the island. Beside the spring we stood atop peat deposits that have eroded considerably over time. The day ended with lunch at Point Lookout. Fish and chips, a walk around the gorge, and some high-density whale-spotting filled in the remainder of the brilliantly sunny afternoon.

Active Tephra in Kyushu 2010: International Field Conference

Workshop on Tephrochronology, Volcanism and Human Activity Kirishima City and (Kagoshima Prefecture), South Kyushu, JAPAN, May 9-17, 2010

Katherine Holt and David J. Lowe

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Figure 1. Participants of the 2010 INTAV-J meeting, with Sakurajima volcano in the background (photo courtesy of Koji Okumura).

In May of 2010 the inter-congress meeting of the INQUA International Focus Group on Tephrochronology and Volcanism (INTAV) was held in Kirishima City, Japan. INTAV was formed in 2007 at the International Union for Quaternary Research (INQUA) congress held in Cairns. It replaced SCOTAV (Sub-commission on tephrochronology and volcanism), COT (Commission on tephrochronology), and earlier groups dating back to the 1960s.

76 participants from 11 countries attended the INTAV-J meeting (Figure 1). The venue of the meeting was the Kokobu Civic Centre, which was very generously provided essentially free of charge by the Kirishima City authorities (in return for the delivery of two public lectures, one by David Lowe and the other by tephra/volcano guru of Japan, Hiroshi Machida, on Sunday 9 May). Participants were treated to a personal welcome by the Mayor of Kirishima City, Shuji Maeda, followed by what appeared to be a very special (and delicious) banquet. However, this spread turned out to be standard lunch and dinner fare provided by the Civic Centre cafeteria and was enjoyed by participants on several occasions during the meeting. Mayor Maeda graciously invited the entire conference group to his personal residence for another spectacular banquet on Monday evening which included the use of dining 'rooms' in caves cut into the c. 30 cal. ka Ito ignimbrite. Traditional Kagoshima fare was put on, accompanied by the local alcohol 'sho-chu', which is made from fermented sweet potato and is not altogether unlike its Russian cousin vodka.

Sukurajima volcano provided a stunning backdrop for a tephrochronology meeting. The volcano has been in a state of ongoing activity since 1955, with approximately 8670 eruptions since 1955, and well over 500 eruptions

already this year. Several small vulcanian eruptions occurred during the meeting, with the first on Tuesday afternoon, exactly as the meeting broke for coffee.

The beauty of such a small gathering of specialists is that there is no need for multiple concurrent sessions, and with 48 talks and 38 posters presented over the 3 days, it was possible to attend every talk and view each poster. Session themes included:

- Tephrochronological frameworks and palaeoenvironmental reconstructions (marine, ice-cores, and terrestrial records), such as INTREPID, INTIMATE and PAGES projects
- Tephra studies and archaeology
- Regional studies
- Geochemical protocols and methods and their development
- Chronological development and databases
- Objective correlation and quantification of uncertainty
- Explosive volcanism
- Magma genesis
- Hazards in volcanic regions

One of the highlights of the oral sessions was a special session on the recent Icelandic eruption from *Eyafjöll* volcano. Presenters Chris Hayward, Thor Thordarson (both University of Edinburgh) and Siwan Davies (Swansea University) presented and discussed some of the first results produced from this 'world stopping' eruption event. It became very clear during the course of the meeting that this series of eruptions will provide an excellent opportunity to enhance knowledge on cryptotephra from Icelandic volcanoes, which are being increasingly utilised for time control in the Northern Hemisphere ice and marine core records. An INTAV-sponsored research project on the eruptives is being planned (see Davies *et al*., 2010). Another highlight was the high-quality invited keynote addresses, of which there were six (each up to 40 minutes): Nick Pearce (UK) (LA-ICPMS applications in tephrochronology), Duane Froese (Canada) (Yukon-Alaskan Quaternary studies linked by tephras), Siwan Davies (UK) (tephras in ice cores), Simon Blockley (UK) (tephra age modelling tephras including via Bayesian studies), Mitsuhiro Nakagawa (Japan) (petrology and eruption processes of Shikotsu and Aira calderas), and Takeshi Nakagawa (latest geochronological and analytical work on the Lake Suigetsu varved sequence).

The majority of the presentations given (other than purely technical talks) were concerned with tephrochronology in the Northern Hemisphere or Japan. Only 6 or 7 presentations discussed Southern Hemisphere studies, which was a little disappointing, but on the positive side there has been an explosion of interest in (crypto) tephra studies in western and central Europe. Australasia-focussed talks and posters included:

Quaternary stratigraphy and tephrochronology in the Chatham Islands, New Zealand.
K.A. Holt, V.E. Neall & R.C. Wallace

Tackling uncertainty in tephrochronology: objective 4 of the INTREPID project.
D.J. Lowe

Using tephrochronology to define and date the base of the Holocene for Australasia at Lake Maratoto (New Zealand) - an auxiliary stratotype for the Holocene GSSP.
D.J. Lowe & R.M. Newnham

Fingerprinting volcanic glasses unravels a new volcanic history for Ngauruhoe Volcano, New Zealand.
A. Moebis, S.J. Cronin, I.A. Smith

Merging eruption datasets: Building integrated eruptive records and realistic eruption forecasts.
M. Turner, S.J. Cronin & M. Bebbington

Developing methods for correlation of basaltic tephra layers to their volcanic sources in the Auckland Volcanic Field.
A. Zawalna-Geer & P. Shane

Two one-day mid-conference fieldtrips were put on as part of the meeting, with the cost included in the relatively modest registration fee. Unfortunately the foot-and-mouth outbreak in the neighbouring Miyazaki region in mid-late April forced a change in the proposed field trip routes, but nevertheless some excellent sites were visited.

