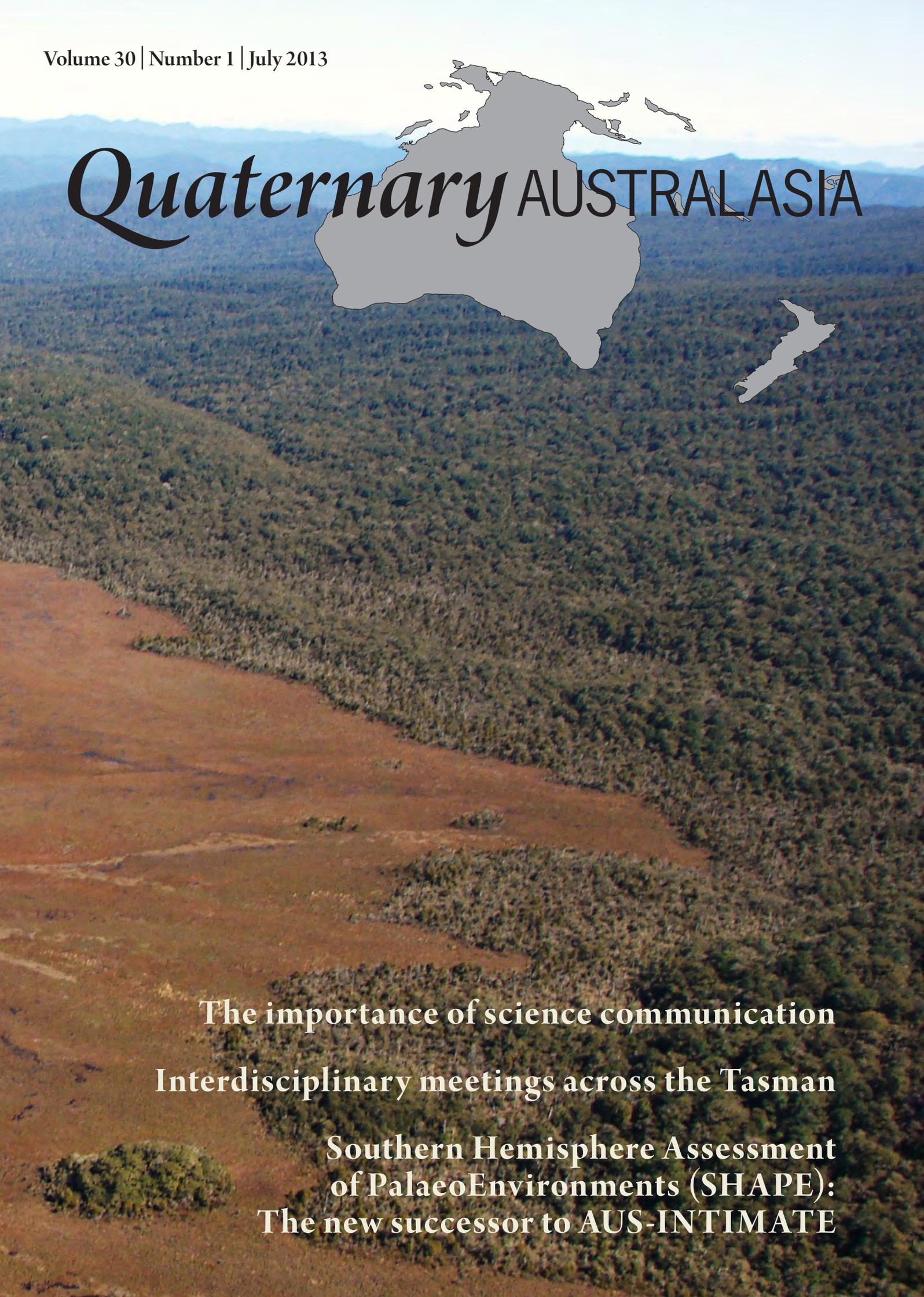


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Quaternary AUSTRALASIA

**The importance of science communication
Interdisciplinary meetings across the Tasman
Southern Hemisphere Assessment
of PalaeoEnvironments (SHAPE):
The new successor to AUS-INTIMATE**

Quaternary AUSTRALASIA



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Cover Photo: Aerial photograph of montane Kaipo bog, viewed looking south-westward, in Te Urewera National Park, eastern North Island, New Zealand. The western arm of Lake Waikareiti is visible at upper left. The bog contains a tephra-peat sequence that forms the designated stratigraphic type record for the Late Glacial cool episode, namely climate event NZce-3 (c. 13.8 to 12.6 cal ka), and bracketing climate events NZce-4 and NZce-2, of the newly-published New Zealand Climate Event Stratigraphy (Barrell et al., 2013). The tephra-peat section, at c. 980 m elevation, is exposed just within the small salient of beech forest visible at the far end of the bog, beyond which the Kaipo Stream drains towards the right initially and then into the narrow valley in upper-middle distance that marks the base of the gently-sloping slip surface (at right) of the extensive Waikareiti landslide.

The photograph (by Dr Chris Ward) is from Lowe et al. (2013) with permission of Elsevier.

Kaipo is an ombrogenous shrub bog dominated by ferns, with occasional *Sphagnum* spp., which form low hummocks amongst numerous small, permanent pools. Beyond a narrow marginal zone of scrub-forest at its edges, the bog is surrounded largely by montane-subalpine beech forest and shrubland.

Barrell, D.J.A., Almond, P.C., Vandergoes, M.J., Lowe, D.J., Newnham, R.M. and NZ-INTIMATE members. In press. A composite pollen-based stratotype for inter-regional evaluation of climatic events in New Zealand over the past 30,000 years (NZ-INTIMATE project). *Quaternary Science Reviews*.

Lowe, D.J., Blaauw, M., Hogg, A.G. and Newnham, R.M. 2013. Ages of 24 widespread tephras erupted since 30,000 years ago in New Zealand, with re-evaluation of the timing and palaeoclimatic implications of the late-glacial cool episode recorded at Kaipo bog. *Quaternary Science Reviews* <http://dx.doi.org/10.1016/j.quascirev.2012.11.022>.

Editorial

Dear Fellow Quaternarists,

As AQUA moves into its fourth(!) decade, the activity of the region's Quaternarists shows no signs of abating! And along with the changing times come new challenges for Quaternary science, not only in terms of research questions but also in terms of the communication of our results. This issue of QA is a case in point for scientific communication. Helen Bostock has written a thought-provoking piece on thinking outside the box with respect to outreach, discussing the various unprecedented avenues now available to us in the electronic age, not to mention exciting public communication opportunities through Pecha Kucha fora. AQUA is embracing these new outlets with gusto, with a facebook page up and running, a revamped website (with electronic membership renewal!), and a soon-to-be-introduced AQUA blog (thanks Ignacio Jara!).

The theme of scientific exchange and communication runs strong in this issue. Colin Murray-Wallace and colleagues provide a response to Slee et al.'s reassessment of the Mary Ann Bay deposits in Tasmania, published in our last issue, highlighting the need for debate amongst scientists which transcends peer review. Australasian Quaternarists continue to actively communicate and exchange ideas at symposia and conferences around the world, from New Zealand (Geoscience Society of New Zealand, Southern Connections) to Australia

(Australian Archaeological Association) and the UK (Quaternary Research Association). The new Southern Hemisphere Assessment of PalaeoEnvironments (SHAPE) initiative promises to encourage further engagement between scientists aiming to understand past environmental changes. Jillian Garvey reviews a recently published book on Australia's fossil sites which compiles important knowledge about existing sites.

We also pay tribute to great Quaternarists of both the present and past, through a special symposium honouring the recent elevation to Member of the Order of Australia of Mike Smith, AM, and an obituary for outstanding soil scientist Ron Paton.

Our news section communicates important information about upcoming meetings – not least the dates for AQUA's next meeting in Mildura next year! – in addition to an introduction to our Secretary and Public Officer, Duanne White, the initiation of an online inventory for sharing scientific equipment, the new AQUA blog, and the 'retirement' from Public Officer duty of our long-standing Exec member, Matt Cupper.

Yours Quaternarily

Kathryn Fitzsimmons and Jasmyn Lynch

Editors

Photo This Page: The collapse of huge ice-dammed lakes has produced some of the largest floods on Earth. We are constraining the timing and magnitude of a cataclysmic flood from the 3000 cubic km Glacial Lake Vitim that drained down the Vitim-Lena river system to the Arctic Ocean. This 14 m thick flood deposit on the Bodaybo River in Transbaikalia (N 57.9216°, E 114.2192°), is located in a back-flooded tributary of the Vitim River and stands ~130 m above river level. The exposure comprises a repetitive sequence of subhorizontal planar-beds of interlaminated coarse and fine sands, with irregular beds of angular, non-imbricated gravel, and occasional ice-rafted drop-stones up to 300 mm in diameter. John Jansen is pictured collecting depth-profile samples for cosmogenic ^{10}Be analysis and OSL dating in September 2012. Four ^{10}Be samples at the bedrock spillway ~200 km upstream yield a weighted mean exposure age of 53 ± 3 ka, suggesting ice-dam collapse following the MIS-4 glaciation. Evidence of subsequent smaller floods is being explored.

Research team: Martin Margold (Durham), John Jansen (Stockholm), Artem Gurinov (Lomonosov-Moscow), Alexandru Codilean (GFZ-Potsdam), Frank Preusser (Stockholm), Toshi Fujioka and David Fink (ANSTO).

Photograph: Martin Margold (Durham).



