

VOLUME 32 | NUMBER 2 | DECEMBER 2015

# *Quaternary* AUSTRALASIA



Reports from INQUA Nagoya, 2015

Order of Australia for Quaternary  
Scientist

Anthropocene survey results





## **AQUA BIENNIAL MEETING:** *Quaternary perspectives from the City of Sails* **AUCKLAND, NEW ZEALAND 5-9 DECEMBER 2016**

AQUA 2016 includes:

- Four exciting days of conference sessions
- Mid-conference field trip to Manukau Harbour and Waitakere Ranges
- Conference dinner during a Waitemata Harbour crossing to Waiheke Island
- Post-conference field trips, 10-15 December 2016

Session themes will be called for in February 2016.

For further information, please contact Andrew Lorrey ([andrew.lorrey@niwa.co.nz](mailto:andrew.lorrey@niwa.co.nz)).

Two post conference field trip options are currently being planned, and will be run according to level of interest.

### **TRIP 1:**

Kauri and the Quaternary (a loop around the sub-tropical Northland/Far North region starting and ending in Auckland; Three nights in Bay of Islands, two nights at Kai Iwi Lakes). The trip will focus on ancient kauri, changes in ecology as seen in pollen records over interglacial-glacial scales, and coastal barrier evolution from OIS5-present.

### **TRIP 2:**

Quaternary volcanism and environmental change (excursion south from Auckland through the Waikato, the central North Island and ending in Wellington; Three nights in Taupo, two nights in Palmerston North). There will be a focus on Quaternary volcanism, tectonism, sedimentation, and climate. Stops will include the Taupo and Rotorua volcanic centres, glaciation in the Tongariro National Park, Napier/Hawkes Bay and the Kapiti-Horowhenua/Wanganui Basin sequences.

***Australasian Quaternary Association Inc.***

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**AQUA**



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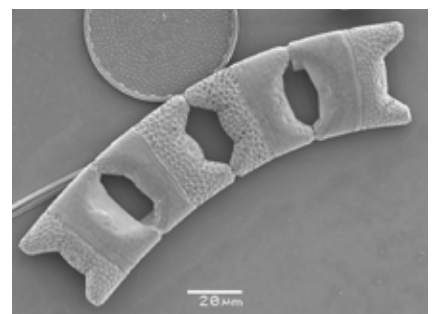


### FRONT COVER PHOTO:

Tswaing Crater, South Africa, created by a meteorite impact 220,000 years ago.  
Photo: Tim Ralph.

### INSIDE FRONT COVER PHOTO:

SEM image of the chain formation in the diatom *Eucampia antarctica* var. *antarctica* from the Subantarctic (Kerguelen Plateau) where it is representative of iron fertilised surface waters. Photo: Nadia Suarez-Bosche and Leanne Armand.



## EDITORIAL

Dear Fellow Quaternarists,

Another year of the Anthropocene draws to a close – and yet, for how long have we been living in this new era? The Anthropocene is a hot topic amongst Quaternarists and climate scientists at the moment, although as yet we have not reached consensus regarding when it began. Helen Bostock updates us on the thoughts of Australasian Quaternarists in this issue – and is sure to spark yet more discussion!

The Anthropocene also formed an active focus for discourse at the July INQUA Congress in Nagoya, Japan. The biggest assembly for Quaternarists yet saw a substantial contingent of Australians, Kiwis and their diaspora meeting up with their international colleagues – learning and debating the most recent scientific advances in our field, establishing new scientific collaborations and partnerships, and for the younger researchers, learning of new employment possibilities. AQUA supported four students to attend the Congress, and their reports on various aspects of the meeting feature in this issue. Well done, Shaun, Claire, Jennifer and Jessica! We also hear from our new Editor, Carol Smith, about the adventures to be had on one of the INQUA excursions, and from Emily Field on the latest activities of the Peat Working Group. Jess Reeves furthermore enlightens (or perhaps reminds!) us as to what INQUA really is, and Craig Sloss and Sallie Burroughs explain what INQUA has been doing to support early career researchers.

The year was not entirely overshadowed by INQUA. Our shadow Editor, Sanja van Huet, describes the CAVEPS (Conference on Australasian Vertebrate Evolution, Palaeontology and Systematics) meeting held in Alice Springs in September. Participation in smaller workshops and research networks is just as valuable as attending the bigger meetings. Especially for young researchers who are establishing themselves in their scientific careers – and often it is an easier opportunity to interact with colleagues and discuss issues in greater depth than during a packed INQUA schedule!

Finally, after nine fascinating years editing Quaternary Australasia, Kat Fitzsimmons will be retiring from the role. Over this time, Quaternary Australasia has experienced a number of changes which has made it into a much more visible, and more widely available publication. In 2007 AQUA signed an agreement with the ePublisher, Informit, and since December 2009 the entire contents of QA have been published through the Informit platform (see <http://search.informit.com.au/browseJournalTitle;res=IELHSS;issn=0811-0433> to browse back issues). Informit is subscribed to by most research institutions in Australia and New Zealand, and a number of institutions overseas as well. In addition, all back issues – extending back to the Australian Quaternary Newsletter from 1973-1980, and into its present form as QA – can be accessed as single PDFs through the new AQUA website ([http://aqua.org.au/?page\\_id=103](http://aqua.org.au/?page_id=103)). We now offer a subscription discount to members when they choose to receive electronic versions of QA; naturally we still offer print copies for those who prefer to flip through something tangible, and for our institutional subscribers. Our visibility vastly increased from January 2015 when we signed an agreement with EBSCO Publishing to be hosted on their international search database. Our arrangements with EBSCO and Informit have the additional benefit of providing us with regular royalties whenever people access QA online through these platforms! Content-wise, we also increasingly



publish more peer-reviewed articles. We hope this will continue, and that the recent developments in our visibility will serve as an inducement! A big welcome also to Carol Smith, who will be joining the Editorial Team, and to Sanja van Huet who will be stepping in for the next issue, but who nevertheless has already been actively engaging with the team!

Yours Quaternarily,

**Kat Fitzsimmons, Pia Atahan and Carol Smith** *Editors*

**Sanja van Huet** *Shadow Editor*



## PRESIDENT'S PEN

It was great to see that so many AQUA members made it to the INQUA meeting in Japan in August 2015 (99 Australians and 19 New Zealanders). This 4 yearly INQUA congress is the “Quaternary Olympics” and it appears that AQUA members performed well, with some great presentations showcasing the research going on in the Australasian region, especially in the well-attended SHAPE session. Congratulations to David Lowe and Brad Pillans on being awarded honorary life membership of INQUA as a result of their enduring and significant service to the international Quaternary community. Congratulations also to Matt Ryan, from Victoria University, Wellington, who was awarded a student poster prize. It was great to see so many of you wearing the AQUA T-shirts in photographs from the congress. Thanks go to Scott Mooney for organising the t-shirts and to Emily Field for the winning design. The t-shirts are available for sale for those that didn't make it to INQUA, and smaller sizes are now available again.

My sources tell me there was plenty of socialising and networking. I look forward to reading the reports from our student travel awards and other INQUA attendees in this issue. For those of you who don't quite understand how INQUA works, Jessica Reeves (Australian Council delegate to INQUA) explains all in her article.

If you missed out on INQUA you don't have to wait another 4 years for the next one in Dublin in 2019, you will be able to present your exciting research in just under a year at the upcoming biennial AQUA meeting in Auckland, New Zealand, from 5-9<sup>th</sup> December 2016. So save the date! We look forward to welcoming you to the city of sails.



We would like to say a big thank-you to our enduring QA editor Kat Fitzsimmons who is stepping down after this issue of QA (see editorial). We welcome our new QA editors Carol Smith (from Lincoln University) and Sanja van Huet (from Deakin University) who will work alongside Pia Atahan (who will step down after the next issue).

In May 2016, AQUA will be holding its AGM (exact date and location TBC). We are looking for some new committee members, as several of the current members are stepping down after serving for a number of years. Anyone who is an AQUA member can be nominated, and it is good to have a wide range of ages, experience (early career to well established researchers) and disciplines represented. It doesn't involve a huge commitment and you can be located anywhere as all meetings can be attended remotely by skype.

Have a great summer and if you have some interesting fieldwork stories please consider submitting them to the AQUA blog on the website [www.aqua.org.au](http://www.aqua.org.au) or publishing them in the next issue of QA.

**Helen Bostock** *AQUA President*

## MEET A MEMBER OF THE AQUA EXECUTIVE COMMITTEE

### CAROL SMITH: EDITOR, QUATERNARY AUSTRALASIA

Carol is currently a senior lecturer in soil science at Lincoln University. Carol spent her formative years in Britain, where a childhood interest/obsession which involved collecting stones and digging holes translated to a more formal qualification of a BSc. in geography. A MSc. from the University of Reading and a PhD in soil science from the University of Aberdeen followed in 1993. Emigrating to NZ with her husband she worked as a tutor at Lincoln University



before moving a few years later with her young family to Sydney. A spell as a freelance environmental consultant followed, before a move back across the Tasman. Two years as a contract lecturer in the Geography Department at the University of Otago was followed in 2005 by her present role at Lincoln. Carol's research interests revolve around pedology, micromorphology, soils and landscapes (in particular Quaternary paleosols and loess), rehabilitating degraded soils, and Antarctic soils.

With two children aged 19 and 17, there is now more time to escape to the hills with her husband Ian to cycle/tramp/ski. However, she still tries to sneak rocks home in the car after family holidays. The children have also grown wise; they no longer stand next to interesting landscapes, lest they turn up in the inevitable lecture slide.

## NEWS

### AQUA BIENNIAL CONFERENCE, AUCKLAND, 5-9 DECEMBER 2016

Planning is underway for the next AQUA biennial conference, which is being held in Auckland. The conference will span from the 5 to 9 December, 2016, and mid-conference fieldtrips will take place on 7 December. Registration and session details will be released in February 2016.

### ORDER OF AUSTRALIA FOR MERNA MACKENZIE

Congratulations to Merna McKenzie on being awarded the Order of Australia. Her citation reads “for service to science, particularly as a researcher”. Merna, a Monash palynologist and a mentor to innumerable palaeo people, is now in her nineties and still counting pollen. A short report later in this issue reflects on Merna’s career and her significant contribution to Quaternary science.

### HONORARY INQUA LIFE MEMBERSHIPS FOR BRAD PILLANS AND DAVID LOWE

Congratulations to Professor Brad Pillans, from ANU’s Research School of Earth Sciences, and Professor David Lowe, from University of Waikato’s School of Science, for gaining honorary life memberships to INQUA. Brad and David were elected at the recent XIX INQUA congress in Nagoya.

### ROYAL SOCIETY OF NEW ZEALAND FELLOWSHIP FOR JANET WILMSHURST

Congratulations to Associate Professor Janet Wilmshurst, from the University of Auckland’s Landcare Research group, for being elected a fellow of the Royal Society of New Zealand. Janet is at the leading edge of New Zealand and global research in fields of pre-historic plant and animal ecology, climate change, fire disturbance, archaeology and restoration ecology. She uses a wide range of fossil types in her research, including pollen, seeds, charcoal, coprolites, bird bones, ancient DNA, dung fungi and amoebae. Her work on rats has provided deep insights into the Polynesian settlement of New Zealand and the Pacific, resolving long-standing controversies over its timing and impacts.



Professor Brad Pillans taking a stroll through Nagoya castle. (Photo credit: Peter Kershaw)

### AQUA T-SHIRTS

The much coveted AQUA T-shirts are still available to buy! And yes, smaller sizes are now available! If you would like to get your hands on one of these blue gems, then please check the ordering information on the AQUA website. Then email vice president, Scott Mooney, to place your order ([s.mooney@unsw.edu.au](mailto:s.mooney@unsw.edu.au)).

### THE QA EDITORIAL TEAM IS CHANGING

Long-time Quaternary Australasia editor, Kat Fitzsimmons, is retiring. She has produced an incredible 17 issues of QA, and began doing so way back in 2007. Her dedication to this publication is remarkable, and greatly appreciated. We thank her and wish her well.

In this issue Carol Smith and Sanja Van Huet join the editorial team, with Pia Atahan continuing until mid-2016. We are looking forward to the new perspectives that Carol and Sanja will bring to QA. Please continue to send QA contributions to [editor@aquagroup.org.au](mailto:editor@aquagroup.org.au).