The first field trip began with a visit to the Uenohara Jomon-no-mori archaeological centre, where remains of a 9,500 year-old Jomon period village have been preserved under layers of ash from repeated eruptions from Sakurajima and other surrounding volcanoes. We then travelled southwards towards Sakurajima itself. Sakurajima is a post-caldera volcano, approximately 26,000 years old and has produced numerous large plinian eruptions over its lifetime as well as vulcanian and stromblian activity. It was formerly an island in Kagoshima Bay, but during the Taisho eruption of 1914 (Figure 2), lava flows from the eastern craters of the volcano linked the western flank of the volcano to Osumi Peninsula.

While visiting the volcanic fan of Jigokugawara on the eastern flank of the volcano, participants were lucky enough to witness two small vulcanian eruptions from Showa Crater (Figure 3). This provided a real treat and really made the conference for many. After dragging the contingent of volcano-watchers back into the waiting buses, the trip proceeded to the western side of the volcano to the observatory to view more 20th century lava flows. Here we were again treated to a small vulcanian eruption.

The second mid-conference field trip took participants into the hills behind the town of Takatoge. We first visited an exposure of tephra and soil layers overlying the c. 30 cal. ka Ito ignimbrite. Most of these layers are derived from Sakurajima, and participants were quick to attack the section with newly purchased 'negeri gama' scraper tools. We then visited Tenjindan archaeological site, another Jomon era site which

Figure 2. Eruption from Showa crater, Sakurajima volcano, 12 May 2010.

was recently discovered during construction of a new roadway. Here a similar sequence of tephras to the previous stop was exposed. Various archaeological artefacts dating back beyond 26,000 years have been unearthed at this site, including pottery, china, stone tools, ovens, cooking pits and remains of dwellings. One of the oldest tephras from Sakurajima (Sz-Tko, 26 cal. ka) provides a critical datum for constraining the timing of human settlement in the southern Kyushu region following the catastrophic Ito ignimbrite eruption at c. 30 cal. ka, and numerous archaeological remains have been found between the Ito ignimbrite and the Sz-Tko tephra. Sites such as Uenohara and Tenjindan really emphasised just how limited our own New Zealand archaeological history is. This was further illustrated by David Lowe's pre-conference public lecture on using tephra to constrain arrival of humans in New Zealand. In this instance we have 2 or 3 marker tephra that are used as marker beds for humans in New Zealand, spanning back some 700 years, compared with southern Kyushu, where tephras and evidence of human activity are interbedded over a period of 26,000 years (or more)!

After leaving Tenjindan we proceeded to the coast at Fumoto to see a spectacular exposure of the deposits of the Aira tephra formation (Figure 4). This formation was produced by a huge eruption (>450 km^3) from Aira caldera at approximately 30 cal ka. The formation consists of a basal plinian fall (Osumi pumice fall) overlain by an intraplinian flow (Tarumizu ignimbrite) from the first phase of the eruption, followed by a post-plinian flow (Tsumaya ignimbrite, not present at Fumoto) during phase two, overlain by a huge thickness of Ito ignimbrite deposited during the climactic phase of the eruption. Exposed in a c. 20-30 m cliff exposure, these deposits were reminiscent of our own Taupo-derived pumice pyroclastic flows and falls, and occurring at roughly the same time, the similarity between the Aira and Oruanui eruptives was remarked upon on more than one occasion.

To close the meeting, participants were treated to yet another spectacular banquet, held this time at the Satsuma Brewery. Food, beer and sho-chu were consumed in vast quantities, topped off by an impressive Taiko drumming performance.

The meeting was then followed with a three-day post-conference field trip attended by 37 participants. The trip traversed some spectacular landscapes and included visits (via ferry crossing) to the dramatic, rather ominous-looking Unzen volcano as a feature of

day 1. Deposits from the 1990-1995 Unzen eruption series included lava domes, block-and-ash flow deposits, and pyroclastic flow deposits. Older tephras, lahar deposits, and debris flows were also visited. Day 2 featured the extremely impressive, 30-km-wide Aso caldera and associated deposits and volcanoes. Within Aso caldera, the summit crater of the basaltic-andesite to basaltic stratovolcano of Nakadake is currently emitting volcanic gas (mainly SO_2) and participants all noted the effect (stinging in the eyes) of such gases as they traversed the active crater area. Boardwalks and stalls, and the arrival of a Harley Davidson motorbike group (complete with a dog in a back-pack), all added to a slightly bizarre but immensely enjoyable, memorable, and instructive atmosphere amidst the landscape of ash deposits, blocks, and bombs. Aso caldera had large numbers of flooded paddy fields on its extensive floor, formed following harvest of winter wheat crops a week or two earlier. After leaving Aso, participants viewed Aso-derived eruptives including fall and flow deposits beautifully exposed in three dimensions in an old tunnel accessed by a wonderful walk through languid, hilly countryside. On Day 3 the featured volcanoes were Kuji and Yufi-Tsurumi and their products. At many stops on the three-day excursion, two very widespread tephras were frequently evident, namely the 7.3 cal ka K-Ah tephra and the c. 30 cal ka AT tephra. The trip concluded at Beppu in time for participants to catch trains or planes or to stay overnight in the famous geothermal spa town.

The next INTAV meeting will be at a symposium planned for the 2011 INQUA congress in Bern: "Advances in tephrochronology and its application to archaeology and past-environment studies". The date and location of the next Inter-INQUA INTAV conference will be decided at Bern.