President's Pen

I recently attended a meeting in Melbourne – the beginnings of a 'Palaeo Discussion Group'. This was an idea first suggested by Michael Fletcher (University of Melbourne) when he was trying to find various bits of field equipment and did some phoning around. What he found was that there was a healthy new crop of palaeo-scientists, including himself, who had recently been appointed at various institutions around Victoria. I too was in a similar situation and got talking to Michael and others at Southern Connections about the idea of an inventory of equipment and opportunities for helping each other out on field-trips. Could you imagine? Cross-institutional collaboration – what would our research offices say?

After a series of emails that were sent around to an ever-expanding list of interested parties, the Inaugural Victorian Palaeo Discussion Group took place on 26th April in the Geography Department of Melbourne Uni. Given that this was intended to be a very informal meeting to find out what toys we all have and who is willing to share, I think we were all overwhelmed by the reaction. Over 30 people from Melbourne, Monash, La Trobe and Ballarat (and a few ring-ins from interstate), ranging from PhD students to two of our favourite Victorian silverbacks, crowded into the map room to discuss what we do and where we do it.

What was astounding was the incredibly diverse range of expertise gathered in one room. Spanning the entire Quaternary period and extending into the future, from tree rings to speleothems, pigments to contaminants, participants included palynologists, geomorphologists, geochemists – even modellers and archaeologists! As Jim Bowler said, 'this is a real opportunity to break down the barriers of institution and discipline, and to demonstrate the relevance of the past to the present and future'.

We made an initial inventory of field and analytical equipment, which I would like to extend to the AQUAlist. One of the perennial problems with equipment is maintenance and repair; when it breaks, our technical staff are often the first heads on the chopping block. A novel suggestion was for combined institutions to make a contribution to a maintenance fund, as part of the communal hiring agreement, so that cost is shared. In an age where multi-disciplinary studies are theoretically encouraged, there seems to be an awful lot of paperwork involved to actually achieve this.

I'd like to thank Michael for his initiative and look forward to the next meeting. And I would encourage those in other regions to consider starting their own groups. You never know who may turn up.

Jessica Reeves
AQUA President



News

Duanne White: Secretary and Public Officer

Duanne is a geomorphologist with expertise in cosmogenic nuclides. He completed his PhD at Macquarie University



investigating links between climate, landscape and ice sheet change in east Antarctica, and has since extended this work to Greenland and South Georgia Island. He is currently an Assistant Professor at the University of Canberra, where he is developing an in situ cosmogenic ^{14}C extraction system which will allow us to tease out complex sediment pathways and sediment recycling, which will improve chronologies of late Quaternary landscape events.

AQUA – the caring, sharing association

Have you ever been planning a field trip and thought to yourself, if only I had a.....? We here at AQUA are putting together an inventory of equipment, held by universities and other relevant organisations, which may be available for hire, contra-arrangements, etc. We are hoping this will establish a) who has pieces of equipment lying around that may be revived, b) what as a community we do not have, which may form the basis of future collaborative grants and c) encourage cross-institutional sharing of resources and fieldtrips. We will be sending around a survey via AQUAlist, with the outcome to be kept as a database on our website. Please participate for the benefit of all!

INQUA Early Career Researcher Inter-congress meeting, 2–6 December 2013

The International Union for Quaternary Research (INQUA) is committed to developing the next

generation of Quaternary scientists. The INQUA Executive Committee has recently approved the inaugural INQUA Early Career Researcher (ECR) inter-congress meeting to provide an avenue for MSc/PhD candidates, postdoctoral researchers and research-active academics in the early stage of their careers (within five years of obtaining their PhD) to attend valuable workshops designed to assist ECRs with career development, to present their science, and gain invaluable mentoring from more senior scientists.

One of the primary objectives is to offer workshops in a variety of research-related issues presented by experienced researchers. Potential workshops include:

- giving oral and poster presentations
- how to write for publication
- various techniques used in Quaternary research (e.g. field methods, geochronology, geochemistry, various proxy analyses e.g. macrofossils, forams, diatoms, ostracods, charophytes, etc.).

As part of the inaugural INQUA Early Career Researcher inter-congress meeting, 'Quaternary International' has kindly agreed to run a special issue for ECRs. The aim is for the ECRs to be either the primary or sole author. More senior scientists will provide editorial advice and guidance during the entire writing progress (a mentoring scheme), then the papers will be submitted to the normal QI review process following the INQUA ECR meeting in December 2013.

Registration will be advertised on the AQUA web page, AQUA Facebook Page and 'INQUA Early Career Researcher Page' on Facebook. For more information, or if you are interested in submitting to the QI ECR Special Issue, contact Craig Sloss (c.sloss@qut.edu.au).

Student Prizes for INQUA ECR

AQUA is offering two student prizes to the value of AU\$500 each to assist in attending the INQUA ECR. Note, only current AQUA student members will be eligible. Please submit an abstract, brief CV and endorsement from your supervisor to Jess Reeves at: president@aqua.org.au.

PAGES Ramsar meeting

The University of Ballarat will be hosting a workshop from November 6-8, entitled: 'Ramsar wetlands: detecting change in ecological character'. The workshop will focus on the use of long-term records of wetland condition (monitoring, historical records, palaeoecology) to inform assessments of 'natural ecological character' and 'limits of acceptable change' under Ramsar. This is under the auspices of Ramsar and IGBP PAGES (Past Global Changes), and is an activity within the University's Collaborative Research Network.

The workshop will be held at the splendid Vue Grande in Queenscliff, Victoria, and will include a visit to the Connewarre wetlands. The ever-evolving website is at: <http://crnballarat.com/ramsar/>. For further details, contact Peter Gell (p.gell@ballarat.edu.au).

Note the date

The date for the biennial meeting in Mildura next year has been set for 1-5 July 2014. Please mark this on your calendars NOW! Further details will be available soon via AQUAlist and the AQUA website.

Online AQUA membership

Memberships are well and truly due and you can pay these easily online at: http://www.regonline.com.au/aqua_membership. There is also a link on the membership page of the new AQUA website. It is easy, so please get yourself signed up and encourage your colleagues, students and friends. If, in the rare case you do have an issue with the online system, please contact our treasurer, Steven Phipps (s.phipps@unsw.edu.au).

Thanks Matt

AQUA has had a few soldiers over the years that have been behind the scenes, ensuring that AQUA continues to function. One of our longest actively serving executive members is Matt Cupper, who has been the Public Officer since 2000. As of December last year, Consumer Affairs Victoria, with whom we are incorporated, decided that the position of public officer of an organisation should sit with the secretary. And so the mantle has been passed to Duanne White. AQUA would like to take this opportunity to thank Matt for his dedication over the years and particularly his keen memory and attention to detail. We hope you don't mind continuing to field the odd query in the future...

And finally...

The winner of the caption competition is Bernie Joyce (University of Melbourne) for the following (photo courtesy of Peter Almond)...



'Keep trying - there should be a full one right at the back!'

Comments on Slee et al. (2012). A reassessment of Last Interglacial deposits at Mary Ann Bay, Tasmania. *Quaternary Australasia* 29: 4-11

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It is always pleasing to see additional work undertaken on sedimentary successions that are critical to the understanding of Quaternary environmental changes. The deposits at Mary Ann Bay, as with other last interglacial (MIS 5e; 128-118 ka) coastal-marine successions in Tasmania, are critical for demonstrating that the region has experienced a different relative sea-level history to mainland southeastern Australia, and that parts of Tasmania have been uplifted by 16-17 m since the last interglacial maximum. Unfortunately, the recently published paper by Slee et al. (2012) gives credence to two thermoluminescence (TL) ages which must be inaccurate. In uncritically accepting the 30 ka TL ages, they encounter the dilemma that relative sea level at this time was 60 to 70 m below present sea level during the latter portion of the cool interstadial MIS3 (Chappell et al., 1996). To resolve their dilemma, they reinterpret the Mary Ann Bay succession as an aeolian facies. This note restates the widely published and unambiguous evidence for the shallow subtidal environment of deposition for the sedimentary succession at Mary Ann Bay and provides a brief commentary on the validity of the luminescence ages.

The sedimentary succession at Mary Ann Bay has previously been described in several works (van de Geer et al., 1979; Colhoun et al., 1982; Murray-Wallace et al., 1990; Murray-Wallace and Goede, 1991, 1995). The succession unconformably overlies a bench formed on Jurassic dolerite and extends up to 24 m above the present High Water Mark (HWM). The succession is capped by a pedogenically modified aeolian cover sand. Correlative cover sands without marine shells occur extensively across South Arm Peninsula. They are of Last Glacial age and significantly post-date in age the shelly marine sands at Mary Ann Bay. The cover sands form a low undulating dune field that contains deflation hollows up to 10 m deep and were derived at least in part by erosion of the interglacial marine sediments.

The subaqueously deposited sediments at Mary Ann Bay comprise several cosets of fining upward tabular cross-stratified shelly sands (Figure 1). The base of

each coset is defined by coarse shell fragments and in places disarticulated *Pecten* sp. (long axes up to 60 mm) that grade into more finely comminuted shells and terminate in medium- to fine-grained quartz sand with a smaller component of comminuted shell (long axes 2-3 mm). The bedforms are consistent with deposition above fair-weather wave base under conditions of fluctuating energy. Large, well-preserved fragments (20-30 mm long-axis) of the fragile mollusc *Fulvia tenuicostata* occur within the succession (Murray-Wallace and Goede, 1991). The succession contains a diverse and abundant thanatocenose assemblage of fossil molluscs ($n=49$ species; Colhoun et al., 1982) and well-preserved foraminifera ($n=12$ benthic species and the planktonic foraminifer *Globigerina bulloides*) showing minimal mechanical abrasion (Lewis and Quilty, 2009). Foraminifera present in wind-blown sand commonly show a high degree of mechanical abrasion generally precluding identification at the species level. In addition, the molluscan fauna is too diverse and derived from too many shallow offshore habitats to have been concentrated by wind action.