Kat Fitzsimmons



## Caption competition

During the INQUA congress, the Nagoya fish market was a popular destination with AQUArians. Clearly, Dr Reeves and Prof Heijnis were suitably impressed with the molluscan delights on offer, especially this geoduck. Please help your editors with an appropriate caption for the photo.

Send your suggestions to [editor@aquas.org.au](mailto:editor@aquas.org.au). The winning entry will appear in the next issue of *Quaternary Australasia*.

## REPORTS FROM INQUA CONGRESS 2015, NAGOYA, JAPAN

### AQUA dinner: Food, fun and friends

Claire Krause

*Research School of Earth Sciences, Australian National University, Canberra, Australia*

It was a hot and muggy evening in Nagoya when approximately 65 AQUArians set off through the streets of Nagoya for the AQUA dinner. A convoy of jovial INQUA delegates, hungry and blindly following a man with an AQUA sign, set off towards the local nightlife hub, halting traffic and spilling across the narrow footpaths. Eventually our march was halted outside an unassuming building as we all wondered if we were there. After standing in line for what seemed like an eternity to our empty stomachs, we realised that the restaurant was accessible only via

a 7 person lift, which was working overtime to ferry us all to the restaurant on an upper floor. When it was finally my turn to squeeze into the claustrophobia-inducing lift, it suddenly became apparent that we didn't actually know where we were going. A game of Chinese whispers, passed on from the first few groups who were following our intrepid leader told us we were after floor 7. The doors finally opened and we were greeted with a sea of sweaty, discarded shoes and a relief that we were actually in the right place. After we too had removed our shoes and added them to the pile, we were



**LEFT Figure 1.** Hot chips, sake and excellent conversation. (Photo credit: Len Martin)

**BELOW Figure 2.** Learning how to take a selfie. (Photo credit: Len Martin)





shown to a very low table, set just above floor level. Much to my knees' relief, the tables were actually set into the floor, leaving ample room to sit comfortably.

As we settled in for a long night of drinks and mysterious food, it quickly became apparent that our lack of Japanese language skills was going to be a challenge. Our intrepid leader informed us that an unlimited bar tab awaited us all, but could only be accessed via an iPad, which only displayed Japanese characters. We quickly grabbed our respective phrase books and google translate apps to desperately try to order a "bee-ru". After a few minutes of only minimal success, it became apparent that at my end of the table was one of the precious few Japanese speakers. Hallelujah! After ordering at least two rounds of drinks for everyone within shouting distance (just to be sure we wouldn't again be faced with the mocking iPad), we began to meet the people we would be spending an evening with.

The food was brought out by gently spoken Japanese servers who looked slightly overwhelmed by the rabble of Australians and New Zealanders who had taken over their establishment. An interesting assortment of local Japanese cuisine and western food came to our tables throughout the evening, with a hotpot in the middle of the table gradually added to with new and interesting ingredients brought out to us. Eventually we all got our fill of soup, meats, Japanese salads, pizza, hot chips (?) and sake. With our bar tab closing at 9:30pm, we quickly ordered a table full of last drinks and I sat contently listening to my new friends' life stories.

A huge thank you to our intrepid leader, Paul Hesse, who organised the nights' festivities and lead us lost souls through the Japanese language. I'm sure I'm not alone in thinking it was one of the highlights of the INQUA conference.

## INQUA Congress in Nagoya, Japan: A week of science, sushi and *shinkansen*

Jennifer B. Wurtzel

*ARC Centre of Excellence for Climate Systems Science and Research School of Earth Sciences, Australian National University, Canberra*

*Jennifer's travel was funded by an AQUA Student Travel Prize with additional support from the RSES D.A. Brown Travel Scholarship.*

It was a hot and humid week at the end of July 2015 when nearly two thousand scientists from all over the world gathered in Nagoya, Japan for the INQUA XIX Congress – the first to be held in Japan since the organization's 1928 inception, and the first in Asia since the 1991 meeting in Beijing. Nagoya is located in central Japan and is easily accessible by *shinkansen* (bullet train) from Tokyo and Osaka. Although there weren't many accommodation options in the immediate vicinity of the Nagoya Congress Center, there were a number of bustling neighbourhoods within 2-3 short stops on Nagoya's efficient subway system.

The conference kicked off on Sunday evening 26 July, with an icebreaker where attendees had the opportunity to catch up with old faces and meet some new ones, all while sampling Japanese beers, tea and snacks. Following the icebreaker, AQUA members proceeded to dinner at a local *izakaya* (Japanese bar and grill), where communal dining and unlimited drinks led to an inevitably good time.

On Monday morning, at the Opening Ceremony, delegates were honoured and awed by the presence of Their Majesties the Emperor and Empress of Japan, as well as Guests of Honour including the Minister of Science and Technology Policy and the Governor of Aichi Province. After brief speeches by the Local Organizing Committee the conference was underway, starting with business meetings in the early afternoon.

Oral presentations began that evening with the plenary lectures. The honour of the first talk went to Georgia Tech's Kim Cobb, who gave a brilliant lecture on Holocene ENSO variability in the tropical Pacific. This was followed by plenary talks on climate impacts on biodiversity, and biomarker proxy development.

After that, delegates broke off to listen to the first sessions on a wide range of Quaternary topics including palaeoclimate, human dispersal, tephrochronology, archaeology and much, much more. The first evening ended with a welcome function that featured greetings from Nagoya's Mayor and traditional Japanese *taiko* drummers (aided by AQUA musical talents).

The conference schedule was intense; the day regularly started at 9am with two oral sessions separated by a 30-minute tea and coffee break (which didn't include biscuits, much to the dismay of the Brits and Aussies who cherish a proper morning tea). While the morning tea left something to be desired, I was personally delighted with lunch. Though there were a few options including Japanese style pork or veggie sandwiches, my absolute favourite was the *onigiri*, which is a Japanese rice ball containing varieties of seafood or vegetables wrapped in *nori* (seaweed).





The hour break for lunch was followed daily by plenary lectures and the poster session, before oral sessions resumed at 5pm, running until nearly 7pm. Throughout the week, up to 14 sessions could be running concurrently, leading to some difficult decisions about which sessions to attend. However, I thought the poster sessions were suitable for the allotted time. It was also nice to not have to choose between attending talks and wandering through the posters.

Thursday served as a reprieve from the overwhelming schedule of talks, with some delegates participating in mid-conference field trips to various geologic sites around Japan and others venturing off on their own.

Friday saw the resumption of presentations, as well as a number of business meetings, including the AQUA business meeting. One major purpose of the business meetings was to vote on the location of INQUA's next congress. Zaragoza (Spain), Rome (Italy), and Dublin (Ireland) all put in bids. The Irish wandered around in bright green INQUA Dublin 2019 T-shirts (apparently catching the Kiwis' eyes, since they voted for Dublin), while the Italians tried to win us over with wines and cheese during one of the poster sessions (this worked on the Aussies, who placed their vote for Rome). In the end, Dublin was the winning bid.



**Top to Bottom, Left to Right:**

**Photo 1:** Nagoya Congress Centre. (Photo credit: Len Martin)

**Photo 2:** AQUA dinner at an izakaya. (Photo credit: Len Martin)

**Photo 3:** Taiko drumming at the Welcome Function. (Photo credit: Len Martin)

**Photo 4:** Group photo of AQUA members following the AQUA Business Meeting. (Photo credit: Gulyás Sándor and Brent Alloway)

**Photo 5:** Zaragoza, Rome, and Dublin try to convince delegates why the next conference should be held in their cities. (Photo credit: Jen Wurtzel)

**Photo 6:** Poster session. (Photo credit: Jen Wurtzel)

**Photo 7:** RSES students Claire Krause, Jen Wurtzel, and Ali Kimbrough bid farewell to Nagoya and the XIX INQUA Congress. (Photo credit: Kelsie Long)

It was obviously not possible to attend all the sessions, and I tended to stick mostly to the palaeoclimate topics. I attended a number of sessions on the Asian Monsoon, interglacial climate, Holocene climate, and Southern Hemisphere paleoclimate. Some of the highlights were hearing UC Berkeley's John Chiang talk about the role of the westerlies in monsoon dynamics, Pedro DiNezio from the University of Hawaii speaking about the Indo-Pacific in models and proxies during the LGM and the role of sea level, and Simon Armitage of Royal Holloway telling us about a new record to help constrain the timing of the onset of the African Humid Period. These are just a few of the dozens of memorable talks I attended during the conference.

Even though I mostly attended the palaeoclimate sessions, I did venture out of my comfort zone a bit by attending a session on human activity in palaeoecology records. When I wasn't being overwhelmed by pollen diagrams, I found the human aspect very interesting. Many of the talks were related to the identification of fire in the record, and whether or not spikes in charcoal could be related to human activity.

My own presentation was given Saturday morning in the SHAPE (Southern Hemisphere Assessment of Palaeo-environments) session. I was a bit nervous as the previous talks had been really well presented and featured cute pictures of small, furry creatures (of which my cave contains none). However, the talk went off without a hitch and was well-received. Relieved to be done, I was able to enjoy that night's conference dinner of *yakiniku* (grilled meat), with the knowledge I had just one more day of talks to attend. Interestingly, a lot of the most interesting palaeo sessions were scheduled on the last two days, which meant things didn't exactly wind down until the very end of the conference, on Sunday, 2 August. Two more excellent morning sessions, a few more plenary talks, and a farewell function brought the conference to a close. With six full days of conference proceedings, the intensity didn't let up until the afternoon of the very last day, at which point our group bid a fond farewell to Nagoya before embarking on some post-conference travels in Japan.

All in all, the XIX INQUA Congress was a huge success, drawing the second largest attendance after the Bern Congress in 2011. Out of the 1,790 participants, Australia and New Zealand sent a combined 122 delegates, increasing their numbers from 105 sent to Bern, and inevitably raising the concentration of high quality research in Nagoya.

## INQUA Highlights: MIS 3 Glaciations Session

Shaun Eaves

*Antarctic Research Centre, Victoria University of Wellington,  
Level 5 Cotton Building, Gate 7, Kelburn Parade,  
Wellington, New Zealand*

Advance and retreat of mountain glaciers occurs in response to variations in a range of meteorological variables, but primarily temperature and precipitation. As physical systems, this response is not complicated by biological processes, therefore geological records of past glacier length changes allow inference of past climate change.

Recent technological and methodological advances now allow direct dating of glacial deposits, using cosmogenic nuclides (e.g.  $^{10}\text{Be}$ ,  $^{26}\text{Al}$ ,  $^3\text{He}$ ). These rare isotopes accumulate in common rock-forming minerals, such as quartz, which are present at Earth's surface. Thus, nuclide concentrations in clasts deposited at the surface by glaciers, serve as a proxy for the time elapsed since deposition. Over the last two decades, this technique has revolutionised our understanding of the timing and frequency of Quaternary glacier fluctuations (Balco, 2011).

Thanks to a generous postgraduate travel grant from AQUA, I was able to attend the recent INQUA Congress in Nagoya, Japan. At the conference, I was particularly interested in a session entitled, 'Global and Regional Patterns of Mountain Glaciation during Marine Isotope Stage 3' (conveners: G. Thackray, J. Shulmeister, P. Hughes), which showcased the most recent research into glacier fluctuations that occurred prior to the global Last Glacial Maximum (LGM; c. 26-19 ka). This session comprised two oral sub-sessions with a total of ten presentations, of which, four were focused on Southern Hemisphere sites distributed across Australasia and South America.

In a talk entitled, 'Mismatch of glacier extent and summer insolation in Southern Hemisphere mid-latitudes', Dr. Alice Doughty of Dartmouth College, USA (formerly of VUW, NZ) presented an extensive dataset of several hundred  $^{10}\text{Be}$  ages from moraines in the Mackenzie Basin region of New Zealand's central Southern Alps. This comprehensive dataset, compiled over the last decade, shows that the former Pukaki and Ohau glaciers advanced at c. 42 ka, 36 ka, 27 ka, 20 ka and 18 ka. Alice highlighted that these advances occur at times of high, low and intermediate local summer insolation intensity, therefore orbital changes are an unlikely driver (Doughty et al., 2015). Instead, Alice noted that moraine building coincided with millennial-scale troughs in proximal sea



surface temperatures. Terrestrial air temperatures are highly correlated with local sea surface temperatures in this maritime climatic setting, thus can exert significant influence on local glacier mass balance.