Reference

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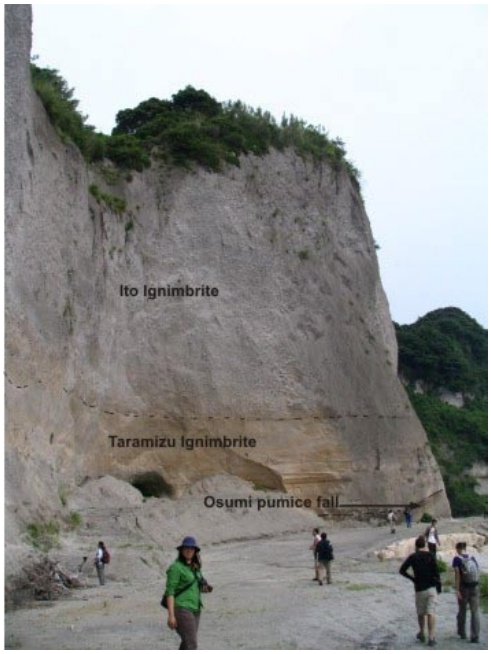

Figure 3 (BELOW). Torii (gateway to shrine) at Kurokami village, buried in 2 metres of pumice fall from the Taisho eruption in 1914.

Figure 4 (RIGHT). Aira tephra formation at Fumoto.

Global Sand Seas: past, present, future

Monday 18th October 2010

Paul Hesse

A group of about 50 people attended this special one-day meeting held at the Royal Geographical Society in London and organized by the Sand Seas and Dune Fields Working Group of the British Society for Geomorphology. Amidst the autumn chill and the sound of the razor being wielded on education and research expenditure not far away in Westminster, this meeting showcased some of the exciting developments in the study of sand dunes, sand seas and desert environments around the world.

Some of those developments are the collaborative efforts to bring together the geomorphology, climatology and Quaternary history of sand seas. The Namib Working Group (of the BSG) has led the way in a case study of this sand sea collating the sparse and temporally patchy wind data, DEM and remote sensing of surface properties. Kevin White (Reading), Joanna Bullard (Loughborough) and Andreas Baas (King's College) explained the challenges and possibilities of using publicly available remotely sensed surface data and observed and reanalysis meteorological data to infer sand dune morphological properties, vegetation status, wind regime and the future evolution of the dunefields. In this last study (Baas) the dune morphology (DEM) and wind regime are linked in a cellular automation model of sand dunes capable of modeling dune migration and evolution. For the larger, bare dunes realistic scenarios can be simulated but there are limitations imposed by the 30m resolution DEM and limited (and sometimes inaccurate) wind data from the centres of the dunefields.

There is also a larger global project (INQUA Dunes Atlas) working towards a database of all Quaternary (i.e. luminescence, radiocarbon, cosmogenic) dates on

Figure 1. Michael Palin and Andrew Goudie fielding questions at the evening lecture. Photo: Stephen Wolfe.

Figure 2. The remains of the tree under which the eminent surveyor and scientist David Livingstone's heart was buried, Royal Geographical Society display. Photo: Paul Hesse.

desert sand dunes. Nick Lancaster (Desert Research Institute, Reno) spoke of the status of this project (which will be reported at INQUA Bern) and the plans for the public Google Earth interface. Stephen Wolfe (Geological Survey of Canada) spoke about the Canadian dune database and illustrated the potential to understand dune development and post-glacial environmental change in Canada using this approach. Several speakers addressed the processes of dune formation and the contemporary and Quaternary climatic interactions. Yang Xiaoping (Academia Sinica) illustrated the climate fluctuations leading to desertification in Chinese deserts and the slender thread by which human populations hang to life within dunefields. In these hyper-arid environments dunes can be robustly active even without particularly windy conditions. Conversely, in 'wet deserts' like Australia, Kat Fitzsimmons (MPI Leipzig) illustrated the prevalence of soil formation and the application of sedimentological study in understanding dune history. I also tried to contrast these two types of deserts and dunes (hyper-arid and semi-arid (for want of a better term)) and their different responses to Quaternary climate change. Phillippe Claudin (CNRS Paris) talked of his group's research into the underlying physics of dune growth and the limits of dune development – again highlighting the contrast in behaviour between dunes where sand availability is unlimited, and more stable dunefields typical of Australia, South America or the Kalahari.

Further talks addressed the importance of understanding climate change in the African deserts to assess hypotheses for the expansion and migration of human populations out of Africa, how people live in sand seas today and how extra-terrestrial dunefields (Mars, Titan) challenge our understanding and resourcefulness.

All small meetings have a social dimension often missing from large conferences and this was highlighted by the evening keynote lecture by Andrew Goudie which also formed part of the regular Monday evening public lecture series of the RGS. The large auditorium was almost at capacity with an enthusiastic audience, the proceedings moderated by RGS President Michael Palin. His performance in taking some rather obscure questions from the audience was superb for his ability to suppress the same urge to laugh that had the rest of us in stitches. Dinner with members of the Society and Club afterwards, beneath portraits of explorers and adventurers, capped a very rewarding meeting.