The assemblage of fossil molluscs as shown in the very useful appendix by Slee et al. (2012) reaffirms a shallow subtidal depositional environment for the sediments at Mary Ann Bay, akin to the modern, open estuarine environments that characterise the region.



Figure 1: Detail of subaqueously deposited shallow subtidal, planar cross-stratified shelly sands with disarticulated *Pecten* sp., Mary Ann Bay, Tasmania (source: Eric Colhoun, 1973).

Some of the species, such as *Kataysia* sp., are infaunal molluscs and therefore reflect a mode of life within previously deposited sediment in a subaqueous environment. The two dominant species of foraminifers, *Ammonia aoteana* and *Elphidium hawkesburiense* are common to open estuarine environments of normal marine salinity. That all genera of foraminifers are well-preserved and show only minor mechanical abrasion precludes deposition under aeolian conditions, as does the coarse shell fragments and disarticulated valves of *Pecten* sp. The multiple chambered and fragile planktonic foraminifer *Globigerina bulloides* appears in pristine form and can therefore only reflect deposition in subaqueous conditions. Slee et al. acknowledge that the molluscan fossil assemblage contains some faunal elements that ‘... are now found only further north, so slightly warmer conditions than those prevailing today are implied’ (p. 7). The most recent interval to account for this explanation is the last interglacial maximum (MIS 5e) between 128 and 118 ka (Murray-Wallace et al., 2000). Late Pleistocene interstadial MIS 3 is precluded as this interval was significantly cooler, with lower sea levels (-60 to -70 m) than present, related to early development of northern hemisphere icesheets.

Slee et al. suggest that the lack of cementation of the sediments ‘... argues against a Last Interglacial age’ (p. 9), yet all coastal successions of last interglacial age (MIS 5e) in Tasmania are unlithified (e.g. the mollusc-rich successions in north-west Tasmania; Colhoun et al., 1982; Murray-Wallace and Goede, 1991). Most coastal successions of MIS 5e on the Australian mainland also share this feature apart from the presence of indurated calcretes capping unconsolidated last interglacial sediments in arid coastal settings (Murray-Wallace and Belperio, 1991). The succession does, however, show evidence of diagenetic modification and the layers that Slee et al. interpret as ‘buried Bk horizons’ are not true pedogenic features but horizons of precipitated calcium carbonate that has been leached through the sands and perched in the basal horizons above the base-rich dolerite. The fine-grained sands show no textural enrichment from weathering as would occur in a paleosol. The clay layer described at the contact with the dolerite surface at the base of the succession reflects progressive illuviation through downward groundwater movement and is of post-depositional origin. Slee et al. also make a misguided uniformitarian comparison in their reference to dolerite boulders at the foot of the modern cliff, suggesting that the same features should be evident at the base of the shelly sand succession that rests unconformably on the top of the planated dolerite bench. The dolerite boulders in the modern coastal landscape reflect local erosional processes, and transgressive surfaces (ravinement surfaces) have not been reported in the literature on such features or at such a scale (Catuneanu, 2006).

Slee et al. also appeal to the work of Davies (1959) [which does not appear in their reference list] concerning purported examples of last interglacial coastal successions at 4-5 m above the HWM in Tasmania. The Llanherne Level defined as being 3.6 to 4.5 m above the HWM at Hobart Airport was correlated with the last interglacial based on weak podsol development. Our unpublished data reveal that many of the sites that Davies (1959) considered to be last interglacial are either Holocene middens or low-angle colluvial slopes truncated by wave action. One of the emblematic aspects of last interglacial coastal successions in Tasmania is their emergent character, in contrast to the Bass Strait Islands, King and Flinders islands and the coastlines of Victoria and New South Wales. Last interglacial emergent shell beds, confirmed on the basis of amino acid racemisation and electron spin resonance have been described from the north-west coast of Tasmania at Montagu (12 m Australian Height Datum (AHD)), Mowbray Swamp (12 m AHD) and Broadmeadows (14 m AHD) (Murray-Wallace and Goede, 1995), and emergent coastal successions and landforms have also been described from the west coast of Tasmania.

The two TL ages of 30.7 ± 1.9 ka and 30.3 ± 3.7 ka reported by Slee et al. are problematic, and it is difficult to fully assess the validity of results in view of the limited contextual information presented. No glow curves were presented, and in situ dosimetry was not undertaken in a field context. More troubling, however, is the manner in which the samples were collected. The photographs showing the field context of the TL samples reveal that Slee et al. collected their samples from sediment that is draping the in situ shelly facies. Having removed a portion of this sediment, they have then inserted the can vertically, in effect, into the very sediment they were at pains to remove. Normal practice is to auger up to 1 m into the exposure (e.g. Huntley et al., 1993).

A last interglacial age (MIS 5e) was previously assigned to the shelly sands at Mary Ann Bay based on the extent of racemisation of several amino acids in multiple shell specimens, the results of electron spin resonance analyses on the same shells, and indirectly based on a finite radiocarbon age of 39.9 ka (Murray-Wallace and Goede, 1991). The ‘finite’ radiocarbon age reflects contamination by $<1\%$ ^{14}C with a modern activity that could not be removed in sample pretreatment. In summary, the shelly sands at Mary Ann Bay relate to shallow subtidal deposition during the last interglacial maximum (MIS 5e), and the inaccurate TL ages reported by Slee et al. reflect inappropriate field sampling practices.

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QA

Reply to Murray-Wallace et al. (2013): Comments on a paper by Slee et al. (2012). A reassessment of Last Interglacial deposits at Mary Ann Bay, Tasmania

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We note that Murray-Wallace et al. (2013), in their comments above and in their original articles (see references in Slee et al. 2012), provide no detailed stratigraphic column or location for their observations or photographs so it is difficult to relate some of their arguments and observations to our described section. Before sampling, we examined the Mary Ann Bay exposure. At the eastern end of the site (Slee et al., 2012, Figure 2) were slumped deposits with concentrations of reworked shells in greater quantity than were found in undisturbed parts of the section. We avoided these areas when sampling and trust that Murray-Wallace and co-workers adopted the same strategy.

It is notable that the soil on the present-day stable and vegetated surface, on which sand deposition is slow or non-existent, has a well-developed Bk horizon (a

pedogenic horizon with carbonate veins; National Committee on Soil and Terrain, 2009, p. 154) which is clearly visible in Figure 4 of Slee et al. (2012). Murray Wallace et al. (2013) acknowledge that carbonate veins present are ‘precipitated calcium carbonate that has been leached through the sands’. However, in a *non-sequitur*, they argue that the veins are ‘not true pedogenic features’, but provide no evidence or reason for rejecting pedogenic formation. There is no reason to suppose that the buried Bk horizons formed any differently from those forming below the present soil surface at Mary Ann Bay; i.e. the buried Bk horizons developed during soil formation in a period of slow or interrupted sand deposition. We note that carbonate accumulations are common in buried soils in aeolian and alluvial deposits found in dry environments in Australia (e.g. Williams and Polach, 1971; Bowler,

1998) and around the world (e.g. Khokhlova and Kouznetsova, 2004). There is no reason to regard the Mary Ann Bay carbonate deposits as a special case. We therefore reject the non-pedogenic conclusion for carbonate vein formation, and reassert that the deep layers with carbonate veins are the buried Bk horizons of paleosols.

The entire Mary Ann Bay profile to 7.70 m depth is weakly weathered and has a very low clay content. Hand-texturing indicates that the <0.06 mm fractions subjected to size analysis (Slee et al., 2012, Table 2) are mostly silt. Where large amounts of clay move through sandy or silty profiles, there is always evidence of clay movement in the form of clay cutans or clay lamellae (e.g. see photographs and discussion in Kemp and McIntosh, 1989). The absence of clay cutans or clay lamellae indicating clay movement between 2.30 m and 8.05 m depth in the Mary Ann Bay deposits demonstrate that the clayey layers at c. 10 m depth (including a clay layer about 0.5 m thick) overlying the dolerite (Slee et al., 2012, Table 1), cannot have been produced by ‘progressive illuviation by downward groundwater movement’, as proposed by Murray-Wallace et al. (2013). Moreover, to argue on the one hand that the profile carbonate is not pedogenic, and on the other hand, that the pedogenic processes of weathering and clay illuviation have occurred at sufficient intensity to produce a 50 cm thick clay band, is inconsistent. Furthermore, in a weakly weathered deposit in a temperate environment, it is pedogenically impossible to convert a 50 cm-thick deposit containing about 80% sand (much of it quartz) to a clay. There can therefore be no doubt that the clay layer has been produced by weathering of the dolerite itself; i.e. it constitutes a palaeosol. We note that throughout Tasmania dolerite weathers to clay-rich soils (Grant et al., 1995). We suggest that the transgressive seas of the Last Interglacial, if they had overtopped the dolerite, undoubtedly would have eroded these incompetent clayey strata, especially as Last Interglacial fossils found locally indicate that the coastal marine environment at this location was in the ‘very shallow, high-energy’ category (Lewis and Quilty, 2009). Thus the preservation of these clayey strata (palaeosols) and associated layers at 8–10 m depth at Mary Ann Bay indicates that the Last Interglacial seas did not overtop the dolerite layer at the described location.