Following this, Professor Jamie Shulmeister, University of Queensland, summarised new and existing glacial chronological work from across Australasia (*'MIS 3 glacial advances of New Zealand and Australia'*). Drawing on existing surface exposure dating chronologies, and new investigations of glacial sediment stratigraphies on the eastern side of the Southern Alps, Jamie showed that glacier fluctuations across the Australasian region exhibit a similar temporal pattern as shown by Alice (above). Jamie invoked a strengthening and/or northward movement of the southern westerly winds as a possible driver of these millennial-scale glacier advances. Enhanced westerlies in the mid-latitudes would increase moisture delivery and extend the northward reach of cool sub-polar air and water masses, thus promoting glacier advance.

Two papers presented in this session demonstrated how cosmogenic nuclide applications have revised pre-LGM glacial chronologies in southern South America. First, Professor Juan Garcia of Universidad Catolica de Chile presented new  $^{10}\text{Be}$  surface exposure ages from previously undated outboard moraines in southern Patagonia, which reveal evidence for expansive glaciation during MIS 3 (c. 50 – 30 ka). This new data shows that glacial extent during this time was far greater in this region than that during the subsequent LGM (*'MIS 3 maximum glacial extent of southern Patagonian glaciers during the last glacial period as inferred from extensive  $^{10}\text{Be}$  moraine dating and glacial modeling'*).



**Figure 1:** Left lateral moraines (foreground) demarcate the former margins of the former Pukaki glacier in New Zealand, with Mt. Cook (3724 m asl) in the background (right). (Photo credit: Shaun Eaves)

Second, Dr. Christopher Darvill of Durham University, UK, presented a novel application of cosmogenic nuclides to refine the age constraints of pre-LGM ice limits in southern Patagonia (*'Extensive MIS 3 advance of the Bahia Inutil – San Sebastian ice lobe in southernmost South America and implications for the timing of ice advances in Patagonia'*). Exploiting the depth-dependence of cosmogenic nuclide production, Chris measured  $^{10}\text{Be}$  concentrations of cobbles in a depth profile within glacial outwash terraces. This approach circumvents the problems, such as boulder erosion and/or exhumation, that can arise when exposure dating boulders on old (i.e. several 10s of thousands of years) moraines. Results show that former glacial limits, which were previously thought to pre-date the global LGM by >100 ka, actually date to MIS 3 (Darvill et al., 2015).

The main message that fell out of this session is that mountain glaciers in many regions of the southern mid-latitudes achieved their maximum extent of the last glacial cycle prior to the global LGM. Whilst not a new concept, the addition of robust chronologies and increased spatial coverage now allows us to begin to consider why this might be.

When considering climatic implications alone, the glacial data would suggest that MIS 3 was colder (i.e. less snowmelt and more snowfall) and/or wetter (more snowfall), than the global LGM. However, there are issues with both of these theories. The former is not supported by many, if any, palaeo air – or sea surface – temperature records, which suggest that the coldest conditions of the last glacial cycle occurred during MIS 2. The latter may contribute – for example the Clausius-Clapeyron relation implies that the slightly warmer MIS 3 climate, relative to MIS 2, would promote a more humid atmosphere. However, physically-based glacier model experiments have demonstrated the insensitivity of temperate, maritime glaciers to precipitation change (Anderson and Mackintosh, 2012).

A question discussed at dinner after the MIS 3 Glaciations session concerned another possibility: what is the role of changing bed elevation over the timescale of a single glacial cycle? For example, basal sliding of temperate

glaciers causes erosion, which lowers the terrain surface. This means that subsequent glacial advances, of similar magnitude, more readily attain lower elevations and thus warmer temperatures, which may restrict ice extent despite similar climatic forcing (e.g. Kaplan et al., 2009; McKinnon et al., 2012). Is this mechanism sufficient to explain the emerging, hemispheric-wide finding that MIS 3 advances were more extensive, or are we missing something? Perhaps we must wait until the next INQUA congress to find out...

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## Report of activities from the INQUA ECR community 2013 – 2015

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We had an overwhelming response from ECRs to participate in the ECR Session at the INQUA Congress in Nagoya. In total, 260 ECRs indicated that they would like their abstracts associated with this session. Unfortunately, we only had 2 session spots available. Nevertheless, such a response is encouraging: to see the enthusiasm and excitement that INQUA ECRs have in communicating their science to their peers.

This session was proposed in order to build on the groundwork laid by the inter-congress ECR meeting held at Wollongong University in 2013. It provided the opportunity for ECRs to re-connect and develop new networks amongst their peers. The session (which was held early in the conference) provided the opportunity for ECRs to have a “practice run” of presentations prior to presenting in their relevant commission. This session was well received, and ECRs later expressed how valuable it was to have had the opportunity to present to peers.

## SOCIAL NETWORKS

Shortly after the 2011 Congress the “INQUA Early Career Researcher Page” was set up in Facebook to foster communication and international collaboration among Early Career Quaternary Scientists. The page quickly took on a life of its own. Posts are typically sent out daily and include information on relevant jobs, grants, meetings, workshops, summer schools, funding, activities of other organisations as well as new and interesting research. The page currently has 760 members, with an average reach per week of ~1000 people, and is a testament to the effort that INQUA ECRs have put into raising their profile and developing the ECR community.

## QUATERNARY INTERNATIONAL: ECR SPECIAL ISSUE

Quaternary International has kindly agreed to run a special issue for ECRs. The aim is for the ECRs to either be the primary or single author. Editorial advice and guidance will be provided during the entire writing progress (thus acting as a mentoring scheme). In terms of administration, Lynda Petherick and Stephanie Kermode will assist Craig Sloss as guest editors.

We are at the final editorial stages and are excited to work on this first ECR special issue and hope that this practice continues on from the INQUA Nagoya congress and future ECR inter-congress meetings.



## PAPERS IN THE SPECIAL ISSUE:

- \*Epure, L., Muntean, V., Constantin, S., Moldovan, O. T., in submission. Ecophysiological groups of bacteria from cave sediments as potential indicators of paleoclimate.
- Harada, M., Watanabe, Y., Nakatsuka, T., Tazuru-Mizuno, S., Horikawa, Y., Subiyanto, B., Sugiyama, J., Tsuda, T., Tagami, T., in submission. Assessment of Sungkai tree-ring  $\delta^{18}\text{O}$  proxy for paleoclimate reconstruction in western Java, Indonesia.
- Kanthilath, N., Boyd, W., Chang, N., in press. Multi-element characterization of archaeological floors at the prehistoric archaeological sites at Ban Non Wat and Nong Hua Raet in Northeast Thailand
- Klasen, N., Loibl, C., Rethemeyer, J., Lehmkuhl, F., in submission. Testing feldspar and quartz luminescence dating of sandy loess sediments from the Doroshivtsy site (Ukraine) against radiocarbon dating.
- Mackenzie, L., Moss, P.T., in press. A Late Quaternary record of vegetation and climate change from Hazards Lagoon, Eastern Tasmania.
- McCarroll, J., Chambers, F.M., Webb, J., Thom, T., in press. Application of palaeoecology for peatland conservation at Mossdale Moor, UK.
- \*Petherick, L.M., Moss, P.T., H.A. McGowan, H.A., in submission. Millennial-scale variability in precipitation during the Last Glacial Maximum: A record from Tortoise Lagoon, subtropical Queensland, Australia.
- Prendergast A. L., Stevens, R. E., Hill, E. A., Barker, G. W., Hun, C., O'Connell, T. C., in press. Carbon isotope signatures from land snail shells: implications for palaeovegetation reconstruction in the eastern Mediterranean.
- Shao-Hua Yu, S-H., Zheng, Z., Kershaw, P., Skrypnikova, M., Huang, K-Y., in press. A Late Holocene record of vegetation and fire from the Amur Basin, Far-eastern Russia
- \* Accepted pending revisions

## INQUA NAGOYA AND BEYOND

The ECR group held their business meeting at the congress to elect a new committee and discuss the future direction of the ECR community. This resulted in a clear mission for the ECR committee and community to:

- Increase the dissemination of information between INQUA, its Commissions and its young members through both ECR networks and social media.
- Reciprocally to represent the views and increase the flow of information from the ECR community to the INQUA Executive Committee.
- To support early-career Quaternary scientists from developing countries and engage them in INQUA activities.
- To more generally promote innovative research, scientific leadership, and community outreach among INQUA ECRs.

As part of the integration of ECRs with the wider INQUA community the International Council also agreed to have the Chair of the ECR committee to hold a permanent position on the INQUA executive committee, reflecting the value and importance of having a voice for ECRs in the future of INQUA and its commissions.

## THE NEW ECR COMMITTEE ELECTED INCLUDING COMMISSION REPRESENTATIVES:

### CMP

Alistair Clement, New Zealand, A.Clement@massey.ac.nz

### HABCOMM

Keely Mills (Palaeoecology), UK, kmil@bgs.ac.uk

Erick Robinson (Archaeology), USA, Erick.Robinson@uwyo.edu

### PALCOMM

Lyudmila (Lucy) Shumilovskikh, shumilovskikh@yahoo.com (CHAIR)

Alistair Seddon (Palaeoecology), Norway, Alistair.Seddon@bio.uib.no

### SACOMM

Andrew Lorrey, New Zealand, Andrew.Lorrey@niwa.co.nz

### TERPRO

Eduardo Guerra, Venezuela, edualarcong@gmail.com

Nadine Hoffman, Israel, na-hoffmann@web.de

## Special Session on SHAPE: Southern Hemisphere Assessment of PalaeoEnvironments

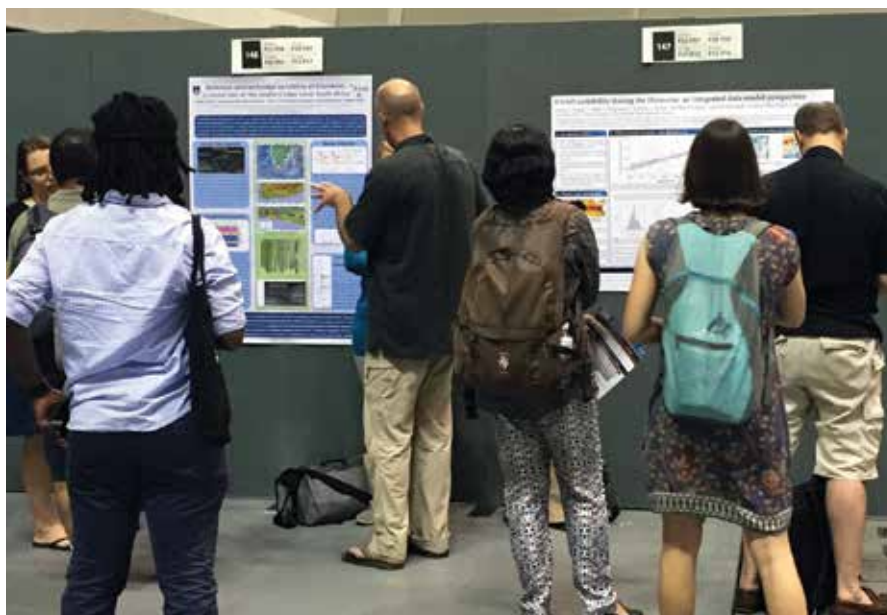
Jessica Hinojosa

*California Institute of Technology (Caltech), Pasadena, USA*

Initiated in 2013, SHAPE is a project under the INQUA PALCOMM commission. The project's primary goal is to produce high-resolution paleoclimate records from the Southern Hemisphere. Additionally, the project supports the development of climate models and the integration of proxy data and modeling work.

With almost 50 presentations, the Southern Hemisphere Assessment of PalaeoEnvironments (SHAPE) sessions at INQUA were a huge success. During the oral sessions, which continued throughout Saturday, attendees heard about exciting new research coming from the Southern Hemisphere, from southeast Africa to the high Andes. The midday poster session was also well attended and led to many fruitful discussions of presenters' work (Figure 1). Despite falling on the penultimate day of the conference, and with the conference dinner immediately after the last SHAPE presentation, all the sessions were packed to the rafters. This highlighted the enthusiasm of the Quaternary community to hear and share new work relating to the Southern Hemisphere.