21st Biennial Meeting of the American Quaternary Association (AMQUA)

University of Wyoming, Laramie, 12-17 August 2010

Esmée Webb

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I always enjoy attending AMQUA conferences. The attendees may be fewer in number (170 this year) than the hordes who attend the Society for American Archaeology or Geological Society of America meetings, but they are collegial and congenial and the fieldtrips are always fun. Visiting North America once every four years (for alternate meetings) keeps me in contact with colleagues and up-to-date on the latest research on when humans first reached the New World, long one of my research foci (Webb and Rindos 1997). I was particularly keen to attend this meeting for the session on *Ancient DNA and the Peopling of the Americas*. Ripan Mahli (Illinois) and Cristina Valdiosera (Copenhagen) concurred that the classic 'Clovis first' scenario in which people reached the Americas from eastern Siberia about 15,000 BP best fits the available data. Liz Hadly (Stanford) described how pocket gopher (*Thomomys* spp.) populations in California evolved in response to climate change.

Unlike AQUA meetings where anyone can present a paper on any Quaternary-related topic, AMQUA meetings are focussed. The subject of this meeting was *Exploring the Pleistocene-Holocene boundary in the Americas: from molecules to continents*; the speakers were selected by the organising committee. Anyone may present a poster, however. There were 66 poster presentations at Laramie covering the full gamut of Quaternary-related topics.

AMQUA was preceded on 10 - 11 August by a workshop on *Teaching Climate Change from the Geologic Record* organised by Karin Kirk (Carleton) that began with a public lecture by David Meltzer (SMU) on *Humans in the Late Glacial landscape*. Dave's ideas are covered in his book *First peoples in a New World: colonizing Ice Age America*. The 30 workshop participants all taught at university level, so I found it curious that they approached the evidence for global warming very cautiously. Nonetheless, the workshop was worthwhile and we got to play with a number of very useful databases, including faunmap, pollen viewer and neotoma. Although they deal exclusively with American data, there is nothing comparable yet for Australia.

AMQUA field trips are wonderful ways of seeing country and biogeographic evidence I would not otherwise be aware of. I was delighted to see Herb Wright (Figure 1), one of the 'grand old men' of the American Quaternary, on the pre-meeting fieldtrip to the Laramie Basin and Medicine Bow mountains on 12 August. We visited short-grass prairies at 2150 m altitude and the sub-alpine forests and parklands of the Snowy Range, whose spectacular peaks rise to 3350 m – real *Brokeback Mountain* country (Figure 2A). We saw para-glacial geomorphic features in the basin (Figure 2B), terminal moraines at the base of the mountains (Figure 2B), an exposure of laminated pro-glacial lake sediments at mid-elevation (Figure 2C) and high-elevation lakes and glacial features at the mountain crests (Figure 2D).

Figure 1. Herbert Wright Jr, still interested and in the field at 90 something.