In regard to sampling methods, we do not understand the reference to the ‘troubling... manner in which samples were collected’. We sampled in a troubling manner: sections were cut back by at least 0.5 m to reveal in situ material and a horizontal bench was then cut into this material so that sampling tins could be driven vertically into undisturbed sediment. This is standard procedure used by thermoluminescence (TL) and

optically stimulated luminescence (OSL) practitioners. The reference by Murray-Wallace et al. (2013) to samples being taken from sediment ‘draping the in situ shelly facies’ is irrelevant and shows that the commentators have not studied our Figure 3. The shelly facies is found in layer 3.3 and in the upper part of layer 3.2, and is stratigraphically above the TL sampling sites, not below them. The meaning of the comment that the sediments sampled were ‘the very sediment they were at pains to remove’ is unclear. We did of course sample sediments we intended to remove and send to the TL laboratory, but perhaps the authors mean to imply that we sampled disturbed sediment? If so, they are incorrect. As stated above, we cut the section back until the undisturbed bedding and stratigraphy were obvious, and sampled the undisturbed layers.

Regarding the reliability of the laboratory TL determinations, we make the following points:

- TL glow curves in themselves are not relevant to TL age validity. However, comparison of the natural and laboratory-induced TL (i.e. temperature plateau comparison and the TL growth curves), certainly do lend confidence to the TL ages determined. The r-square correlation values for the two samples’ regenerated growth curves are 0.993 for the upper sample and 0.995 for the lower.
- The length of the temperature plateau comparisons (a proxy for the natural glow curve shape compared to that induced in the laboratory following resetting and irradiation), as indicated by Slee et al. (2012), extends between 300°C and 500°C. This demonstrates excellent TL resetting during the final transport phase and stability of trapped electrons within the crystalline lattice and is typical of temperature plateaux found in aeolian deposits. Again, this lends considerable confidence to the validity of the TL ages determined.
- As stated by Murray-Wallace et al. (2013), in situ dosimetry was not performed. However, the homogeneity of the site over almost 4 m is clearly shown by the laboratory measurements of the specific activity values and potassium concentrations. In fact, the two annual radiation levels vary only by the difference between the cosmic radiation contributions at different sample depths.

Regarding the fossil assemblage and its state of preservation: we have no reason to doubt its Last Interglacial age (Murray-Wallace and Goede, 1995). Its state of preservation is variable: larger shells are all disarticulated and most are damaged, as would be expected from abrasion on an Interglacial beach or in littoral deposits. Murray-Wallace et al. (2013) state that the foraminifera are ‘well preserved’ but omit to mention that Lewis and Quilty (2009) noted that ‘many species have minor abrasion or breakages consistent with a

high-energy environment'. Although Murray-Wallace et al. (2013) remark that 'the fragile planktonic foraminifer *Globigerina bulloides* appears in pristine form', it should be noted that this delicate species was only noted once among the 350 foraminifera identified (i.e. it constituted 0.3% of identified specimens), so its presence cannot be used to infer conditions of deposition. We concur with Lewis and Quilty (2009) that the shell assemblage, including the foraminifera, was deposited in a 'very shallow, high-energy, fully marine' environment. In the Last Interglacial, such an environment probably occurred close to the present-day shoreline, so the shells present in the Mary Ann Bay deposits may have moved by wind at most a few hundred metres and possibly only a few tens of metres, or metres. Given the short transport distance required to emplace the deposits, state of preservation cannot be used to distinguish between shells transported by wind or subject to abrasion in a high-energy shallow water environment.

In summary, contrary to the suggestion of Murray-Wallace et al. (2013) that we have encountered a 'dilemma' that requires explanation, we find that all indicators of age and environmental deposition are consistent: the TL age obtained; the weak weathering of the deposits; their stratigraphy; the bedding within the sandy formations; and the presence of paleosols; and preservation of the clayey layer between sandy layers; the likely proximity of the Last Interglacial beach to windward; the presence of a source area for sands (the River Derwent floodplain) to windward; the abrasion of the shells; the wind-exposed nature of the site; the undoubted thick aeolian deposits at many locations on South Arm and on the spit adjoining Seven Mile Beach, some of which have been dated to the Last Glacial; and the lack of independent tectonic evidence for uplift.

For the reasons proposed above, we do not find the arguments of Murray-Wallace et al. (2013) convincing and on present evidence argue that aeolian deposition around 30.5 ka BP provides the best explanation for the formation of the Mary Ann Bay deposits. We do of course welcome further study of this important Quaternary site, and detailed sedimentological investigations and further dating of sands and shells by a variety of methods would be especially useful.

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QA

Science communication

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Once upon a time, thousands of years ago....

We all know that we should communicate our science. Some grants and funding bodies even require 'outreach' to be an integral part of the project. Over the last year, I have been exploring some ideas and so this article provides some personal reflections on my experiences. Other ideas in this article come from AQUA committee members after an email conversation prompted by the 2012 Science meets Parliament (SmP) event.

Traditional methods of communicating science to the general public

Of course there are the traditional methods of communicating your science to the public. The most obvious is to give a public talk to a society or group. I have been invited to give talks to the Federation of Women Graduates and the University of the 3rd Age (the retirees – half of whom fell asleep during my 45 minute presentation). I have also given talks to school kids, which requires much more energy, but is much more fun – especially when they all want to ask a million questions at the end. If you are lucky enough, you might get the chance to be selected to attend SmP in Australia (see article by Stephanie Kermode in *QA*, December 2012), and talk to your elected officials about the importance of your science. You may or may not be aware that every year an AQUA committee member goes to SmP to represent Quaternary Science, and that every other year a student gets the opportunity to go along too – a prize that is given out at the biennial AQUA conference.

If you have managed to get a paper with a good story published in a high profile journal it is also very common for the University or Research Institute media team to put out a press release. Then you have to wait to see if the media bite!

Alternatively, there are a few dedicated science journalists out there that are always on the lookout for good stories about science. In New Zealand, we have a couple of journalists that interview scientists for the 'Our changing world' show on radio New Zealand. I was surprised how easy and comfortable I felt having a 'chat', completely forgetting about the microphone. They did a great job of editing back the chat to fit their

seven minute slot, without losing the critical information. There are also a few journalists that write for the local papers and magazines (the latter will be very interested if you have good photos and images). If your science involves something charismatic, or has really dramatic results, you might get really lucky and get your ten seconds of fame on TV (e.g. *Catalyst* in Australia).

All of these methods rely on other people asking you to give a talk, or having the big impact journal article that attracts the media's attention.

Think outside the box

In Randy Olson's book 'Don't be such a scientist!', he says that long gone are the days when scientists came to town to give public lectures and people would queue to get in to the hall and hear what they had to say. Now, if you give a public scientific lecture, you are lucky to get a handful of people, including your partner and/or friends and you are most likely preaching to the converted.

What has changed? We live in an age of information overload. There are lots of other distractions for people. We need to come up with a new style and methods of communicating. To that end, Randy quit his job as a professor of marine biology and went back to film school in Hollywood (where else) to make movies about environmental issues. In his book, he challenges scientists to come up with new and innovative ways to communicate science.

Over the next few paragraphs, I will throw out some ideas I have tried, or heard about...

Firstly, we should all sign up as experts at Science Media Centres (SMC) (<http://www.smc.org.au/> or <http://www.sciencemediacentre.co.nz/>), which aim to link journalists with the appropriate expert scientist to comment on issues. The Australian SMC has 3000 scientific experts on its database, with over 1000 journalists receiving their regular alerts. The SMC are the first port of call for many journalists tackling science issues. These SMC also run courses to help scientists become more media 'savvy'. Quaternary and earthquake geologist Mark Quigley, who was awarded the 2011 NZ Prime Minister's Science Media Communication after

his efforts to communicate the issues to the general public in the wake of the Christchurch earthquakes, helped set up the NZ initiative and is involved in running these courses, which have been oversubscribed (<http://www.sciencemediacentre.co.nz/science-media-savvy-workshops/>).

Also check out 'The Conversation' (<http://theconversation.edu.au/>), which employs journalists and editors to translate and edit your story. This website is run by a consortium of universities in Australia and has 3600 registered researchers from 240 institutions and claims to have 550 000 readers each month. You can sign up for regular alerts.

Half a year ago, I was invited to give a PechaKucha talk. PechaKucha is a format that was invented in Japan by two architects in 2003. They were bored from listening to long and awful architecture presentations, (but the same can be said for many powerpoint presentations). The format is 20 slides, each slide stays up for 20 seconds and they move on automatically. If you thought that giving your scientific conference presentation in 12 or 15 minutes was hard, I found it incredibly difficult to complete my talk in under seven minutes. The key is keeping your images simple, and several hours of practise to distil the message down to keep within the time. Sometimes they have theme nights, other times it is completely random, and anything goes. I can tell you from experience that there were all manner of talks in an ocean theme session ranging from art, poetry, literature, history, voyages and a couple of science talks, usually about ten talks in an evening. The audience is very open to hearing anything and everything, and very forgiving if it isn't as polished as you hoped. If they get bored, then the talk is over in seven minutes and they move on to the next one. It seems to have a cult following, and I have never been to a PechaKucha night in Wellington that wasn't full to overflowing. I am now addicted and keep going back as it is a great way to meet people as they often come up to you after your talk in the bar and ask you questions. PechaKucha nights are now hosted in over 600 cities the world over, usually in a fun space such as a bar and usually with minimal entry cost. You can find out if one is near you at <http://www.pechakucha.org/global>. If not, start one up....

Or find your local Cafe Scientific (<http://www.cafescientifique.org/>), a similar, but different forum, with only one talk, and more open discussion and debate.

If you are feeling really sassy, how about making a movie? Julia Mullarney, a lecturer at the University of Waikato, got her undergraduate students making movies to get across oceanography concepts – rather

than writing another essay. There are lots of science talks and short movies that have been recorded and uploaded on www.TED.com and www.youtube.com.

If standing up on stage at a PechaKucha night, or making a movie isn't your thing, then how about writing?