Several talks and posters were particularly exciting for me, especially those that relate to my own research into Holocene Southern Hemisphere westerly wind variability. Invited speaker Patricio Moreno, from the Universidad de Chile, discussed the precise chronology of the Last Glacial Maximum and provided evidence for a southward shift of the westerlies during Heinrich Stadial 1. However,



**Figure 1:** Visitors crowd around the SHAPE poster session. In total, 22 posters were presented, covering proxy reconstructions and model simulations from Australia, Antarctica, New Zealand, Chile, South Africa, and the oceans of the Southern Hemisphere. (Photo credit: Jessica Hinojosa)

work remains to understand the triggers and mechanisms that cause these shifts – as well as related shifts in the Northern Hemisphere – during the end of the last glacial period. Additionally, poster presentations from Maisa Rojas (Universidad de Chile) and Steven Phipps (University of New South Wales) highlighted the important advances in modeling studies that investigate westerly wind variability and associated Southern Hemisphere climate changes. In particular, these model investigations support a contracted westerly wind belt during warm intervals and an expanded belt during cold intervals, consistent with observational data from the past few decades.

In addition to the research sessions, there was a SHAPE business meeting held at lunchtime on the same day, hosted by Drew Lorrey and Steven Phipps. Several things were discussed as people munched on their sandwiches and rice balls, including many suggestions to keep SHAPE alive and healthy in the future. Drew discussed the potential for a SHAPE special journal issue in the near future, which could easily be filled by all of the presenters at the INQUA conference. The group also discussed whether SHAPE should extend its focus to beyond 60,000 years – a conclusion that was largely supported, although the new extent remains to be determined. Maisa Rojas, a Chilean SHAPE delegate and one of the session conveners, brought up her concern that SHAPE was not tapping into the full potential of non-Australasian countries, such as South America and parts of Africa. Since SHAPE is intended to integrate records from throughout the Southern Hemisphere region, active incorporation of all eligible countries should be emphasised.



# Tectonics, tsunami and active faults on Omaezaki: hazards for Hamaoka Nuclear Power Plant (M1 Mid-Congress excursion)

Carol Smith

*Department of Soil and Physical Sciences, Lincoln University, Christchurch, New Zealand*

I was looking forward to this field trip. Coming from Christchurch we are not unaccustomed to tectonic activity, so I was curious to visit a country which not only utilised nuclear power, but was also seismically active. What were the challenges in this? A group of 40 INQUA delegates from over 20 countries assembled at the Convention Centre and it soon became apparent that this was more than just a "let's-look-at-some-tsunami-deposits" trip. The wider responsibility of science to society was the purpose of the M1 excursion. The organiser of the excursion, Dr Yugo Ono (who unfortunately was not able to attend personally due to family illness), had stated that he passionately believed that all nuclear power plants (NPP) in Japan should be closed. Moreover, he believed it was the responsibility of Japanese Quaternary researchers to show the Hamaoka Nuclear Power Plant (NPP) to INQUA participants and to discuss its risk and safety from the (objective) viewpoint of Quaternary science.

As we drove through the Urban fringe of Nagoya in our air conditioned, fossil fuelled coach, this wider remit prompted a philosophical moment in my mind: what *do* we use our science for? Sure, it is to publish our research; to feed that curiosity inside us all. But we also have a wider responsibility to society: to promulgate our ideas and research for the benefit of all. But sometimes the dissemination of our ideas can be frustrating: the battle

to make the real science visible in a sea of alternative advocacy. There is a danger that the real science issues get drowned out. Often with a paucity of scientific literacy and the proliferation of selectively filtered information through the media, the public struggle to grasp the scientific issues and hence the relevance of science to society and their lives. Dr Ono urged us to consider our roles as scientists in decision making and outlined four idealised roles that are summarised in Table 1. In particular, advocating for a move from a linear model "pure scientist" to a stakeholder model: in particular the "honest broker of policy alternatives" (Table 1).

Thus we started our journey, through the science/society nexus and the equally enchanting landscapes of Aichi Prefecture. The planned trip was to drive east from Nagoya to first visit tsunami deposits and uplifted marine terraces close to the Hamaoka NPP. This power plant sits at the junction of 4 tectonic plates (Pacific, Philippine, Eurasian and North American). As a result, this NPP is widely regarded as the most dangerous in Japan. Reassuring.

In 36 degrees Celsius and 80% humidity, we first visited the locations of historic tsunami deposits in the Otagawa river lowland, a strand plain facing the Enshu-nada coast. Always good to set down some unequivocal scientific markers in the landscape, upon which to build the tectonic story. Here, the 1498 Mejo Tsunami deposit was clearly visible as laminated fine sand and silt deposits 20 cm thick, intercalated with the flood plain deposits. The laminated tsunami deposit indicated the repeated occurrence of the sediment flows; tsunami run up and return flows. The tsunami deposit is also very fine grained, and located about 2.5 km inland from the 1498 Mejo coastline. Current ripples in the deposits indicate landward water currents, allowing differentiation from the river flood deposits (Fujiwara, 2014). Three older tsunami deposits are now below the water table, and these represent tsunami events in the 7th, 9th and 11th centuries. Evidently, tsunami events are frequent in this part of the world.

We next moved to view some of the community/local government responses to the tsunami hazard. Recognising that tsunamis are a regular occurrence, the local authorities have been quick to construct appropriate refuge structures. Heisei no *inochi-yama* is a recently built flood evacuation mound, constructed

**Table 1.** Four idealised roles of scientists in decision making (after Ono (pers comm.) and Pielke (2007)).

	VIEW OF SCIENCE	
	LINEAR MODEL	STAKEHOLDER MODEL
	Pure scientist	Issue advocate
VIEW OF DEMOCRACY	Studies the science only for scientific interest.	Intervenes actively in the issues; with a focus of insistence and a narrowing of perspectives.
	Science arbiter Offers data to scientific committees or Government if asked.	Honest broker of policy alternatives Scientists who wish to intervene actively in the issues, but not bound to a single insistence. Shows balanced options (both positive and negative) and objective scientific data to society to help widen their perspectives. Allows the public to judge the issues on the facts.

after the 2011 Tohoku-oki tsunami (*Inochi* = lifesaving and *yama* = mound) (Figure 1). Located 1.3 km inland from the coastline, it is an oval shaped mound, the top of which is 10 m asl and can hold approximately 1300 evacuees (Figure 2). Also visible were many steel tsunami evacuation towers. We also saw the Nakashinden *Inochi-yama*, a smaller evacuation mound, built in the Edo era (17th – 19th Centuries). It is now tucked away somewhat incongruously, behind suburban houses. Clearly, this is a community used to living with tsunami inundation. The scientific evidence in the landscape was clear: tsunamis have happened in the past and are expected to happen in the future. Fact.

And so onto the Hamaoka NPP. To aid our understanding of the societal impact of the NPP we had with us Aileen Smith, of Green Action. Aileen is a passionate environmental advocate; her first environmental advocacy work was being involved with the Minamata disaster back in the late 1960's. In addition, there is currently a lawsuit against the Hamaoka NPP, seeking the permanent decommissioning of the reactors. The lawyer representing the plaintiffs, Mr Yuki Kaido, was also in attendance to fill us in on the wider societal impacts of the NPP.



**Figure 1.** Heisi no *inochi-yama*, a tsunami evacuation mound built in 2012. (Photo credit: Carol Smith)

**Figure 2.** View from the top of the Heisi no *inochi-yama*: designed to accommodate 1,300 people. Squeeze up everyone! (Photo credit: Carol Smith)

The location of the Hamaoka NPP is a geologically challenging one. It is located within a syncline, sandwiched between the Atsemi upwarping to the NW and the Ebshu-Nada flexure to the SE. The Hamaoka NPP commenced operation in 1976, but the extent of the tectonic setting was (apparently) not fully appreciated at that time. There are 5 reactors, with two currently being decommissioned (following hydrogen explosions in 2006) and the remaining 3 being offline for safety checks and remedial seismic strengthening. Following the 2011 Tohoku-oki Tsunami and the inundation of the Fukushima Dai-ichi NPP (490 km to the north), all NPP's were closed in Japan to allow for safety checks. All the reactors except the most recent one, are BWR (boiling water reactors – the same technology as at the Fukushima Dai-ichi NPP). Once at the Hamaoka NPP, we were shepherded up to the observation tower, where we had a panoramic view (from 62 m asl) of the compound and the surrounding landscape. Cameras were strictly prohibited, with vigilant security guards present to ensure compliance. A quick Google search afterwards demonstrated the futile nature of their request (for example <http://fukushimaupdate.com/safety-screening-sought-for-hamaoka-reactor/>). From this vantage point, we learnt of the two major seismic risks to the NPP.

Firstly, earthquake. The subduction of the Philippine plate under the Pacific plate results in the Nanki-Sugura trough offshore. Significant local earthquakes in the past associated with this system have included the M8.4 Ansei-Tokai (1854) and the M8.4 Hamaoka To-nanki (1944). Historically, there have also been earthquakes centred north of Hamaoka NPP at Odawara (1633, 1782 and 1853) and the 1923 Great Kanto Earthquake in Yokohama. The outer edge of the continental shelf has been deformed by the active Enshu-nada and Kumano-nada flexure. An inferred active fault related to this flexure could generate a significant earthquake at the plate boundary. Of equal concern is a fault line under the NPP itself.

Secondly, tsunami. The NPP is built on a reclaimed back beach of the Niino River, behind a fore dune and is at 6-8 m asl. This part of the coastline consists of late Pleistocene fluvial and marine terraces and more recent Holocene marine terraces, clearly demonstrating evidence of recurring millennium scale seismic uplift events. The marine terraces are covered by thick aeolian sand deposits. We observed construction of a 22 m high tsunami wall, anchored into the friable mudstone of the Plio-Pleistocene Kakegawa Group. The coastal sea wall defences on the beach designed to disperse energy were indeed impressive. But having just observed the sequence of tsunami deposits on the Otagawa River and appreciating the tectonic setting, the tsunami risk at this site is clearly significant. A projected tsunami wave height

of 19m has been modelled, based on a possible local source region of a M9.1 Tokai earthquake. While there is only a 3% probability of a tsunami >19m high, the fore dunes in front of the wall offer a run up “ramp” that would likely result in a wave coming close to overtopping the wall.

Combining these seismic risks, we were told that the concern here is of a *genpatsu-shinsai* – or domino-effect NPP disaster (a phrase coined by Prof. Ishibashi in 1997). This is where a major earthquake causes a severe accident at a NPP, near a major population centre, resulting in an uncontrollable release of radiation and significant local and global economic and societal consequences. 860,000 people live within 30 km radius of the Hamaoka NPP and major transport arterial routes are nearby. Evacuation of the area would be challenging, despite the man made “refugia” or *inochi-yama* and evacuation towers we saw earlier in the day.

Further evidence of this flexure zone caused by the tectonic setting was seen at the last stop of the trip– the uplifted MIS5a marine terrace at Omaezaki Cape. Here, the Enshu-nada flexure stretches NE and continues to the Makino-hara flexure, which has tilted the MIS5e-d surfaces. The MIS5e-d geomorphic surface is presently covered by immaculately clipped tea gardens, and formed of thick marine deposits including sands and gravels deposited during a regression, following a peak of marine transgression of the MIS5e. The Makino-hara surface is intensively tilted and uplifted to the SE, reaching >160m asl in the NW to around 40m asl in the SE. This is in fact the highest MIS5e surface on the Japanese mainland.

This evidence in the landscape begs the question – why build a NPP in such a high risk area? The answer partly lies in the fact that each electricity company in Japan is required to generate electricity from within their own geographical region. Hamaoka must have ticked a number of boxes, apart from that for avoiding seismic risk. Ironically, following the closure of all NPP for safety checks in 2011, Japan has been generating nuclear-free electricity for close to 2 years (with the first recommissioned NPP coming back on stream in August 2015). But at the cost of fossil fuel – generated electricity.