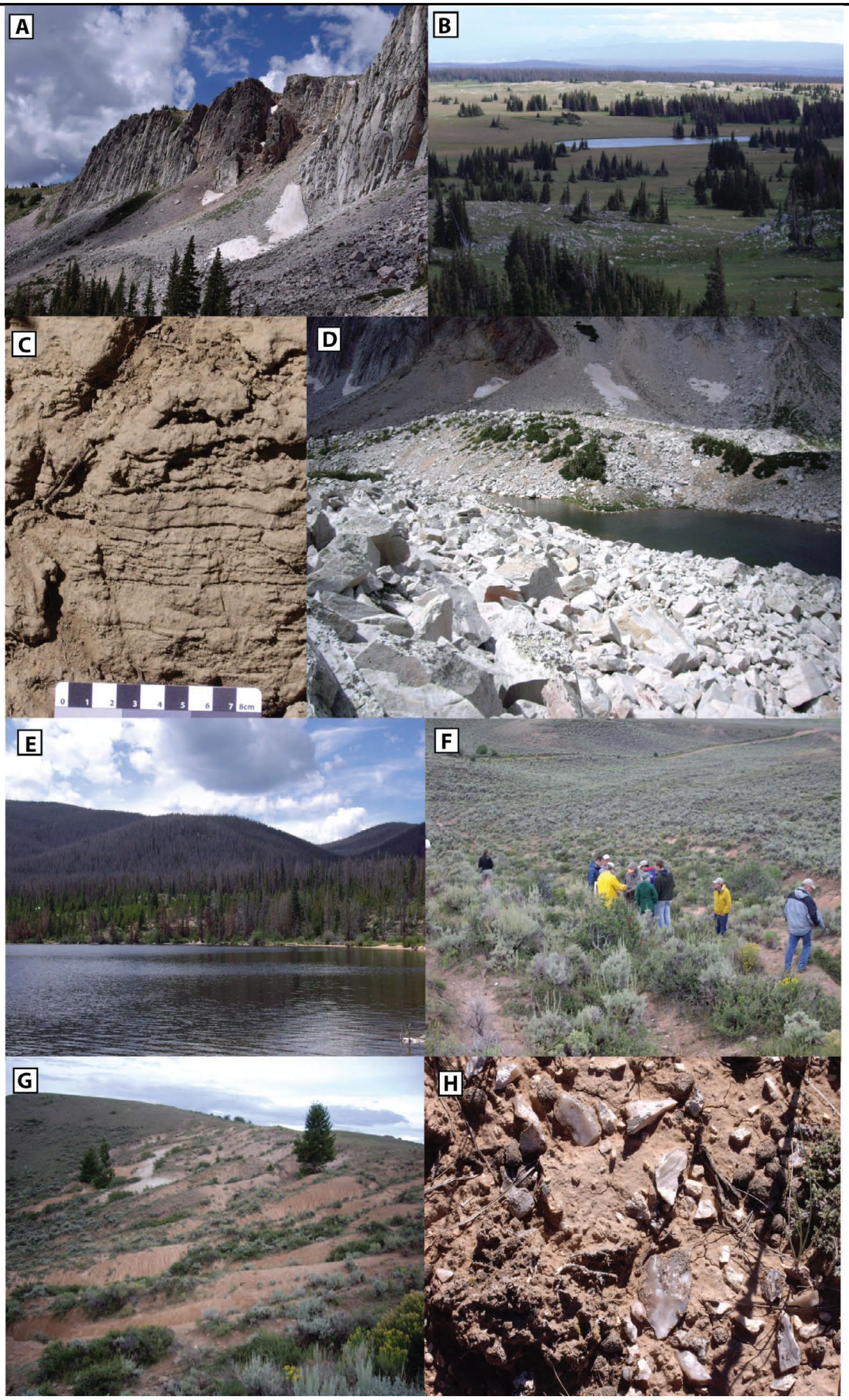

Figure 2: **A.** Spectacular peaks in the Snowy Range, Wyoming; **B.** 'Dead ice' topography in the Laramie Basin; **C.** Laminated pro-glacial lake sediments at mid-elevation in the Laramie Basin; **D.** A high elevation glacial lake and rock moraine in Medicine Bow National Park; **E.** A moraine-dammed lake in North Park, Colorado. The trees are suffering 'die back'; **F.** AMQUAns in deep discussion at one of Marcel Kornfeld's Palaeo-Indian sites in Middle Park; **G.** Gully erosion in Middle Park. Bison were driven down these slopes and butchered at the base; **H.** Waste flakes of chalcedony near a bison kill site in Middle Park; the only stone tools I saw!

AMQUA proper began on 13 August with the DNA session. Russ Graham (Penn State), Jacqui Gill (Madison) and Eric Grimm (Illinois State Museum), discussed how plants and animals responded to environmental change during the Pleistocene-Holocene transition. There are no analogues for some of the environments that existed 25,000-5000 BP. Russ and Jacqui, another student presenter, also addressed another of my core interests, megafaunal extinction (Webb 1998). Day 1 ended with Jack Hofman (Kansas) and David Rhode (Desert Research Institute) considering how people responded to environmental change on the Great Plains, in the Rocky Mountains and the Great Basin. Marcel Kornfeld (Wyoming) gave an overview of the archaeology of the High Plains, which I visited on 16-17 August.

Day 2 started bright and early with Joe Mason (Madison), Vance Holliday (Arizona), Ed Hajic (Illinois Museum), Dan Muhs (USGS) and Lee Nordt (Baylor) discussing landscape responses to climate change with respect to loess deposition, lake level changes, river regime changes, sea level change and the stable carbon isotope record in plants. That session was followed by the AMQUA awards ceremony and business meeting: Distinguished Career awards to George Frison (Wyoming) and Peter Birkland (Colorado); Eric Grimm is now President. After lunch, Al West (Geoscience Consulting), Todd Surovell (Wyoming), Ted Bunch (Flagstaff), Mark Boslough (Sandia Labs), Jim Kennett (Santa Barbara) and Nick Pinter (Carbondale) debated Firestone's hypothesis that the Younger Dryas (YD) cool period was the result of cometary impact and caused megafaunal extinction. The speakers were alternately for and against the hypothesis. Discussion grew quite heated at times, but remained well behaved! Ultimately, the speakers had to agree to disagree, while admitting that more data are needed.

The traditional banquet followed this session: roast bison, we were in Wyoming, after all. I discussed one of the most notorious allegedly pre-Clovis sites in North America, Calico Hills in the Mojave Desert, with Eric Scott (San Bernadino Museum). Because Louis Leakey thought some of the geofacts found there *could* be artefacts, the site refuses to die, unfortunately.

The last day of the conference, began by considering glacial dynamics. Thom Davis (Bentley), Shaun Marcott (Corvallis), Dave Ullman (Madison) and Julian Murton (Sussex), discussed alpine glaciers, ^{10}Be dating of cirques, the maximum extent and rate of decay of the Laurentide icesheet and the flood path (melt water channel) from Lake Agassiz to the Arctic Ocean, respectively. This work also has relevance to how humans adapt to rapid landscape change. Shuan and Dave were to be congratulated on the quality of their papers. Both presented their doctoral research.

In the final session Bob Thompson (USGS) discussed the botanical record of the Pleistocene-Holocene transition, Adrian Melott (Kansas) considered atmospheric chemistry and Peter Clark (Corvallis) discussed forcing mechanisms and global responses.

As far as I was concerned, the organising committee (chaired by Steve Jackson, Wyoming) had saved the best till last. Amongst many provocative ideas, Clark argued that massive melt of *Antarctic* ice caused the YD, *not* cometary impact. If Clark is correct, we could look for a YD signal in pollen and other proxy records in southern Australia. Certainly, I propose to check those Western Australian pollen records that go back far enough to record a cold phase about 12-11,000 cal BP. Steve and Rolfe Mandel (Kansas, President of AMQUA) then wrapped up the meeting. They are to be congratulated on organising an excellent programme.

After lunch, I joined the optional hike (actually it was a stroll, albeit at 3000 m) to Medicine Bow National Forest. The scenery was stunning.

On 16-17 August, we drove down to North Park and Middle Park in northern Colorado, where the Platte and Colorado Rivers begin. We stayed in the tiny town of Kremmling at an hotel built in 1906. The parks are >2500 m, montane valleys amid a series of mountain ranges whose peaks reach 4000 m. In North Park, we visited terminal moraines related to the ice cap that covered the Continental Divide and moraine-dammed lakes that are the second largest in Colorado (Figure 2E). Now, the lakes overflow into the North Platte River, but flow ceased in the mid-Holocene. In Middle Park, we visited several Palaeo-Indian sites that provide a unique view of the earliest occupation of the southern Rocky Mountains (Figure 2G).