In the age of the internet, there are many more outlets for writing about your science and getting it out there. I like to read some of the blogs on Sciblogs.co.nz run by the New Zealand Science Media Centre. I have recently returned from a research voyage to Antarctica during which I wrote daily blogs (often with the help of my colleagues on board) and they were posted on Sciblogs.co.nz/fieldwork/. The nice thing about writing a blog for Sciblogs is that it already has an established readership. I thought that we might get around 50 people reading the daily blogs – basically our parents and a few friends – but was pleasantly surprised to find that approximately 6000 people had viewed the blogs over the six weeks and it was the seventh-most visited blog on Sciblogs. They are looking for other scientists to write about their adventures... so if don't want to commit to writing a blog for the next few years, but you really want to tell someone about your latest expedition and what you discover, then there are opportunities for this.

If you want to capture a larger and more international audience, then the popular science magazines all seem to have blogs, including *Scientific American*, *National Geographic*, *Cosmos Magazine* etc. Some of these also have an expedition blog. The *New York Times* recently had Aaron Putnam, a Quaternary scientist who has done a lot of work on glaciers in New Zealand, writing for their expedition blog 'Scientist at work' from the Himalayas. It does rely on you having access to the internet, or at least email, while in the field.

AQUA also hopes to have a regular Quaternary Blog in the near future. If you have any suggestions or ideas of what you would like to see on the blog, please get in touch.

Alternatively, if you have a favourite field site (see December 2012 QA article by Kat Fitzsimmons) that you, or others, have published on, you could write a Wikipedia site about it. Wikipedia is now officially the largest encyclopaedia globally and is one of the first things that comes up when you type a search in to Google. Wikipedia are always keen to have people write or add to pages. Bruce Hayward recently updated all of the Auckland volcano data after he published his recent book. This is something that AQUA will be looking into more over the next few years. We would love to hear from you if you have written stuff for Wikipedia in the past or would like to write a Wikipedia page

about some kind of aspect of Quaternary science in Australasia.

Another thing that I have discovered lately is earthcaching (a type of geocaching). Geocaching, for those of you who aren't familiar with it already, is a global treasure hunt where you use a GPS (Global Positioning System) and clues to find treasure boxes, called caches (www.geocaching.com). One type of geocache is an earthcache (www.earthcache.org, but its also on the geocaching website), where instead of finding treasure, your reward is learning about the geology/earth science/history of the location. There are 221 earthcaches around New Zealand and 240 around Australia. These have been set up by individuals and provide information about each locality, sometimes along with an exercise to learn about a geological technique (e.g. one of the ones in Wellington is about magnetic declination, the difference between Magnetic North and Grid North). This would make a great resource for schools studying the local area. So, if you have a field trip guide to an area, or you want to introduce people to your favourite geological site, why not set one up. Earthcaching is sponsored by The Geological Society of America and supported by the Geological Society of Australia. At the recent Geosciences New Zealand meeting in Hamilton in November 2012, Jacqui Malpas, a visitor to New Zealand, said that she had set up a bunch of earthcaches as part of a Geopark that had been created in the Brecon Beacons in Wales. International Earthcache day is October 13th, 2013, so why not go and check one out.

Communicating with other Quaternary scientists

Every two years, we have the AQUA conference, which is a great chance to catch up, meet and develop collaborations with fellow Australasian Quaternarists. How do we keep the conversations going in between these meetings? Firstly, we encourage you to write articles for Quaternary Australasia. Of course, there is Aqualist, the AQUA e-mail list, which people can use to circulate adverts, questions etc. AQUA also has a new website. So, get in touch if you have ideas about

what you would like to see up on the website that would be useful for AQUA members. For example, would you like to see a list of Quaternary scientists on the website with their speciality and contact details? We have also embraced the new social media age with a Facebook page (search for Australasian Quaternary Association) where you can post adverts for jobs, conferences or workshops, or let everyone know about your latest paper.... We currently have over 60 members on the Facebook page and it would be great to build it up and have lots of people actively posting. Does anyone use Twitter? Stephanie Kermodé 'tweeted' about SmP and thanked AQUA for sending her. This seems to be quite common at large events or conferences.

It would also be great to actively engage with other related science fields, such as climate science, oceanography, soil science, and archaeology. I know that I commonly only find out what my fellow oceanography colleagues are up to when I go to the annual New Zealand Marine Science Society conference. Perhaps we should just invite colleagues to go for coffee or spend more time in the tea-room chatting and finding out more about what each other does – you never know what kind of collaborations or spin offs might occur. Or you could invite colleagues who use Quaternary Science to come to AQUA conferences. AQUA is certainly trying to have sessions at other conferences such as the Australian Archaeological Association, thanks to efforts from Patrick Moss (UQ) and Simon Haberle (ANU) and their interactions with the archaeological community.

So, lots of different ideas for communicating your science.... Why not give one or two a try. This is by no means an exhaustive list – there are plenty of other ways – feel free to share your ideas with us through QA. If you are lacking in confidence, you might want to start off small and build up. Or sign up for a science communication course at your institution. The more of us that are out there trying, the more the public will understand and hopefully be interested, and the whole Quaternary science community will benefit – it may even translate into more students and increased funding!

And the Quaternary community grew and thrived, and continued happily ever after.

The End.

QA

2013 Southern Connection Congress, Dunedin, New Zealand

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During the last week of January 2013, the seventh Southern Connection Congress, hosted by the University of Otago in Dunedin, New Zealand, gathered a diverse group of students and academics with common interests in the natural histories of the southern continents. This scientific meeting is held every three years and gathers researchers from Australia, New Zealand, Chile, Argentina and South Africa, Europe and the USA with shared research interests ranging from ecology, biogeography, taxonomy and evolution of the southern landmasses since the breakup of Gondwanaland. Quaternary science had a leading role at Dunedin, with plenary talks, symposia and more than 30 papers. The next venue will be Chile and participation is strongly recommended for all Quaternarists with interests in the Southern Hemisphere.

Southern Connection at Dunedin had a special significance, since it was the 20th anniversary of the first meeting in Tasmania in 1993. As a result, the atmosphere of the conference was very pleasant. On the first day, all participants came together to experience a Māori welcoming to open the anniversary celebrations at the Otago Museum.

As a Quaternary student, I was pleased to realise that palaeoenvironmental research has become one of the main foci of the Southern Connection Congress, including at least two plenary talks, two complete symposia and more than 30 contributed presentations and posters.

Over the last decade, the role of the southern ocean and the southern westerly winds in controlling climate regimes of the southern hemisphere has been broadly recognised, and therefore there has been an increasing scientific motivation to improve the understanding of their past dynamics and interactions with terrestrial environments. Southern Connections included a plenary talk on the southern ocean, and an entire symposium dedicated to the southern westerly winds, with more than 15 oral presentations. Some remarkable insights from these contributing papers included new methodologies for proxy development and their potential value as westerly indicators. Notable examples of this were hydrological changes inferred from peat humification in New Zealand (Newnham et al., 2013) or salinity variations in subantarctic lakes (Saunders et al., 2013), and the quantification of Australian wind-blown dust deposited in New Zealand alpine peat



Figure 1: Māori welcoming in the anniversary celebrations at the Otago Museum (Courtesy of William Henríquez).

cores (Marx et al., 2013). Other papers presented more established westerly wind proxies, such as stable isotopes or pollen data, to reconstruct past variations on its present-day latitudinal core of intensity (between 50–55°S; Lamy et al., 2010) around the southern mid-latitudes, either at multi-millennial time-scales for subantarctic New Zealand islands (McGlone, 2013) or at millennial and centennial timescales in southwest Patagonia (Moreno et al., 2013; Moy et al., 2013).

Another Quaternary discipline raising considerable interest among the conference participants was palaeoecology. A highlight was the presentation by Dr. Janet Wilmshurst. Dr. Wilmshurst pointed out that one of the next challenges for palaeoecologists lies in the integration of different palaeoenvironmental proxies in order to improve the understanding of sometimes intricate past plant–animal interactions, as well as the environmental transformation associated with early periods of human colonisation. In this regard, New Zealand presents a ‘fresh’ case study due to its recent human settlement. Dr. Wilmshurst showed some remarkable results of her work reconstructing extinct bird diets from the analysis of coprolites (fossil dung), dating prior to the most accepted date of Polynesian arrival, as determined by radiocarbon analysis of rat-gnawed seeds (Wilmshurst and Wood, 2013a), and detecting human-induced herbivore extinction by the disappearance of dung fungal spores on sediment samples (Wilmshurst and Wood, 2013b). In a similar vein, McWethy et al. (2013) presented a compilation of more than 20 radiocarbon-dated macrofossil records retrieved from wetlands and lakes to show how a brief and intense period of widespread fires and forest openings changed the landscape soon after the arrival of the first human populations on the South Island.

Within ecological sciences, a popular theme during the conference was the influence of wildfires on the temperate ecosystem. Papers were centred on determining the role of post-industrial human activities on wild-fire regimes and the nature of their association with large-scale climate oscillations, such as the El Niño Southern Oscillation (ENSO) or the Southern Annual Mode (SAM). Techniques for fire assessment included remote sensing, fire scars on tree rings, and charcoal accumulation on sediment sequences. Documentary fire records from Tasmania, South Africa, south-west South America and New Zealand show how some of these modes of climate variability are able to generate fire-prone conditions by their interaction with different vegetation types. Interestingly, the prevalence of anomalous wet conditions during years prior to fire events seems to be an important factor in enhancing the build-up of fine fuels critical for fire spread in landscapes where burnable biomass is not continuous; while dry conditions seem to be the main driver

of fires in regions boasting a relatively closed canopy but weather unsuitable for fire occurrence (Holz et al., 2013). Similarly, vegetation types appear to be important for fire recurrence. Whilst shrublands seem to regenerate in an equally fire-prone vegetation type after fire events, dense temperate forest regenerates in more fire-prone bushland (Paritsi et al., 2013).