**Figure 3.** Aileen Smith outlining the challenges of locating a NPP within a seismically active landscape (Photo credit: Carol Smith)

So, where does this leave electricity power generation in Japan and the role of Quaternary Science? With our “pure scientist” hat on, we observed during the trip some impressive and objective evidence of seismic signatures in the landscape in the form of tsunami deposits and tectonic uplift. Plus some power-generating infrastructure at risk of damage. Now viewing this through the “honest broker” lens, clearly the message from the seismic signatures does not sit conformably with the NPP infrastructure, and the community must be made aware of both the positive and negative aspects of the NPP.

And therein lies the challenge: the science message is clear, but it sits within a social-eco-political setting and decision making process. For the wider community to judge properly the issues involved also requires a level of understanding and scientific literacy: free from unbiased, selectively filtered information. How often have we heard that? Perhaps there is some merit in adopting the “honest broker” approach in our current science/policy debates around climate change.

With thanks to Prof Yugo Ono, Prof. Hirakawa (Hokkaido University) and Dr. Osamu Fujiwara (Geological Survey of Japan) for guiding us through this complex landscape where Quaternary science meets society. Aileen Smith and Yuki Kaido who offered us highly informative views and a valuable insight into the societal impacts of NPP's.

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# The formation of an Australasian peat working group (AUZPeat)

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Australasian Quaternarists of a peaty persuasion noticed a similar theme running through several of the non-antipodean presentations during the peat sessions at the Nagoya INQUA Congress, 2015: there is plenty of peat across the globe... yet Australasia doesn't seem to have any. Right? Wrong. The global peat map (Figure 1) was also frequently shown which did little to challenge this idea. During the C-PEAT (Carbon in Peat on Earth through Time) business meeting we began to discuss how we might address this misconception by raising the profile of peat-based research in Australia – to place ourselves on the peat map (so to speak) – and help one another with peat-related technical questions along the way. Following a brief meeting, the Australasian peat working group (AUZPeat) was born.

## AUSTRALASIAN PEAT DEPOSITS

Peatlands are excellent archives of palaeoenvironmental change (Chambers et al., 2012), and whilst most are undoubtedly found in the northern high latitudes, several are found in Australia and New Zealand: often in small, niche environments across a wide range of habitats (Whinham and Hope, 2005). They are therefore useful archives of change across a region which can otherwise prove elusive with regards to continuous records. Several of Australasia's peatlands are outlined by Whinham and Hope (2005), and new research is building on earlier work from some of the best studied records such as Lynch's Crater (eg. Kershaw et al., 2007) and Okarito

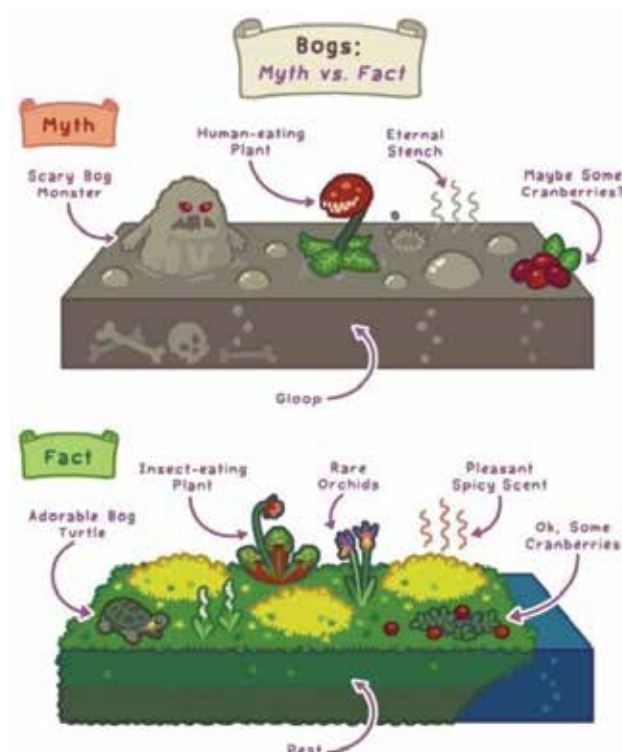
Bog (Vandergoes et al., 2005; Newnham et al., 2007). Areas of new peat research include deposits on South East Queensland sand islands (eg. Moss et al., 2013; McGowan et al., 2008; Petherick et al., 2013), the Atherton Tablelands (eg. Burrows et al., 2014), the Blue Mountains (Benson and Baird, 2012; Fryirs et al., 2014) and around inland springs (eg. McGowan et al., 2012). Australasian peats have also proved to be excellent archaeological archives, with the Wyrie Swamp peat beds in South Australia revealing early wooden artefacts including 9,000 year old boomerangs (Luebbers, 1975).

## KEY OUTCOMES AND FUTURE DIRECTIONS

A mailing list has been formed to disseminate peat-related information to the group including relevant upcoming conference sessions, new publications, and any queries or technical issues people wish to discuss in adapting established methods to Australian conditions and sites. If you wish to be included on this mailing list please contact Emily Field ([e.field@uq.edu.au](mailto:e.field@uq.edu.au)).



LEFT: Figure 1. Global peat distribution (Pravettoni, 2009)



RIGHT: Figure 2. Bogs: myth vs. fact (after <http://birdandmoon.com>)

Len Martin and Geoff Hope are attending the C-PEAT workshop (Peat On Earth through Time) in New York between 11-13th October 2015. The overarching focus of the workshop includes: controls on the formation, persistence and disappearance of peats in different climates (present); changes in peat carbon stocks in Earth history (past); and the fate and trajectories of existing peat carbon stocks. The overall goal of this workshop is to facilitate research coordination and the synthesis of knowledge and data on peat accumulation processes and histories on Earth. Australasian research can make important contributions to the field partly because of the lack of large peat stocks. In Australasia, peat only forms in niche environments which means it is inherently sensitive to drivers of environmental change – especially in such a climatically variable region. Geoff and Len intend to highlight this as well as the improvements in palaeoenvironmental understanding brought about by peat research. We plan to distribute some of the data synthesis and discussion outcomes from this workshop which will no doubt be of interest to the Australasian peat community.

There is enthusiasm from AUZPeat for a peat session at the next AQUA conference in Auckland, December 2016. There is also a spark of interest in trying to develop an official Australasian peat project (perhaps under the SHAPE and C-PEAT International Focus Groups) with the aim to write a paper updating the current state of knowledge regarding peatlands in Australasia, following on from Whinham and Hope (2005) and using this text as a starting point. Funds could be used to hold a workshop and allow ECRs to attend. Any paper resulting from this work could be the lead-off talk to the proposed AQUA session.

Finally, there is also talk of creating an AUZPeat Facebook page or twitter account, where members can post interesting results from field work, or perhaps even general information about peat proxies such as humification and testate amoebae in an informal setting. For an idea of a similar example in the UK, see <http://bogology.org/>. This page could also be used as a forum for hilarious peat fieldwork photos and perhaps the odd bog-joke or meme, such as the apt example on the previous page (Figure 2).

If you wish to be involved in any of the above either now or perhaps down the track, please contact Emily Field ([e.field@uq.edu.au](mailto:e.field@uq.edu.au)).

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## What is this thing, called INQUA?

Jessica Reeves

*School of Applied and Biomedical Sciences, Federation University Australia, Ballarat, Victoria*

For many of us, INQUA is one of the major international conferences in our field that comes around every four years. An opportunity to meet some big names, and hopefully present our latest findings to a captivated audience. Whilst this is true of the INQUA Congress, the association itself is a bigger beast. This year at the INQUA Congress in Nagoya I had the opportunity to represent Australia on the International Council, so I got a bit of an insight into the inner workings of the association. As such, I present here a 'users' guide' to the International Union for Quaternary Research (INQUA), with the hope that you will be able to make the best use of your association.

INQUA is one of the 31 scientific unions that make up ICSU – the International Council for Science. ICSU is a global non-governmental organisation, whose mission is to strengthen international science for the benefit of society. INQUA was established in 1928, initially to investigate environmental change during the glacial age and to encourage interdisciplinary research to achieve this end (INQUA, 2015). Today INQUA seeks to “encourage and facilitate the research of Quaternary scientists in all disciplines” and “promote improved communication and international collaboration in basic and applied aspects of Quaternary research” (INQUA, 2015). Membership of INQUA is by country and our dues are paid by the Australian Academy of Science and the Royal Society of New Zealand.

INQUA is administered by an Executive Committee, with positions open for nomination at the INQUA Congresses. Our new President is Prof Allan Ashworth (USA), our Secretary is Dr Brian Chase (France) and we have four Vice Presidents from Venezuela, China, Netherlands and India. Dr Marie-France Loutre (Belgium) has been Treasurer for some time, but is about to step down (any volunteers?). In addition, each member country puts forward a national member to the International Council (IC). David Lowe is member for New Zealand and I represent Australia. The IC is the body that approves INQUA's remit, business, policies, organisation and statutes. The IC meets during the INQUA congress. We sit around the room behind our country badges – a bit like the UN. As well as approving reports and any actions, members of the IC vote on behalf of their member country or region on the new Executive and the location of the next INQUA Congress. (And yes, there are voting blocks reminiscent of Eurovision!) As many of you will be happy to note, the next INQUA Congress will be held in Dublin in 2019.

The majority of the work of INQUA is organised under the five Commissions: CMP (Coastal and Marine Processes), PALCOMM (Palaeoclimate), HABCOM (Humans and Biosphere), SACCOM (Stratigraphy and Chronology) and TERPRO (Terrestrial Processes, Deposits and History). Each commission has an advisory board of 12 senior scientists, covering the broad thematic interests

of the commission and from different geographic regions. The Commissions allocate funding to the International Focus Group and Projects and report on their progress. Anyone is welcome to become a member of the Commissions.

In terms of funding research, there are three categories: International Focus Groups (IFGs), Projects and Skills Enhancement. An IFG is a collaboration designed to address scientific issues of wide international significance. It is seen as an umbrella for more targeted Projects. IFGs are typically funded for an inter-congress period (4 years), but may apply for a second term. Projects are smaller and more specific. They typically run for two years, but again, may apply for a second iteration. Projects must sit within IFGs. Anyone can propose a project or IFG, as long as the goals are clear and fit within one of the commissions, an inclusivity plan (especially for early-career scientists and low-GDP country participants) is clearly articulated and concrete outcomes are defined.

Funding from IFGs and Projects may be utilised for enhanced communication (e.g. a website), database creation/maintenance, and participation of early career researchers or developing country researchers who are members of projects to attend IFG or Project workshops. Funds cannot be spent on senior scientist participation, fieldwork, purchase of equipment or analyses. Funds for IFGs are in the order of 5000-8000 Euros per year and for Projects are in the order of 4000-5000 Euros per year. Projects and IFGs must report to their Commission annually.



Skills Enhancement is a new scheme introduced in 2013. The goal of the scheme is to widen the skill base within INQUA through assisting scientists who lack well-developed infrastructures or networks through information exchange and training workshops. Funds could be applied to support training workshops, development of handbooks, or running networking opportunities around specific regions/techniques. Funding is once off, and in the order of 4000-5000 Euros. Deadlines for funding for each of these schemes are typically at the end of January and application forms can be found on the INQUA website under Awards.

INQUA also offers funding to ECRs and low-GDP country researchers to attend the Congress. Typically INQUA supports 100-150 participants each Congress. INQUA also awards two prestigious medals at the Congress: the Liu Tungsheng Distinguished Career Medal for service to the international community in Quaternary science; the INQUA Distinguished Service Medal for service to INQUA and the Shackleton Medal for outstanding young Quaternary scientists. These were awarded to Prof. Ann G. Wintle, Prof. Nathaniel W. Rutter and Assoc. Prof. Robert E. Kopp, respectively in Nagoya.

INQUA's other main outreach function is to publish *Quaternary International*. QI publishes peer reviewed research papers from symposia, workshops and meetings

sponsored by the Commissions, committees and working groups. Now in its 382nd volume, QI has been published since 1989. Astonishingly, Norm Catto has been on the Editorial Board for the entire life of QI and has just stepped down as Editor in Chief this year. Min-Te Chen is about to take up this position. INQUA's other output is *Quaternary Perspectives*, which is in newsletter format and is used to update on progress of Projects and IFGs and inform of upcoming events and other news.