AMQUA 2012 will be in Duluth, Minnesota. In 2014, it will be at the Hot Springs Mammoth site, South Dakota.

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National Committee for Quaternary Research

Allan Chivas and Craig Sloss

Allan Chivas: University of Wollongong
Craig Sloss: Queensland University of Technology

The Australian Academy of Science's National Committee for Quaternary Research (NCQR) reconvened on 11 November 2010, in Canberra, for the first time since the last INQUA Congress in Cairns (July 2007). Part of the responsibilities of the NCQR is to undertake discipline reviews, initiate forums, prepare submissions to government, provide advice to the Academy Council, and to contribute to science policy issues. The Academy of Science is also Australia's adhering body to the International Union for Quaternary Research (INQUA), and the NCQR is concerned with liaison with INQUA, The Australasian Quaternary Association (AQUA) and other professional organisations interested in Quaternary research nationally and internationally.
The current committee's composition is:
Allan Chivas (U Wollongong) (Chairperson)
Craig Sloss (QUT) (Deputy Chairperson)
Richard Hobbs (Plant Biology, UWA) (Academy liaison)
Michael Bird (JCU)
Brad Pillans (ANU)
Steven Phipps (UNSW)
Mike Smith (National Museum of Australia)
Pauline Treble (ANSTO)
Jon Woodhead (U Melbourne)

Figure 1. National Committee for Quaternary Research. Top row (L-R): Mike Smith, Brad Pillans, Michaeil Bird; Middle (L-R): Jon Woodhead, Craig Sloss; Front (L-R): Pauline Trebble, Allan Chivas, Steven Phipps. Phote: Jeanette Mills.

At the November meeting, the committee discussed the forthcoming INQUA Congress (Bern, Switzerland, July 2011), noting financial support schemes by INQUA and AQUA to assist attendance by young scientists (deadlines 3 December and 30 November, respectively). Craig Sloss and Steven Phipps will be Australia's voting delegates to the INQUA International Council in Bern and, accordingly, assist in deciding incoming INQUA office-bearers and the venue for the 2015 INQUA Congress, as well as general matters. There will be an opportunity for a meeting, in Bern, of all Australian participants, to discuss Australia's voting intent on these matters. The NCQR also supported a joint bid from AQUA, the University of Wollongong, the Australian Nuclear Science and Technology Organisation (ANSTO) and the Australian Institute of Nuclear Science and Engineering (AINSE Ltd) to hold the 2013 PAGES Open Science and Young Scientists meetings in Australia.

The principal activity for the NCQR for the next two years will be the preparation of the first national position paper and strategic plan for Australian Quaternary Research. This is intended to be comprehensive and include all Quaternary researchers in Australia in the preparation of an initial statement of capabilities. Accordingly, sometime before April 2011, all Quaternarists will be approached to provide brief details about scientific interests and resources. The more strategic aspects will progressively follow, and be discussed and formulated in an open forum at the AQUA bi-annual conferences.

Kershaw-fest 2010 – the Peter Kershaw Retirement Symposium

1-2 November 2010
Royal Society of Victoria, Melbourne and School of Geography and Environmental Science (SGES), Monash University, Clayton.

Tara Lewis

Figure 1. Tyrendarra Swamp, western Victoria 2005, species from left to right *Eleocharis sphacelata, Rumex bidens, Peter Kershaw, Villarsia reniformis.* Photo: Tara Lewis.

On Monday the 1st November 2010 an excited group of Quaternarists gathered at the Royal Society of Victoria in the heart of Melbourne to celebrate the career of Professor Peter Kershaw (APK). The grand building was a fitting place to hold such a memorable event. We were welcomed by the Royal Society CEO who gave us a history of the Society and noted that this will be Peter's 12th and final year serving as a councillor on the Society committee.

The day saw the congregating of 85 local, interstate and trans-Tasman guests. The invited speakers for the day were Matt McGlone, David Mercer and Homer Le Grand, Martin Williams, Jim Bowler, Patrick De Deckker, John Dodson, Richard Cosgrove, Lesley Head, Peter Gell, Patrick Moss, John Tibby and Kale Sniderman.

The keynote address of Matt McGlone provided a humorous and informative reflection on the trans-Tasman connection, pointing out that when New Zealand is removed from a world map not even they notice the omission! We were then taken back to Phase 1 of a possible six phases of the Monash School of Geography (now SGES) by David Mercer, former head of school, and through Peter's career there. We were told that he entered the department during Phase 2 and has remained ever since. Homer Le Grand, former Dean of the Faculty of Arts at Monash talked of the fruitful relationship with the SGES; in response, Peter told of an application for support for an OSL facility at Melbourne University for Bert Roberts. The Dean's response was to support his application commenting that he'd just written a paper on single-grain Optically

Figure 2 (TOP). A pensive Matt McGlone. Photo: Kara Rasmanis. Figure 3 (ABOVE). From left to right Matt McGlone, Patrick De Deckker, Peter Kershaw and Simon Haberle. Photo: Kara Rasmanis.

Figure 4. Homer Le Grand. Photo: Kara Rasmanis.

Stimulated Luminescence dating, both much to Peter's surprise, not having expected a Dean of Arts to support or acknowledge the importance of such an endeavour.

Patrick De Deckker chose to adopt the oceanographers' method of applying the names of people in their field to certain events by naming the Peter Kershaw Event, much to the amusement of the audience. He also produced a T-shirt for Peter with a diagram showing the APK Downfall in the late Holocene corresponding with a reduction in sea surface temperature in Core MD 2611.