A special mention is deserved for the symposium ‘Chile/New Zealand a continental scale experiment’, which gathered a heterogeneous cluster of presentations comparing environmental patterns in both countries. Armesto and McGlone (2013) stressed how the geological, geographical and climatic settings of both countries contribute to a suite of floristic and structural resemblances between their native floras, but also pointed out some interesting differences, such as the lack of tree fern species in Chile and the absence of deciduous *Nothofagus* species in New Zealand. Interestingly, Pauchard et al. (2013) presented a comparison between the non-native floras in both countries, while Moreno and McGlone (2013) placed some of these similarities and differences in a longer-term perspective, showing the main vegetation trends in Chile and New Zealand over the last 3000 years.

Overall, the Southern Connection Congress at Dunedin was successful in stimulating knowledge exchange, collaboration and inter-cultural experiences between researchers from many regions in the world. The organising team did a tremendous job and I got the impression that everyone was satisfied with the selected themes over the week. The conference also gave us the opportunity to spend an enjoyable time in Dunedin. There were plenty of chances to explore the city and surroundings through mid-week thematic fieldtrips.

Chile will be the next host of Southern Connections and I would strongly recommend the submission of papers from AQUA members with interests in biogeography and palaeoclimates.



Figure 2: Ignacio Jara presenting during the last day of the conference (Courtesy of William Henríquez).

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Quaternary Research Association annual discussion meeting, Newcastle University, UK, 2–4 January 2013

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Whilst studying for my PhD in New Zealand, I had the opportunity to attend and present at two AQUA biennial meetings. Now that I have returned to England, I thought it was time to attend the British equivalent, the QRA (Quaternary Research Association) annual discussion meeting. This year, the meeting was jointly hosted by Newcastle and Northumbria Universities and held at the Newcastle University campus between 2–4 January. The meeting, under the theme ‘Leads and lags: correlation, comparison and causation’, presented recent advances in Quaternary research, including developments in geochronology and stratigraphy, calibration of proxies, and the use of modelling to better understand the spatio-temporal structure of Quaternary environmental change. Research presented at the meeting was of the highest quality and contained much that I believe would be of interest to

the AQUA community. The following is a review of the meeting with an emphasis on developments and pitfalls that might be of interest.

After a welcome speech, the first day began with the first of four themes: ‘General advances in Quaternary research’. The first three talks included research on Greenland tidewater glaciers, luminescence dating of the ‘lost’ Saraswati River, and the use of morphosedimentary archives to assess river system response to Pleistocene glaciation. These talks were followed by two presentations on transfer functions. The first paper, presented by Emma Watcham (Newcastle University), investigated the implication of model choice in transfer functions; specifically, the effect of local-, subregional- or regional-scale modern diatom training sets in sea-level reconstructions. She concluded

that, for relative sea-level reconstruction in Alaska, regional modern training sets are superior (Watcham et al., 2013). The second presentation, by Steve Juggins (Newcastle University), was provocatively titled 'Why transfer functions don't work'. Steve critically assessed the ecological and statistical basis of these models and highlighted three key assumptions of transfer functions that palaeolimnologists potentially violate. Steve concluded that palaeolimnologists should take a more critical approach when using transfer functions (for more detail, read Juggins, 2013). Furthermore, Steve as creator of the statistical package C2, which many of us have used to perform transfer functions, announced that this package will not be updated in the future and he recommended that people use the statistical package R as an alternative.

The evening poster session gave each presenter an advertising opportunity by allowing us to introduce our posters with only one PowerPoint slide and a two-minute time limit, to which everyone strictly adhered. A wide range of topics were on display; e.g. Late glacial sea-level minima in the Irish Sea (a shameless self-plug), a tephra record of the Greenland ice cores, and a Late Glacial/ Holocene vegetation history of Tierra del Fuego, among others. To conclude the day, we were treated to a plenary lecture by Paula Reimer (Queens University Belfast) entitled, 'Towards a 50 ka bona fide terrestrial radiocarbon calibration curve'. Paula brought us up to speed with developments of the latest radiocarbon calibration curve, IntCal13, and Marine13 that is expected to be released early this year.

The second day began with the session 'Advances in dating and correlation methods', with Siwan Davies and Anna Bourne from Swansea University presenting two talks on the Tephra constraints on Rapid Climate Events (TRACE) project. This is a new initiative to

precisely correlate marine and ice-core records in the North Atlantic region and assess the lead/lag responses between atmospheric and oceanic systems during the last glacial period. Four talks on luminescence dating followed, and contained a number of methodological developments, including a new methodology that has the potential to date the entire Quaternary. New Zealand also got a mention in this session with Rachael Smedley (Aberystwyth University), who tested a new luminescence dating method for feldspar against the radiocarbon age of the Kawakawa Tephra. This new method provided a close fit with the recently published refined age by Vandergoes et al. (in press) and seems to be a promising development on reconciling the luminescence and radiocarbon ages of the Kawakawa Tephra. The session ended with a talk by Chris Ramsey (University of Oxford), who presented a talk on Lake Suigetsu as an example of a complete terrestrial radiocarbon record that spans from 11.2 to 52.8 ka BP. Lake Suigetsu is a Japanese lake that contains annually laminated sediment containing a large abundance of plant macrofossils that have been used for radiocarbon dating. A comprehensive record of terrestrial radiocarbon has been achieved by tying 651 radiocarbon measurements to a timescale derived from varve counting (see Bronk Ramsey et al., 2012). This record is to be incorporated into the new IntCal13 radiocarbon calibration curve.

Session 3, 'Leads and lags between regions', began with a keynote lecture by Thomas Blunier (Centre for Ice and Climate, Copenhagen) entitled 'Leads and lags from an ice core perspective'. Thomas highlighted the methods used to synchronise the ice core records from Antarctica with Greenland, the see-saw relationship between the poles, and the recent studies confirming a link between the poles via the oceans. His talk was followed by a range of topics including Swedish varve



Figure 1: Participants at the 2013 QRA annual discussion meeting held at Newcastle University (photo by Steve Juggins).

chronology, speleothem records from the northern Alps, and a further two talks on Lake Suigetsu. These talks highlighted the importance of high resolution records with accurate chronologies for assessing if any leads or lags exist between regions. The day ended with a second evening poster session followed by a rather tasty meeting dinner.

Friday started a little later than the previous day, perhaps to compensate for the dinner the night before. The theme 'Leads and lags between proxies and archives' began with a presentation by Erin McClymont (Durham University) on the use of a new multi-proxy marine record from the Gulf of California to assess whether tropical Pacific climates are sensitive to millennial scale climate events observed in the north Atlantic. The results suggest an atmospheric response in the tropical Pacific to events originating in the north Atlantic, including Heinrich I and the Younger Dryas. Erin's talk was followed by three interesting presentations on multi-proxy records from both the marine and terrestrial realm. Ian Candy (Royal Holloway, University of London) ended the meeting by presenting an interesting talk on tracking abrupt climate shifts with stable isotope records from sites across the British Isles. By combining existing datasets with new oxygen and carbon isotope records from lacustrine carbonate sequences, spatial variability of climate events spanning the period 8-15 ka BP was investigated. In this study, the records from eastern Britain contained

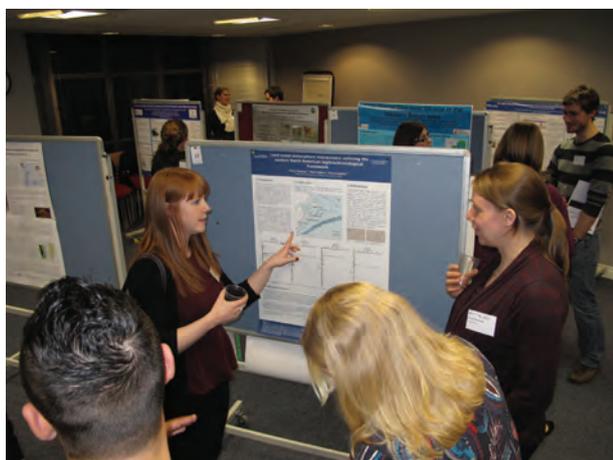


Figure 2: Poster session in action (photo by Steve Juggins).

patterns of cooling and warming that were comparable to those observed in Greenland, whilst records in western Britain showed more subdued climatic oscillations that lagged behind the Greenland record. The difference between east and west may reflect shifts in atmospheric circulations and would have major implications for understanding the re-arrangement of the climatic system during periods of transition. Importantly, the results suggest that even over relatively small spatial scales the structure of abrupt climate can be highly variable.

With the meeting over, we headed our separate ways, or at least the majority did. After Steve Juggins' warning regarding C2, I joined a handful of others and attended the 1.5 day post-meeting workshop 'Analysing Quaternary science data using R'. R uses programming language, and not having a computer programming background, I initially found the experience daunting. However, after a few hours of playing around and expert advice, I started to find the benefits of this powerful program and even began to enjoy myself. The program is capable of a wide variety of statistical and graphical techniques and the best part of all, it is free (see the www.r-project.org). So, after 24 talks, 18 poster presentations, three lunches, two poster sessions with wine and cheese, and one R workshop, the 2013 QRA annual discussion meeting was over.