INQUA has been making a real effort to engage more Early Career Researchers since 2012, through the INQUA ECR Committee. INQUA defines an ECR as someone who is within 8 years of being awarded their PhD. The INQUA ECRs have their own website, Facebook page and twitter account. The purpose of the INQUA ECR Committee is to increase dissemination of information between INQUA and ECR members, support and provide mentorship for ECRs, particularly those from developing countries and increase community outreach. Each of the Commissions has two ECR representatives on their committees. As well as specific sessions at the Congress for ECRs, there is an INQUA ECR inter-congress meeting. The first of these, held in Wollongong in 2013, was a tremendous success. The next meeting will be in Reading, UK, in September 2016. For more details, have a look at the ECR Facebook page or contact Craig Sloss (c.sloss@qut.edu.au).

Remember that INQUA is your organisation and is what you make of it. It is going through a bit of a transformation at present and very open to suggestions as to how to move forward. If you have some good ideas, please feel free to pass them on to me and I will ensure that they are heard (j.reeves@federation.edu.au). For further information, please take a look at the INQUA website: <http://www.inqua.org/>.

## REFERENCE

INQUA, 2015. International Union for Quaternary Research. [ONLINE] Available at: <http://www.inqua.org/>. [Accessed 19 October 2015].

## Queen's Birthday Honour to Australasian Quaternarist

Peter Kershaw

*Emeritus Professor, School of Earth, Atmosphere and Environment, Monash University*

An Order of Australia Medal (AOM) has been awarded this year to Quaternary palynologist Dr Gwendolyne Merna McKenzie “for service to science, particularly as a researcher”. Merna currently holds the position of Adjunct Research Fellow in the School of Earth, Atmosphere and Environment, Monash University.

Merna was nominated for her contribution to education and research in palaeoecology, particularly the application of fossil pollen, plant macrofossil and charcoal analyses to the reconstruction of the history of vegetation, climate and forest fires from continuous lake and swamp sediment cores within Australia.

Merna's interest in palaeoecology was sparked whilst a student in the School of Botany, Melbourne University in 1945 and re-kindled while furthering her education at Monash University from 1969 after a career as a biology teacher shared with bringing up four children. Initially, in the School of Geography and Environmental Science at Monash, she completed a Master of Environmental Science degree that incorporated a thesis entitled *An Environmental Studies Centre as a Resource for Informed Environmental Education* that reflected the educational side of her background, as well as course units on *The Status of Australian Vegetation* and *Quaternary Environments* that led to a PhD project on *Late Quaternary Vegetation and Climate in the Central Highlands of Victoria, Australia, with special reference to Nothofagus cunninghamii* (Hook) Oerst. Rainforest.

After obtaining her Doctorate, Merna continued, largely in an honorary capacity, to undertake research on the history of the highlands of Victoria as well as contribute her botanical and palaeoecological expertise to projects of others, especially research students, within the broader Australian region. Project design often began with the identification of suitable study sites identified by Merna and her husband on their many reconnaissance trips into often remote and difficult terrain. Merna presented results of her research at many national and international conferences as well as in some 17 peer-reviewed papers.

A number of specific features of Merna's contribution to palaeoecology are regarded as having special significance.

1. The provision of important insights into the history and dynamics of wet sclerophyll forests that generate the most intense and destructive bushfires in southeastern Australia.
2. Production of pioneer rigorous quantitative pollen estimates of past climates in south-eastern Australia from bioclimatic analysis of the changing distribution of the refugial rainforest tree *Nothofagus*.
3. The construction of the only high resolution pollen record providing responses of alpine vegetation and the treeline to climate change during the full last glacial-interglacial cycle of mainland Australia.
4. The identification of a long term drying trend in northern Australian climate with implications for understanding the extinction pattern of



Merna in her element (Photo: Peter Kershaw)

Australian megafauna and accelerated loss of rainforest.

5. The contribution of records to major global and broad regional quantitative syntheses of changing biome distributions and fire regimes in response to climate.
6. The provision of assistance and guidance to a multitude of palaeoecological students both in the field and laboratory for over 30 years.
7. A more general appreciation of the general character of Merna as a guiding light in the School of Geography and Environmental Science exemplified by her recent selection as the motivating speaker at the annual student prize giving ceremony.

An outstanding feature of Merna is the way she has maintained her enthusiasm for and dedication to palaeoecological research and instruction over the last 35 years. Through much of this period she has worked full time except for periods accompanying her husband who had short-term adjunct appointments in the USA. Recently, she has shared work with study for yet another degree – a Bachelor of Letters with a major in Latin – in true Monash ‘Ancora imparo’ spirit. Although now 92 years old, she shows little sign of slowing down, and provides an inspirational role model to all, especially women, young and old.



INQUA

International Union for Quaternary Research

## FUNDING OPPORTUNITIES WITH INQUA

INQUA funding is designed to support and facilitate activities that are considered priorities by its Commissions. Seed money for activities – prioritises support for the participation of early-career and developing-country scientists in INQUA activities.

### International Focus Groups (IFGs)

Address a 'specific scientific question' of wide international significance; provide an umbrella for one, or several, more focused “**projects**”; An explicit plan for activities throughout the proposed duration of the IFG; A high-level of buy-in from the international INQUA community and involvement of early-career and/or developing-country researchers.

**Project funding could be used for:**

Costs for creation of a website to enhance communication; creation/maintenance of database central to IFG activities; production of handbooks or other publication costs associated with IFG outputs; Participation of early-career or developing-country researchers in IFG workshops.

IFG would typically be for funding of the order €5000-8000.

### Projects

Activities, with very specific aims, objectives and outcomes, which contribute to one or more IFGs. Projects are developed by, or in consultation, with an IFG.

**Project funding could be used for:**

logistics for workshop centralized costs (e.g. room hire); costs associated with travel and participation of early-career and/or developing-country scientists.

The “project” scheme would typically be for funding of the order €4000-5000.

### Skills Enhancement

The goal of this funding is to widen the skill base within the INQUA community, specifically through assisting scientists who lack well-developed infrastructures or networks. Applications for skills enhancement funding must demonstrate: the need for skills enhancement in a particular region/field; how the proposed activities will foster skills enhancement; who will benefit directly from the funding; how the skills enhancement activity will benefit the INQUA community in the longer term.

**Project funding could be used for:**

partial support for training courses or “summer schools”.

Funding “skills enhancement” scheme would typically be for of the order €4000-5000.

### More information

[www.inqua.org/awardsCat.html](http://www.inqua.org/awardsCat.html)

**Application forms:** [www.inqua.org/awardsForms.html](http://www.inqua.org/awardsForms.html)



# CAVEPS (Conference on Australasian Vertebrate Evolution, Palaeontology and Systematics)

SEPTEMBER 1-5, 2015, ALICE SPRINGS, NORTHERN TERRITORY, AUSTRALIA

Sanja Van Huet

*Deakin University, School of Life and Environmental Science, Victoria*

This year is a significant anniversary: the first CAVEPS was held in Alice Springs 30 years ago. Approximately 70 attendees 'escaped' teaching and other duties to attend the conference. Symposium topics included 'Vertebrates and the Aridification of Australia' and 'The Intersection of Palaeontology and Zooarchaeology'. Peter Murray presented the plenary address and the keynotes were given by Richard Cosgrove (La Trobe University) and Anusuya Chinsamy-Turan (University of Cape Town).

There were 37 talks over the four days. Quaternary related themes included: building a biogeographic map for fossil bandicoots and bilbies from Quaternary deposits (Kenny Travouillon, University of Queensland and WA Museum); dental microwear of macropodids (Sam Arman, Flinders University); megafauna from the Jenolan Caves

complex, NSW (Anne Musser, Australian Museum); and The biogeography and biodiversity of late Holocene mammal faunas in S.E. Australia (Diana Fusco, Flinders University). Jillian Garvey (La Trobe University) presented a 'gruesomely fascinating' talk on the distribution of flesh, bone, fat and marrow on animal bones and the possible association with human prey choice and body part selection.

One talk generated a great deal of interest and discussion. Anusuya Chinsamy-Turan, from the University of Cape Town, spoke of her work on the histology of preserved fossil bone. Chinsamy-Turan demonstrated that bone is highly responsive to its environment and how microscopic evidence can reveal factors such as rate of bone formation, biomechanics, ontogenetic age, sexual maturity,

gender, prevalence of disease and ability to compare between species from high and low latitudes.

The Riversleigh Medal 2015 (an award for services to Australian palaeontology) was presented to Michael Lee of the South Australian Museum for his long-term and outstanding research in palaeontology. (Previous winners have included Sir David Attenborough, Mary White and John Long.) The student prize was awarded to Ada Klinkhamer of the University of New England. There is now a Facebook site for CAVEPS, with regular postings and updates of palaeontological interest. The next CAVEPS will be held in New Zealand in 2017.

# When did the Anthropocene start? Survey results

Helen Bostock

NIWA, Wellington, New Zealand

When did the Anthropocene start? Following on from an article published in the previous Quaternary Australasia that discussed this topic (Bostock et al., 2015), the question was put to the AQUA community in an online survey in September, 2015.

The results of that survey are now in.... “The Great Acceleration and Atomic Bomb” was the most popular response and just edged out the “Industrial revolution” and “The Anthropocene should remain an informal unit”. Thank you to the 123 of you who took a minute to answer the survey. Below are the official statistics.

A few of quotes from those who selected ‘other’ or who emailed me with comments.

*“It’s an interesting thing to think about and I’ve used it in class to stimulate debate, but I do not yet think that I’m convinced that there is a compelling need/justification for it as a geological interval....On our human time-scales the event has been diachronous and progressive. A single age will be relatively meaningless. Those which focus on historical events are condemned to only be of regional extent. Those which focus on ‘datability’ (e.g. nuclear testing) are not necessarily marking a significant geological event (as opposed to a social event).”*

*“Considering that the Holocene began at the end of the Ice Age, and humankind’s biggest impacts began as early as the onset of agriculture, which began early in the Holocene, why do we need an Anthropocene? The Anthropocene is almost synonymous with the Holocene, so the Anthropocene is not needed, and instead seems to have been created to grab newspaper headlines. “*

*“Looking at the geological history of the Earth, with regard to mean surface temperature, sea levels, etc. it seems perfectly clear to me that we are still in the Holocene, which apparently began around 11,700 years ago, when the great ice sheets melted..... All of human history is within the Holocene, so you could rename the Holocene the Anthropocene, but I don’t see any need for this.”*

*“In the interests of enduring stratigraphic identification, I plump for the signature of atmospheric weapons testing, which also signals the Great Acceleration.”*

*“I voted for the bomb (there is a phrase I never thought I’d write!), because it is well defined and measurable. However, good arguments are made for all.”*

ANSWER OPTIONS	TOTAL	% OF TOTAL RESPONSES
Great Acceleration and Atomic Bomb ~AD 1950	44	35.8%
Tambora eruption April AD1815	4	3.3%
Industrial revolution AD 1760	36	29.3%
The Anthropocene hasn’t started	1	0.8%
The Anthropocene should remain an informal unit	28	22.8%
Other	10	8.1%

These results will be sent to Dr Jan Zalasiewicz, who is the chair of the Anthropocene Working Group (AWG) and presented at the International Commission on Stratigraphy in Cape Town in 2016. The AWG are also looking for potential Global Boundary Stratotype Section and Point (GSSP, commonly known by geologists as a golden spike) or at least auxiliary sections. For example the Holocene boundary is officially in the NGRIP Greenland ice core, but there are a number of auxiliary sections around the world, including one at Lake Maratoto, near Hamilton in New Zealand (Walker et al., 2009; Green and Lowe, 1985).

For a GSSP to be considered it must be able to be defined using a primary marker of either a fossil, geomagnetic reversal, chemical or radiometrically dated. The marker has to have regional and global correlation in outcrops of the same age and should be independent of facies. The sedimentation of the outcrop has to be continuous with no changes in facies and must be unaffected by tectonic and sedimentary movements or metamorphism. The outcrop has to be easily accessible to research, kept in good condition, allow for repeat sampling and open and free to access to researchers of all nationalities. Some possible ideas for the Anthropocene may be high resolution lake sediments or perhaps tropical coral records. If you know of any geological records that might make a suitable Anthropocene GSSP then please get in touch (helen.bostock@niwa.co.nz).