The speakers of the day were all of high calibre, being leaders in the Quaternary field and former students of Peter's. We were treated to a series of papers covering a diverse range of fields. Some of those were presented by Peter's past students and their varied contributions demonstrated the breadth of study that can stem from palaeoecological beginnings. The inspiration provided by Peter to generations of budding Quaternary scientists was emphasized on multiple occasions throughout the day. It was clear from many of his graduates that over the years he has provided high levels of guidance, support, inspiration and the flexibility to develop their own lines of independent enquiry. This was reflected in the areas of expertise engaged in by Peter's past students.

Many entertaining anecdotes were recollected over the course of the day. As far as I am aware Peter remained awake throughout the entire proceedings, a sure commendation to the presenters and possibly a conference first for Peter! Heartfelt thanks were expressed for Peter's contributions to Quaternary Science in Australia. His continued involvement in the field helped lay the solid foundations for the research environment we find ourselves in today. Peter acknowledged the fine work of his friend and collaborator Merna McKenzie, who continues to support him on the technical side of his work by producing many high resolution pollen records.

The party migrated to Coopers Inn where the merriments commenced. Beer was the drink of choice.

Figure 5. The congregation for the Kershaw-Fest. Photo: Kara Rasmanis.

Coinciding with Melbourne Cup Eve, we were lucky enough to be able to participate in mock horse races and betting for charity. While being unexpected, this activity provided some light entertainment. The group reduced in size and headed to Crystal Jade restaurant in China Town. A transition was made to red wine; drinking from the bottle was not unheard of. The fried tofu was delectable. The minced pork and vegetable dish bore a striking resemblance to a shallow lake filled with the submerged macrophyte *Vallisneria*. A resilient few then chose to dance the night away.

Celebrations continued on Tuesday with a more informal lunch at Monash University. An impressive spread was provided and an array of colourful hats were sported to mark the running of the Melbourne Cup. The two day event was a great success and enjoyed by all. Many thanks to the organizing committee Cassandra Rowe, Simon Haberle and Priya Rangan for coordinating the events, to Heather Fletcher and Bianca Roggenbucke for catering and to Kara Rasmanis for taking photographs on the day.

A volume of contributions entitled 'Human landscapes: Biogeography, Geomorphology and Archaeology. Collected papers in honour of Peter Kershaw', edited by Simon Haberle and Bruno David is expected to be published in Terra Australis, volume 34 in mid 2011 to commemorate the event. Though Peter is officially retiring, we hope he will not be leaving the Quaternary world just yet as he still has much to offer to the palaeoecological community. After a career so far spanning 46 years, over 150 peer-reviewed papers, 16 co-authored books or journal special issues, 25 completed PhD students, numerous masters and honours students, and many Bob Dylan renditions after a hard day of field work over a few 'quiet' beers, our wish is that the next 40 years will be as productive, diverse and fun!

Figure 6. Time for siesta: All tuckered out after two days of celebrations. Photo: Kara Rasmanis.

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Correlation of river terrace sequences: Widden Brook, Australia

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Terrace sequences can represent regional or continental scale factors such as climatic fluctuations, neotectonic activity and base-level change. However, they can also reflect random incision events brought about by local scale, geomorphic threshold exceedance and subsequent complex response. Through the description and interpretation of the physical landscape and by use of a detailed construction of the chronology, this study explores the formative processes of three discontinuous but adjacent, Late Quaternary step-terrace sequences.

Terrace remnants on Widden Brook, a sandy alluvial stream in southeastern Australia, were examined and correlated longitudinally to establish their evolutionary history. Three distinct, discontinuous terrace sequences, the Baramul, Widden and Kewarra, were identified within a 26 km reach using sedimentology, topography and chronology. Each terrace sequence occurred within a geomorphically distinct valley setting; an upstream constriction, a valley expansion and a highly constricted downstream section. Combined use ^{14}C and OSL dating techniques allowed for a more rigorous assessment of the alluvial record and indicated that each terrace sequence was formed during the late Pleistocene and Holocene (16.7 ka cal BP – 0.5 ka cal BP). The three terrace sequences identified yielded, continuous chronologies, indicating continuous alluvial deposition throughout the Holocene. A geomorphic model of floodplain abandonment and terrace formation for this valley setting was then constructed.

The confinement of these sequences within the different valley settings and the continuous chronology was a clear indication that localised processes have influenced their formation. Most of southeastern Australia has shown no evidence of tectonic uplift during the late Quaternary. Bedrock bars on the Hunter River isolate the study reach from downstream base-level changes. The non-synchronous, episodic behavior of incision events, in this catchment, strongly indicates that climate is not a dominant control on terrace formation. The Widden catchment, therefore, provides an ideal landscape to discriminate regional from local controls on terrace formation. These terraces reflect random incision events brought about by intrinsic threshold exceedance. This process was intermittently interrupted or accelerated by large-scale events that stripped sections of the floodplain down to a basal gravel lag. This study emphasises that random geomorphic threshold exceedance must be considered when relating incision events to wide-scale allogenic factors.