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QA

Quaternary symposium and discussion, Geoscience Society of New Zealand annual conference 2012, Hamilton, NZ

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The annual conference of the Geoscience Society of New Zealand was held at the University of Waikato in Hamilton, North Island, New Zealand, in the last week of November, 2012. Around 250 people attended. The conference programme was organised into eight broad scientific themes that covered 17 symposia. The first theme, 'Cenozoic climatic and environmental change', included Symposium 1.1 entitled 'Quaternary records including Australasian Quaternary Association INTIMATE project'. This symposium was convened in part on behalf of AQUA by David Lowe (University of Waikato), Peter Almond (Lincoln University), and Rewi Newnham (Victoria University of Wellington), and comprised 20 oral papers, 5 poster papers, and a spectacular plenary presentation by David Barrell entitled 'Wrinkles in time - putting the New Zealand glacier landform record of climate change on the world map' (e.g. see Barrell et al., 2011). At the conference dinner the night before his plenary talk, David was awarded the premier prize of the society for 2012, the McKay Hammer Award, for the 'most meritorious contribution to New Zealand geology published 2009-2011'.

Quaternary symposium

The Quaternary symposium, in terms of numbers of papers presented, was the largest at the conference, attesting to the high level of research currently being undertaken by the New Zealand Quaternary community. A number of papers in the symposium, all excellent, were given by students. In part, the strong interest in the Quaternary stems from the impetus provided by the NZ-INTIMATE project (INTEgration of Ice-core, MARine, and TERrestrial records) (Alloway et al., 2007; Bostock et al., 2012), and several papers in the symposium related to that project. In addition to the symposium, a pre-conference Quaternary field trip was led by David Lowe. Entitled 'Where geology meets pedology: Late Quaternary tephtras, loess, and paleosols in the Mamaku Plateau and Lake Rerewhakaaitu areas', the one-day trip included a stop where the emerging New Zealand climate event stratigraphy (Barrell et al., 2013) was presented with respect to a sequence of Last Glacial Maximum (LGM) and late-glacial loess



Figure 1: Participants relaxing at Half Moon Bay, Lake Rerewhakaaitu, near Mt Tarawera at the end of David Lowe's Quaternary-related field trip.

deposits and intercalated tephra marker beds (Lowe et al., 2012) (Figures 1 and 2).

Poster papers

Poster papers, viewable for the entire conference, were 'presented' by lead authors at a dedicated poster session (Figure 3). Posters in the Quaternary symposium comprised the following topics: surface exposure dating of late Quaternary moraines on Tongariro and Ruapehu volcanoes (Shaun Eaves et al.), a sea-level curve based on a salt marsh foraminiferal proxy record at Whanganui inlet in the Nelson area (Brigida Figueira and Hugh Grenfell et al.), an investigation of Holocene westerly wind variability using sedimentary and water column records from Fiordland (Jessica Hinojosa et al.), late-Glacial to Holocene pollen-based vegetation and temperature reconstructions from Lake Rangatuanui in central North Island (Kat Holt et al.), and Holocene and modern dinoflagellate cyst flux in subtropical and subantarctic waters, southwest Pacific Ocean (Joe Prebble et al.).

Oral papers

The symposium's keynote paper on chronologies was given by Alan Hogg (Waikato Radiocarbon Dating Laboratory) and entitled 'Radiocarbon calibration: the Southern Hemisphere curve update and calibration problems in the Younger Dryas'. He was followed



Figure 2: A loess and tephra sequence on the margins of the Rotorua caldera near Ngongataha seen during David's trip. Kerri Lanigan (pictured) worked on this sequence as part of her MSc thesis project (see Lowe et al., 2012). Named tephras have been recently re-dated by Lowe et al. (2013) and Vandergoes et al. (in press). Rk, Rerewhakaaitu; Kk, Kawakawa.

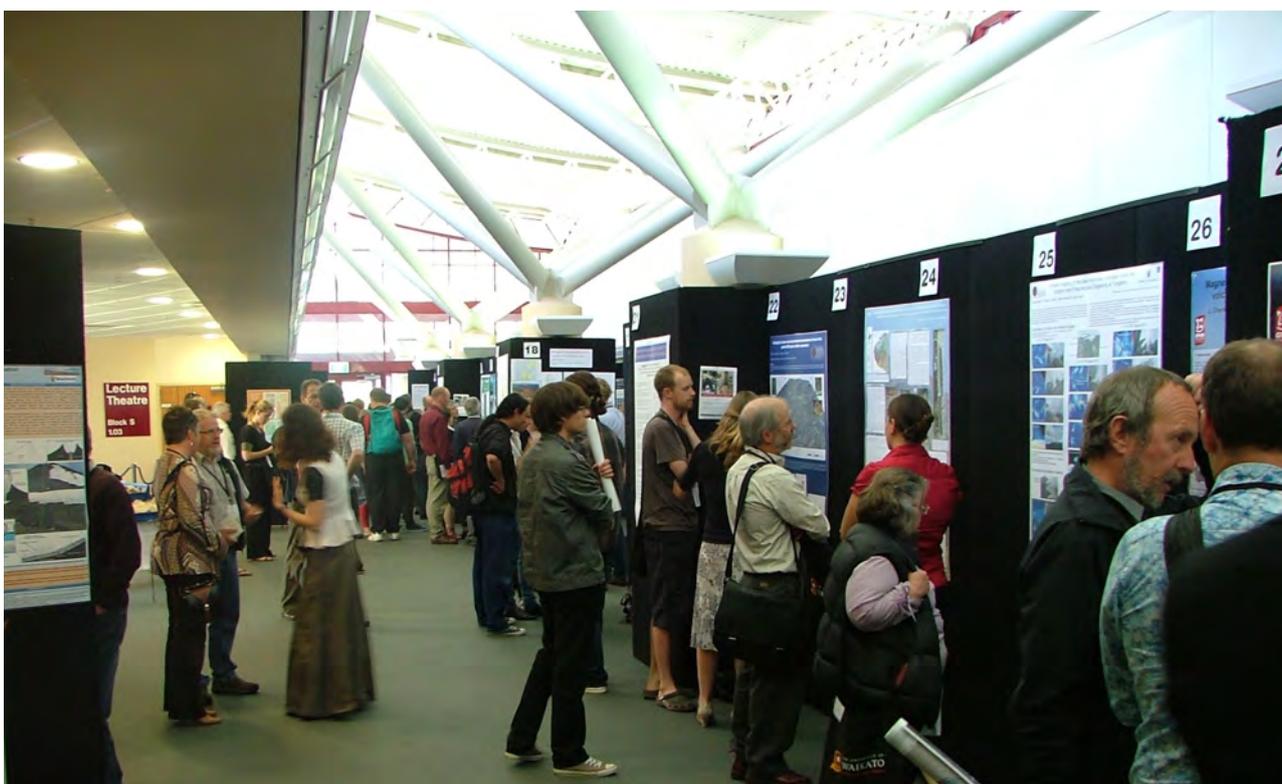


Figure 3: Some of the conference participants enjoying a poster session.

by speakers who discussed the timing of the late-glacial cool episode at Kaipo bog using new Bayesian age modelling (David Lowe et al.), timescales of glacial and periglacial processes in central Otago (Kat Lilly et al.), and cosmogenic nuclide exposure ages of West Coast moraines (Peter Almond et al.).

The second session comprised a range of papers on late Quaternary and Holocene records from New Zealand and South America, including a South American perspective on Holocene Southern Hemisphere westerly wind variability (Chris Moy et al.), two linked papers on the palynology and plant macrofossil assemblages, and other data, from ca. 14 000-year-old Adelaide Tarn in north-west Nelson (Ignacio Jara et al.; Courtney Foster et al.), a reconstruction of late Quaternary glacier activity on Tongariro and Ruapehu volcanoes (Shaun Eaves et al.), and (something completely different) a very interesting paper on late Quaternary beetles and ants from Rano Kau, Easter Island (Maureen Marra et al.).

Papers in the third session expanded into the marine realm and the Ross Sea area, as well as terrestrial New Zealand. The first paper examined the question 'Do winds control the confluence of subtropical and subantarctic surface waters east of New Zealand?' (Denise Fernandez et al.), and was followed by three papers that included work on the last interglacial: the southwest Pacific Ocean response to a warmer climate and lessons from the last interglacial (Lionel Carter et al.), the last interglacial shoreline in Northland as a potential analogue for sea-level rise effects from global warming (Jeremy Gibb), terrestrial vegetation and climate reconstruction for interglacial stages 1, 5e, and 11, from marine sediment cores, offshore from South Island (Matt Ryan et al.). The final paper examined the LGM to Holocene glacial and depositional history of Coulman High from analyses of cores beneath the Ross Ice Shelf (Sanne Maas et al.).

The final session comprised a set of papers dealing with the Holocene: fossil cuticles as a potential tool for palaeoenvironmental studies via an Holocene estuarine case study (Aline Holmes et al.), the development of a proxy-based 20th century curve of sea-level rise from



Figure 4: Rewi Newnham giving his paper on the proposal to subdivide the Holocene.

North Island (Hugh Grenfell et al.), tight coupling of peat carbon processing and Northern Hemisphere warming over the last 1100 years (Adam Hartland et al.), and Rewi Newnham (Figure 4) presented the case for subdividing the Holocene into early, middle, and late periods delineated by the so-called 8.2 cal. ka and 4.2 cal. ka events (see Walker et al., 2012). Rewi's talk led neatly, as planned, into a 30-minute discussion session: firstly about his proposal, and secondly, how the Holocene might relate to proposals for defining a new period, the so-called Anthropocene.