## REFERENCE

Bostock, H.C., Lowe, D.J., Gillespie, R., Priestley, R., Newnham, R.M. and Mooney, S.D., 2015. The advent of the Anthropocene in Australasia. *Quaternary Australasia*, 32(1), 7-16.

## ARC RESULTS

### ARC LINKAGE PROJECT RESULTS

Congratulations to the latest recipients of the recently announced Linkage Grants. Here is a summary of those projects related to Quaternary research.

### THE AUSTRALIAN NATIONAL UNIVERSITY

Morphy, Prof Howard; Nugent, Dr Maria; Bolton, Dr Lissant; Sculthorpe, Dr Gaye; Coates, Dr Ian; Trinca, Dr Mathew

#### Project Summary:

This project, being conducted in collaboration with Indigenous communities and regional museums in Australia and the United Kingdom, aims to develop and to pilot approaches that facilitate Indigenous people's access to and engagement with museum collections and objects. Reconnecting Indigenous Australian communities with ethnographic collections is central to contemporary museum practice. Yet, the historical dispersal of objects across museums, nationally and internationally, makes relationship and reconnection a challenge to communities and museums alike. The project seeks to address this and to contribute to new museum practice and museum development in Australia.

**National Museum of Australia;  
British Museum; Wagga Wagga City  
Council**

**\$699,310**

### THE UNIVERSITY OF WESTERN AUSTRALIA

Professor Peter Veth

#### Project Summary:

This project aims to examine the role that art has played in managing social and environmental change over the past 50 000 years. The project seeks to carry out the first systematic comparative analysis of different rock art repertoires and associated archaeology from the Kimberley and Arnhem Land. It is intended that identifying continuities and changes in this archaeological signature will provide direct evidence of how people adapted and signalled their identity. Intended outcomes are new understanding to contribute to inter-regional rock art studies and inform Indigenous and government heritage management practices.

**Kimberley Foundation Australia;  
Department of Parks and Wildlife/  
Department of Environment and  
Conservation; Dunkeld Pastoral Co.  
Pty Ltd/Dunkeld Pastoral Co. Pty Ltd**

**\$865,905**

### THE UNIVERSITY OF MELBOURNE

Professor David Karoly

#### Project Summary:

This interdisciplinary project plans to assemble a world-class team of hydrologists, climate scientists and water managers to investigate the history and future risk of decadal to multidecadal droughts (megadroughts). Despite Australia's vulnerability to water scarcity, the likelihood of persistent megadroughts has not been assessed in Australia. This has resulted in inadequate capacity to prepare for and adapt to megadrought under future climate change. For the first time, palaeoclimate reconstructions and climate change projections will be used to constrain future

hydroclimatic variability, advancing the decision-making capacity of Australian water resource managers.

**Melbourne Water Corporation/  
Melbourne Water; Department  
of Environment and Primary  
Industries/Department of  
Sustainability and Environment;  
Bureau of Meteorology**

**\$387,041**

### THE UNIVERSITY OF NEW SOUTH WALES

Professor Andrew Baker

#### Project Summary:

This project aims to determine how non-conventional lithium and silicon isotopes can be used to understand groundwater processes using an innovative source-to-target approach. The project aims to apply these isotope tracers to trace the water cycle within a well constrained system: an island aquifer with a dense borefield which has been analysed using traditional isotopic techniques. Supporting hydrochemical data will be used to determine the relationship of the isotopes with environmental processes. The project's impact will be the development of new methods to help understand our groundwater resource. The improved process understanding will be translated to groundwater management in general. The projects' focus on carbonate aquifer systems typical of coastal regions of southern, eastern and western Australia will have relevance to groundwater management in urban areas such as Perth and in rural areas for tourism and viticulture, and for management of natural resources in National Parks.

**Australian Nuclear Science and  
Technology Organisation; Rottneest  
Island Authority; Department of  
Water**

**\$138,091**



**GRIFFITH UNIVERSITY**

Professor David Lambert

**Project Summary:**

A number of studies of human migration suggest that after initial colonisation of Australia around 45,000 years ago, these people remained largely isolated until the arrival of Europeans. In contrast recent studies have suggested that a wave of migration from India into Australia occurred approximately 4,230 years ago. However, a major drawback of these recent studies is that sequence data used was from modern indigenous Australians who were potentially admixed with Europeans. To address this issue we will sequence complete genomes from sub-fossil bones of ancient Indian and Indigenous Australian people and directly investigate this possible India-Australia connection.

**Centre for Geogenetics, Natural History Museum of Denmark;  
Novogene Bioinformatics  
Technology Co. Ltd**

**\$570,000**

**Soils: Genesis and Geomorphology**

Randall J. Schaetzl and Michael L. Thompson

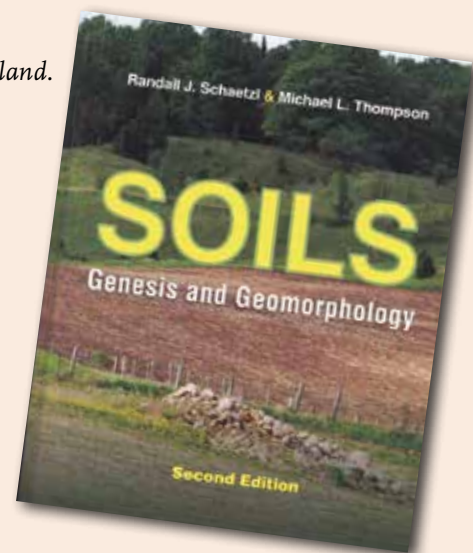
*Cambridge University Press, New York, 2015. ISBN 9781107016934, 778pp.*

*Cost: USD104 (Hardback), USD57 (Kindle)*

Reviewed by Peter Almond

*Department of Soil and Physical Sciences,  
Lincoln University, Christchurch, New Zealand.*

This book is an update of the same title published in 2005, but with a different co-author (previously Sharon Anderson). Randall Schaetzl is a professor in the Department of Geography at Michigan State University, and Michael Thompson holds a tenured position at the University of Iowa in the Agronomy Department. Their respective interests in soil science are broadly aligned with their departmental affiliations. The previous edition of the book was well-received by soil scientists, integrating a rigorous approach to soil morphology, classification and genesis with geomorphology. The update in this edition includes new sections on soil chemistry, digital soil mapping, soils and archaeology, and the World Reference Base soil classification system, as well as new theoretical developments. For that, it remains very similar in length at 640 pages of text, plus references and a comprehensive glossary; the reference list is available as an electronic file.



I have tuned this review to address the relevance of this book to the part of the readership of Quaternary Australasia who stand to gain from a better understanding of soils: Quaternary scientists, geomorphologists, (palaeo) environmental scientists and archaeologists. The authors unapologetically acknowledge a bias towards North American landscapes and literature, although the book is not without examples from other continents, including our part of the planet. It has been my experience as a soil scientist who crosses over into the earth sciences that many earth scientists are not willing to cross the other way, either because they lack confidence or because they are unconvinced of the value soils can bring to their research questions. The authors have pitched the book at non-specialists, requiring only some background in the natural sciences. The yard stick I apply to the book is: is it accessible to the target group I've identified and can it help them 'cross over' in their research and teaching?

After a brief history of the young discipline of soil science (<150 years), Part I ("The Building Blocks of Soil") of the book deals with the components of soil and the system of nomenclature used to describe soil profiles. The first hurdle to the non-specialist arises here: the reader is going to have to invest significant time in getting to grips with the full "alphabet soup" of soil horizon nomenclature including both master and subordinate horizon terms. Used throughout the book to summarise soil profile features and properties, this code is one of the keys to what comes later. The highlight for me of Part I

was the treatment of soil minerals. After a discussion of primary minerals inherited from rocks, a well-illustrated and explained section on secondary minerals is given. Whereas primary minerals speak to conditions within the mantle or ocean in which rocks formed, soil secondary minerals (clays, oxides, oxyhydroxides) are a product of the surface (soil) environment. Hence, they carry important information about current or past environments, which is discussed later. The chapters on soil chemistry, biology and physics could be used in any introductory to intermediate university environmental sciences course to convey the basics of soil as a chemical reactor, an ecosystem, or as a medium for water infiltration and storage.

Part II (“Parent Material to Soil”) addresses soil genesis and begins with soil classification. This is the other ‘gatekeeper’ chapter; if you don’t master the essentials of the soil classification system, your enjoyment and the value you extract from the rest of the book will be hamstrung. Soil classification is daunting for non-specialists and often a source of derision from non-soil scientists. Even amongst soil scientists, competency in soil classification is limited to pedologists. The soil classification system used is the United States Department of Agriculture’s *Soil Taxonomy*. This is one of the more forbidding systems but Schaetzl and Thompson do a very good job of presenting the essentials of it. They focus on the rationale of the system’s structure (hierarchy), and the conceptual basis of the diagnostic features and the taxa they’re used to define. The complexity of defining criteria are by-and-large avoided. At this point in the book you may find yourself questioning the investment you need to put into becoming competent with this classification system, but I’d

argue that the value in the rest of the text is worthwhile. What’s more, you are learning what has become one of two *de facto* global soil classification systems, the other being the FAO’s World Reference Base. A section on soil mapping will probably be overlooked by many, though a discussion of pedogeomorphic analysis piqued my interest. Essentially this is a spatial analysis of the shapes, sizes and topology of delineations on a soil map. It’s the pedo – equivalent of morphometric analysis in geomorphology. The discipline of Pedometrics, which has a strong Australian heritage with the likes of Alex McBratney and Budiman Minasny at the University of Sydney, is introduced as well.

Chapters on chemical and physical weathering approach these phenomena from a descriptive point of view, a style used in the rest of the book for tackling *process*. A contrasting approach is exemplified by the accomplished recent text by Anderson and Anderson’s (2010), *Geomorphology, the Chemistry and Mechanics of Landscapes* which comes from a thermodynamical or physical standpoint. I prefer the latter, though I know my students don’t. Soil parent materials are considered in terms of regolith types and mineralogy, which again is jargon-intensive, but more familiar to the earth science audience. Various kinds of saprolite, residuum, and transported regolith are considered in terms of their influence on soils at time <sup>zero</sup>.

The chapter on pedoturbation (soil disturbance mechanisms) sets this book apart from many other soil texts. The importance of soil disturbance processes to soil genesis has been the emphasis of two of the three scholars this book is dedicated to: Francis D Hole from the University of Wisconsin, and Donald Johnson from the University of Illinois. I have had the

pleasure of meeting both of them. The former while he enthralled first year students in introductory classes with soil puppets, and soil songs such as Darkle, Darkle Little Grain (to the tune of “*Twinkle, Twinkle Little Star*”), and the latter on a field trip to the Palouse Region of eastern Washington. Pedoturbation, and the influence of Donald Johnson, appears in the next chapter on models and concepts of soil formation. Just about anyone who knows anything about soils will have heard of the soil-forming factor model. From its origins in Russia to its formalisation with Hans Jenny, this has been the conceptual framework that has dominated pedology for over 100 years. Johnson went on a career-long crusade (taking inspiration from Darwin) to change the paradigms from *zonality*, *normal soils*, and *soil development* to notions of *progressive* and *regressive* pedogenesis in which soils are not on a fixed trajectory to an endpoint. Instead they are dynamic entities responding to a changing environment whilst retaining signatures of previous ones. The biomechanical significance of organisms was re-established after the long predilection for their biochemical importance as promoted by Jenny. This chapter is a scholarly piece of work.

Part II concludes with a long review chapter on soil processes (melanisation, lessivage, calcification, salinization etc). I devoured this chapter but I realised part way through that my familiarity with soils in the field gave me the context to compartmentalise and contextualise the material. Others less experienced with soils will have to digest it incrementally, using it as reference when exposed to new soil delights. Despite this book having a North American focus, just about all soil-forming processes from across our planet are discussed.

The easy style of the writers and the comprehensive and attractive graphics makes this essential reading and reference material.