Late Quaternary Environments of Freycinet Peninsula, Eastern Tasmania

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A palaeoecological study of the late Quaternary from Hazards Lagoon on the east coast of Tasmania is the first complete palynological record for the region and reconstructs a picture of vegetation and environmental change since the Last Glacial Maximum. By comparing key regional studies to the findings from Hazards Lagoon broad scale change in vegetation composition are identified, which are likely to be responding to periods of climatic and sea level change in the Southern Hemisphere. Pollen and charcoal analysis identify a steepe community being established on the east coast of Tasmania during the height of the Last Glacial Maximum developing into an open *Eucalypt* forest 17,000 yrs BP in response to regional climatic amelioration. The Hazards Lagoon record suggests a significant change in the catchment morphology from a permanent lake surrounded by steepe and woodland during the Last Glacial Maximum to the development of a peat swamp and the local establishment of a sclerophyll forest during the last termination. During the Holocene extant vegetation composition and local fire regimes at Hazards Lagoon have responded to rising sea levels, the onset of modern climatic factors and human occupation. The palynological record from Hazards Lagoon provides the oldest study of the late Quaternary for the east cost of Tasmania and has been compared to key sites within Tasmania and south-eastern mainland Australia identifying temperature and precipitation as the climatic constraints on the development of vegetation since the last glacial maximum. While there are similarities seen between sites, further research into the late Quaternary dynamics of eastern Tasmanian are needed to support these initial findings.

Unveiling Rock Art Images: A Pilot Project Employing a Geophysical Technique to Detect Magnetic Signatures

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The use of geophysical techniques in archaeology has become widespread; however these methods have rarely been applied to rock art research. There is a need to record and document rock art images as they face deterioration from environmental, industrial and human impacts. This project trials the use of a magnetic susceptibility (MS) meter to non-invasively detect and spatially resolve ochre rock art images. Ochre is frequently used in rock art production and previous research in other contexts has shown that it emits a MS signature due to its inherent magnetic characteristics. These ochre images can be hidden behind silica or carbonate crusts or may deteriorate over time limiting their visibility. The rock art images that lie behind such crusts are likely to be protected from weathering and are amenable to dating using such techniques as uranium-series and radiocarbon accelerator mass spectrometry (AMS).

This research demonstrates that, if present in sufficient abundance, red ochre can be imaged and spatially resolved with a MS meter when applied to a rock face in a variety of geological environments. The type of binder used, pre-application heating or the rock type does not appear to have a significant effect on the viability of the technique. More important to the success of a survey is the equipment setting, spatial resolution of the survey and the use of a correction to control instrument drift.

Imaging ochre beneath a proxy crust was trialled without success; however this is attributed to poor survey design rather than a fundamental problem with the technique. The success of this trial demonstrates the validity of continuing investigations in the emerging field of rock art geophysics and highlights the importance of future trials on field sites.

Human impact recorded in sediment cores from estuarine environments – an example from Moreton Bay, southeast Queensland, Australia

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Coastal marine embayments and intertidal areas are important ecologic environments supporting high biodiversity. Increasing urban and industrial development along the coast is posing increasing pressure to these natural environments, by altering the natural processes controlling sedimentation, and by potentially increasing the flux of heavy metals from the catchments to the sea. Moreton Bay in southeast Queensland (Australia) has high ecological significance, and since European settlement in ~1824 the Bay has been subjected to rapid and drastic modification, with deforestation, and changes in land use and industrialization. A temporal record of these changes is preserved in the sediments deposited across the Bay.

This study investigates the extent of human impact recorded in sediment cores from intertidal areas across the shores of Moreton Bay, evaluating temporal and spatial variability of trace metal contamination associated to increased urban development. A total of forty sediment cores were collected from intertidal mud sand flats in different parts of the Bay and with different impact histories. Total metal concentrations and the exchangeable fraction of metals were determined on fifteen representative cores, together with sedimentologic analyses (grain size, volatile content, and XRD). Short-lived radionuclide activities were measured in nine cores to obtain precise geochronologies (^{210}Pb and ^{137}Cs).

The integration of sediment geochronology with geochemical and sedimentary characterization allowed the definition of a natural geochemical background that can be used to quantitatively assess the impact of European settlement in Moreton Bay.

The ^{210}Pb geochronology associated with ^{137}Cs dating provides a record of sediments deposited in the last ~100 years. Sedimentation rates obtained varied between 0.20 cm/y and 0.69 cm/y, and show that sediment deposition is controlled by local factors (river discharge, tidal action, catchment land use) in each area, and that sedimentation has high spatial variability across the Bay. Increasing sedimentation rates over the past ~100 years (e.g in the Pine River from 0.31 around 1906, to 0.71 cm/y in the present days) corresponds to the period of major development in the area, and is a consequence of European land use intensification.

Geochronological data were integrated with down-core trace element distributions to establish pre-European trace metal backgrounds in the Bay sediments. Crustal elements such as Al, Fe, Ti, and rare earths were used as proxies to define the natural background. The increasing temporal trends in Pb, Zn, Cd, and Ni were correlated to the major periods of development in the Moreton Bay catchments (deforestation for agriculture development, industrialization, and urban expansion). Two main periods were identified: 1) A pre-European settlement period (pre-1824), when the natural variability of sediment supply and metal contribution to the Bay was not significantly disrupted by human activities; and 2) a post-European settlement period (post-1824), which can be further subdivided into a period of relatively low impact until 1930, and a phase of major development between 1930 and 1990. Overall metal concentrations increased from about one to two orders of magnitude since about 1920, compared to background values.

Results from the cores collected in Moreton Bay show that the record of anthropogenic contamination is preserved, but is related to the physiographic characteristic of the bay. The combination of ^{210}Pb and ^{137}Cs geochronology, and heavy metals and sediment properties, with the known historical events allowed to establish a geochemical background (pre-European sedimentation), and to assess human impact in Moreton Bay. The significant spatial and temporal variability observed indicates that in such complex estuarine-marine embayments, the assessment of contamination in sediment cores requires the careful integration of different proxies. In addition, this study demonstrates the importance of the knowledge of past sediment characteristics, for the management of intertidal areas.

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