The final part of the book is dedicated to *soil geomorphology*. The third scholar to whom the book is dedicated, Peter Birkeland, looms large here (Birkeland, 1999). Soil geomorphology aims to add the soil dimension to landscape and palaeoenvironmental studies, but also considers the influence of landscape on soils. All geomorphologists will benefit from the discourse on geomorphic surfaces, soil stratigraphy and stratigraphic principles as applied to soils and geomorphic surfaces. A formal stratigraphic unit, known as the geosol, has been accepted within the North American Stratigraphic Code for buried soils with stratigraphic significance. Buried soils in a stratigraphic sequence mark periods of landscape stability, and much can be inferred from their properties and stratigraphic context about landscape evolution. The pioneering work of Robert Ruhe in Iowa is given many pages of text. For those not interested in mid-latitude, continental glaciation, the chapter on the Quaternary landscape of Iowa (Ruhe, 1969) could be too long. However, this is a classic piece of work where many principles I now take for granted were deciphered. The famous Iowa drift was debunked as a glacial deposit based on Ruhe's meticulous soil stratigraphic work. Also addressed in this chapter is the controversy of stone line formation. The erosional and pedoturbation origins are reviewed, with the conclusion that both can be right. This discussion leads on to a small section at the end of the chapter where the implications of soil and slope processes for geoarchaeologists are considered.

A large chapter is also given to the soil catena concept. Soil catenas – soil-slope sequences – have been promoted as the fundamental soil-landscape unit for study, which integrate pedogenesis with hillslope processes. While the authors state that their approach is two-way – considering both the effect of slopes on soil pattern and the influence of soils on hillslope evolution – by-and-large slopes are treated as templates for modifying soil-forming processes. An example of this was the conventional treatment of slope elements and their relationships to soils. Hillslopes have traditionally been divided into summits, shoulders, backslopes, footslopes and toeslopes. Shoulders are described as being erosional, backslopes transportational, and footslopes/toeslopes as depositional. The explanation of downslope variations of soil properties are couched in this process-form framework. This ignores the reality that hillslopes (ignoring constructional relief) are erosional by nature driven by local base-level lowering. If all erosion were restricted to shoulders, hillslopes would erode in an unusual way! What's the relevance to soils? Transport and soil production (=denudation) on backslopes contribute to both soil and landscape evolution. Recent work by Kyungsoo Yoo, Simon Mudd, Arjun Heimsath, and Josh Roering (amongst others) is on the cutting edge of this soil-hillslope evolution feedback research, but they are not cited (see for example Yoo et al., 2005; Mudd and Furbish, 2006; Yoo et al., 2006; Roering, 2008; Yoo and Mudd, 2008).

A chapter on soil development and surface exposure dating will be of most interest for the use of soils as a relative or calibrated dating technique. The discussion of other

dating techniques will probably be familiar territory.

The final chapter is definitely a case of last but not least. The analogy of soils as a palimpsest is evocative, and taught me a new word. The subdivision of possible manifestations of paleosols into buried, relict and exhumed may be new to non-specialists. The distinction is important for landscape reconstructions and palaeoenvironmental interpretation. A selection of soil morphological and chemical properties, and other accessions gives the reader a flavour of what information can be extracted from soils.

In summary, this is a scholarly contribution to soil science and geomorphology, and largely it delivers what it promises. It is a pleasure to read; it is well organised and illustrated, and it conveys the passion of the authors for their topic. Some colour plates would have really helped to appreciate the subtleties (and beauty) of soils, but no doubt would have added greatly to cost. How does it measure up on my yard stick? If the challenge of terminology can be overcome, I think this is a book that will aid and inspire non-specialists to delve into the glorious world of soils. As with anything, the more one looks and learns by experience, the more the theory in the book will gain relevance and illuminate. However, this is not a "How to" book. If you are looking specifically for assistance on how to describe a soil, or guidelines on how to classify soils, you will need to consult manuals. Likewise, methods for analyses of soils are not covered. It is suitable as an undergraduate text from second to final year soil and earth science specialisations.

The final endorsement: I'll be buying my own copy.



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# Reconstructing Past Variations in Erosion and Sediment Transport using Uranium-Series Isotopes

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Understanding how erosional and sediment transport processes have responded to past environmental changes has become increasingly important with the increased risk of future climate change. Recently-developed geochronological tools have enabled the response of hillslope-fluvial systems to such changes to be studied. This thesis focuses on the developing comminution dating (or the comminution age) technique that utilises uranium (U) isotopes to constrain the time elapsed since detrital minerals were reduced to ca. <63 µm. Applied to hillslope and fluvial systems, the comminution age represents the sediment residence time, and applied to sedimentary deposits of known depositional age, the palaeo sediment residence time can be constrained.

Non-detrital matter e.g. carbonates, organic matter, and clay minerals must be removed in order to isolate detrital minerals and calculate accurate comminution ages. In Chapter 2, existing sample pre-treatment methods were evaluated by monitoring the ( $^{234}\text{U}/^{238}\text{U}$ ) activity ratio and applying a novel mild HF/HCl etching procedure. This was used to show that the removal of non-detrital matter by existing pre-treatment methods was incomplete. Particle-size distribution measurements showed that the decrease in the ( $^{234}\text{U}/^{238}\text{U}$ ) activity ratio was likely due to the dissolution

of clay minerals. Although tests on a rock standard revealed a small amount of preferential leaching of  $^{234}\text{U}$  (< 1%), an additional mild HF/HCl etch following sequential extraction is recommended.

In Chapter 3, to investigate the relationship between climate and sediment residence times, sediment was sampled from a range of catchments in northern Australia, with mean rainfall ranging from 400 to 1600 mm a<sup>-1</sup>. Near-surface bedrock was also sampled to test the assumption that the detrital minerals are in secular equilibrium following comminution. No first-order relationship was observed between sediment residence times and mean annual rainfall of catchments. Sediment residence times were also not related to key geomorphic variables including slope, discharge or catchment area. Long sediment residence times in small catchments and the lack of increase in residence times downstream suggest that storage in hillslope and/or weathering profile is significant. The majority of bedrock samples were depleted in  $^{234}\text{U}$ , and for some samples, the measured ( $^{234}\text{U}/^{238}\text{U}$ ) activity ratio could not be accounted for by the direct recoil fraction. This is attributed to the preferential leaching of  $^{234}\text{U}$ , suggesting that detrital minerals are not in secular equilibrium before or following comminution. This study demonstrates that sediment

residence times in large monsoonal fluvial systems are strongly dependent on hillslope and regolith storage, and lithology – possibly due to  $^{234}\text{U}$ - $^{238}\text{U}$  disequilibrium in the parent material.

In Chapter 4, the comminution dating technique was applied to sedimentary cores from the Gulf of Carpentaria in northern Australia. Rainfall in the study region is mainly sourced from the Indo-Australian monsoon, and large variations in palaeo sediment residence time are expected to result from past changes in the strength of the monsoon. The sedimentary record covers the past 120 ka and variations in sediment transport can be assessed over one glacial-interglacial cycle. Palaeo sediment residence times were long during interglacial periods (40 – 150 ka), and short (0 – 30 ka) during glacial periods. Longer residence times are attributed to wetter conditions and active alluvial reworking of older material; whereas shorter residence times are inferred to represent reduced alluvial reworking and sediment being mainly sourced from the erosion of younger hillslope material. Palaeo sediment residence times increased following the Last Glacial Maximum from 20 ka onwards to present. These results from tropical Australia are consistent with other studies that also show sediment residence times are generally short during glacial periods and longer during interglacial periods.

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## BOOK CHAPTERS

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# UPCOMING MEETINGS

## AQUA BIENNIAL MEETING

Venue: Auckland

Dates: 5-9 December 2016.

Five or six day post conference trips commencing 10 December 2016.

See details elsewhere in Quaternary Australasia.

[http://aqua.org.au/?page\\_id=19](http://aqua.org.au/?page_id=19)

## OTHER MEETINGS

### JANUARY 2016

#### VIII Southern Connection Congress 2016

Venue: Punta Arenas, Chile

Date: 18-23 January 2016

<http://southernconnection2016.com/congress/>

### FEBRUARY 2016

#### 2016 AMOS/ARCCSS national conference

Venue: Melbourne

Dates: 8-11 February 2016

<https://www.amos.org.au/conferences/2016-amosarccss-national-conference-melbourne>

#### Future Earth Extremes Cluster Initiative: Cross community workshop on Extreme Events and Environments from Climate to Society (E3S)

Venue: Beijing and Berlin

Date: 14-16 February 2016

<http://www.e3s-future-earth.eu>

#### AGU 2016 Ocean Sciences Meeting

Venue: New Orleans, USA

Date: 21-26 February 2016

<https://osm.agu.org/2016/>

### MARCH 2016

#### Ice Core Young Scientists (ICYS) Workshop

Venue: Hobart, Tasmania

Date: 6 March 2016

<http://www.ipics2016.org>

#### IPICS 2nd Open Science Conference

Venue: Hobart, Australia

Date: 7-11 March 2016

<http://www.ipics2016.org>

### APRIL 2016

#### IVX Subfossil Cladocera Workshop

Venue: Levico Terme, Italy

Date: 5-8 April 2016

<http://www.pages-igbp.org/calendar/all-events/127-pages/1507-ivx-subfossil-cladocera-workshop>

#### European Geosciences Union (EGU) General Assembly 2016

Venue: Vienna, Austria

Date: 17-22 April 2016

<http://www.egu2016.eu>

**MAY 2016****PAGES SSC/EXCOM Meeting 2016**

Venue: Cluj-Napoca, Romania

Date: 21-22 May 2016

<http://www.pages-igbp.org/calendar/all-events/127-pages/1523-pages-ssc-mtng-2016>

**PAGES Romanian Paleoscience Symposium**

Venue: Cluj-Napoca, Romania

Date: 23-24 May 2016

<http://www.pages-igbp.org/calendar/all-events/127-pages/1524-pages-romanian-symposium>

**JUNE 2016****Comparing data and model estimates of hydroclimate variability and change over the Common Era**

Venue: Palisades, NY, USA

Date: 1-3 June 2016

<http://www.pages-igbp.org/calendar/all-events/127-pages/1535-data-model-comp-hydroclimate>

**11th International Conference on Permafrost (ICOP 2016)**

Venue: Potsdam, Germany

Date: 20-24 June 2016

<http://icop2016.org/>

**Australian Earth Sciences Convention**

Venue: Adelaide

Dates: 26-30 June, 2016

<http://www.aesc2016.gsa.org.au/>

**JULY 2016****Palaeo Down Under 2**

Venue: Adelaide, Australia.

Dates: 10-15 July, 2016

<http://aap.gsa.org.au/PDU2.html>

**AUGUST 2016****15th International Peat Congress 2016**

Venue: Kuching, Sarawak, Malaysia

Dates: 15-19 August, 2016

<http://www.ipc2016.com/>

**35th International Geological Congress (IGC)**

Venue: Cape Town, South Africa

Date: 27 August – 4 September 2016

<http://www.35igc.org/>

**12th International Conference on Paleoceanography**

Venue: Utrecht, Netherlands

Date: 29 August – 2 September 2016

<http://icp12.uu.nl/>

**SEPTEMBER 2016****CLIVAR: Early Career Scientists Symposium**

Venue: Qingdao, China

Date: 16-18 September 2016

<http://www.clivar.org/>

**CLIVAR Open Science Conference (OSC2016): Charting the course for future climate and ocean research**

Venue: Qingdao, China

Date: 18-25 September 2016

<http://www.clivar2016.org/>

**DECEMBER 2016****AGU Fall Meeting 2016**

Venue: San Francisco, USA

Date: 12-16 December 2016

<http://fallmeeting.agu.org/2015/>

**AUGUST 2017****10th International Carbon Dioxide Conference (ICDC10)**

Venue: Interlaken, Switzerland

Date: 20-25 August 2017

[http://www.oeschger.unibe.ch/services/events/conferences/10th\\_international\\_carbon\\_dioxide\\_conference/index\\_eng.html](http://www.oeschger.unibe.ch/services/events/conferences/10th_international_carbon_dioxide_conference/index_eng.html)



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# Quaternary AUSTRALASIA



Quaternary Australasia publishes news, commentary, notices of upcoming events, travel, conference and research reports, post-graduate thesis abstracts and peer-reviewed research papers of interest to the Australasian Quaternary research community. Cartoons, sardonic memoirs and images of mystery fossils are also welcome.

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