Discussion session

Holocene

Generally, the proposed subdivision of the Holocene was supported. Although a type section has not been formally designated for the Holocene in the New Zealand climate event stratigraphy, Barrell et al. (2013) proposed that the sedimentary record of Lake Maratoto near Hamilton could be a potential type section (pending the integration and updating of existing stratigraphic and proxy datasets, and age models), mainly because the lake is already the Australasian parastratotype for the Pleistocene-Holocene boundary (Walker et al., 2009). An alternative for a New Zealand Holocene reference locality was discussed briefly at the conference by David Lowe, namely Kopouatai bog in the Hauraki lowlands. Kopouatai has been an international Ramsar Convention site since 1989, and is gazetted as a Wetland Management Reserve under the *New Zealand Conservation Act 1987* and managed by the New Zealand Department of Conservation. At 10 200 ha, and readily accessible, it is the largest unaltered restiad peat bog in New Zealand and is also unique globally (de Lange et al., 1999; Clarkson et al., 2004; McGlone, 2009).

Kopouatai comprises thick peat (up to 14 m deep) dating back to late-glacial times (ca. 14 cal. ka) and thus provides a high-resolution record for the Holocene based on both pollen and plant macrofossil analyses (Newnham et al., 1995). Numerous cores and around 40 local ¹⁴C dates have been acquired for the bog, which contains 17 visible tephtras as well as cryptotephtras (de Lange and Lowe, 1990; Hodder et al., 1991; Gehrels et al., 2006, 2008). The tephtras include the Mamaku at ca. 8.0 cal. ka and Stent (Unit Q) at ca. 4.3 cal. ka, close in age to the proposed Holocene subdivisions at 8.2 and 4.2 cal. Ka, and are relatively widespread in the North Island (Lowe et al., 2013). Kopouatai's modern climate (described as a 'wet desert' paradox), unique vegetation, hydrology, carbon exchange, and other aspects, have been (and continue to be) the subject of intense investigation by researchers at the University of Waikato, Landcare Research, and elsewhere (e.g.

Campbell and Williamson, 1997; Thompson et al., 1999; Nieveen and Schipper, 2005; Clarkson et al., 2009; Wagstaff and Clarkson, 2012).

Anthropocene

The Anthropocene was seen as problematic, especially the tricky questions of when it began and how it could be demarcated stratigraphically and globally (e.g. see Steffen et al., 2011; Gale and Hoare, 2012; Wolfe et al., 2013). Phil Gibbard (Quaternary stratigrapher, UK) and Bruce Smith (archaeologist, USA) engaged in a discussion on the topic on a Science Live chat using Skype on 25 April with journalist Michael Balter (available at <https://www.youtube.com/watch?v=mFZT3ypoOPA>). Essentially, the archaeological community comments that significant human impacts can be discerned almost globally for much of the Holocene (hence Phil argued that the erection of a new name for this period would seem somewhat pointless given that the name ‘Holocene’ already exists). Steffen et al. (2011) argued the case for formally recognising the Anthropocene beginning with the advent of the Industrial Revolution around 1800 AD (presumably when the Holocene would finish), and they also noted that the so-called ‘great acceleration’ began after World War II, around 1950 AD.

NZ-INTIMATE, SHAPE, CELL-50K

David Barrell described the culmination of the NZ-INTIMATE project and the development of the New Zealand climate event stratigraphy, summarised in the form of a new poster displayed at the conference (Figure 5) and as a paper in a special issue

of Quaternary Science Reviews on the Australasian INTIMATE project (Barrell et al., 2013). This special issue, comprising 18 papers on New Zealand and Australian research, effectively completes the AUS-INTIMATE project with respect to INQUA support (now finished). INTIMATE groups will continue, however.

Peter Almond rounded out the discussion session with a brief introduction to two new projects, SHAPE and CELL-50k. AQUA vice-president Helen Bostock (NIWA) reported on these developments in an AQUA news flash in December 2012, and in the most recent QA newsletter. SHAPE (Southern Hemisphere Assessment of Paleo-Environments) is being led by Drew Lorrey (NIWA) and Steven Phipps (University of NSW), and forms part of the newly-formed international focus group, CELL-50k (Calibrating Environmental Leads and Lags over the last 50 kyr), which is led by Simon Blockley (Royal Holloway, University of London) within the palaeoclimate commission (PALCOMM) of INQUA.

Conclusion

All in all, the conference provided a stimulating and enjoyable Quaternary symposium and a very successful conference. I thank Peter Almond and Rewi Newnham for their help in convening the symposium, David Barrell for developing the new poster and for his top-notch plenary talk, Jessica Reeves for her support for the symposium and for providing the AQUA poster, conference convenor Adrian Pittari for providing space for the AQUA and NZ-INTIMATE posters, and all those who participated in the symposium and discussion.

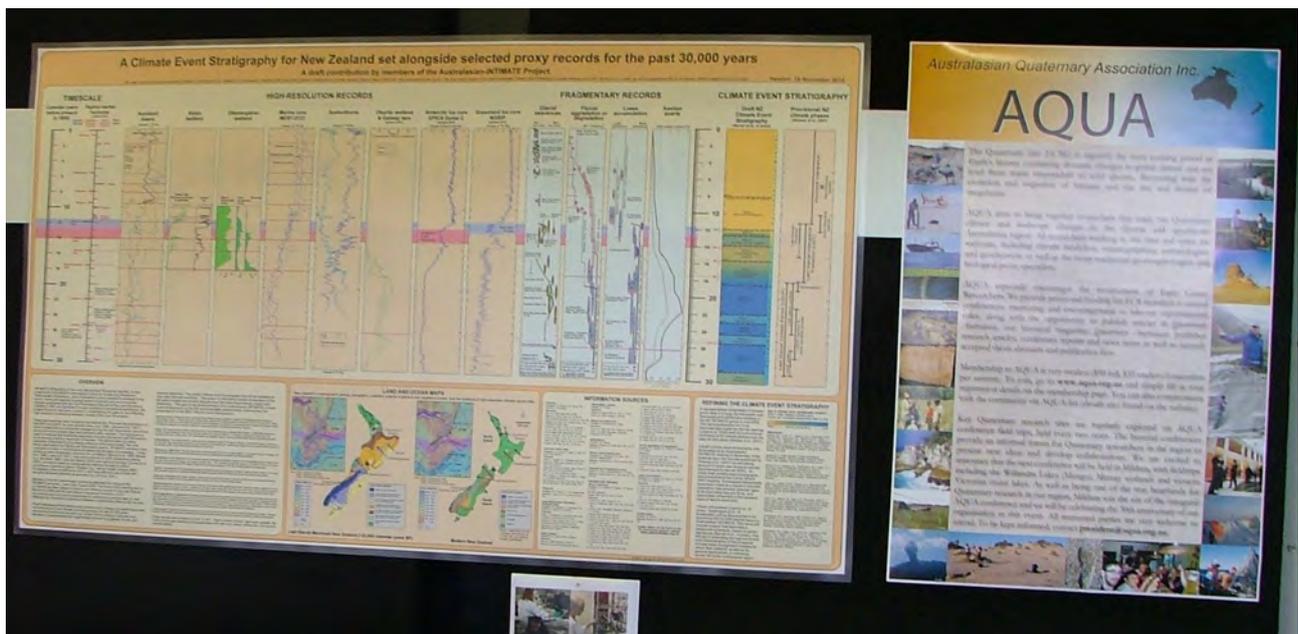


Figure 5: David Barrell’s new poster displaying the New Zealand climate event stratigraphy (Barrell et al., 2013) and selected proxy records (Barrell et al., 2005; Alloway et al., 2007). At right is the AQUA poster prepared by Jessica Reeves.

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QA

‘The Compleat Archaeologist’: Mike Smith, desert archaeology and museums

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A tribute to Dr Mike Smith AM was held at the National Museum of Australia, Canberra, on 8 February 2013, to celebrate Mike’s career as a pioneering desert archaeologist.

At Mike’s specific request, the one-day symposium was multidisciplinary and pitched to interest non-scientists as well as fellow archaeologists and museum staff, plus historians, geoscientists, artists and poets. The event encompassed some three decades of Mike’s work in prehistoric archaeology and Aboriginal history, Quaternary environments, geochronology and past climate change, human-environment interactions in Australian and other Southern Hemisphere drylands, the history of ideas, the history of science in arid zones, and environmental history.

Mike’s career has included the post of archaeologist with the Northern Territory Museum in Darwin and Alice Springs, Research Fellow in the Research School of Pacific and Asian Studies at the Australian National University (ANU), lecturer in archaeology in the Department of Archaeology and Anthropology, ANU, and Director of Research and Development at the National Museum of Australia (NMA). His latest roles have been those of Senior Research Fellow at the NMA’s Centre for Historical Research, and Adjunct Professor in ANU’s Fenner School of Environment and Society. Mike was awarded an AM in the 2013 Australia Day Honours list for his ‘significant service

to archaeological scholarship, particularly Australia’s desert regions’ and to recognise his last 30 years of inspirational work in reconstructing the environmental and Aboriginal histories of our desert continent.

The ‘Mikefest’ was chaired by Peter Stanley, Head of the Centre for Historical Research, NMA, and introduced by the NMA Director, Andrew Sayers. Mark O’Connor, Australian poet and environmental writer, recited an incisive and eloquent poem, ‘Desert Archaeology’, that he had written to encompass serious and lighter aspects of Mike’s outback expeditions and his fascination with stratigraphy that underpinned these journeys.

Mike’s career has been a great enterprise to uncover the deep history of our desert continent and the history of its people. His early archaeological research provided a very significant revelation of central Australia, showing that Aboriginal groups were already established in the heart of the desert 35 000 years ago, at a time when modern humans were moving into western Europe half a world away. Mike’s career is virtually synonymous with the development of Australian desert archaeology as a field.

Three distinctive but intermingled sessions provided the main content of the symposium. June Ross chaired a session on ‘Inventing Australia’s desert archaeology’, joined by John Mulvaney, Barry Cundy, Giles Harm

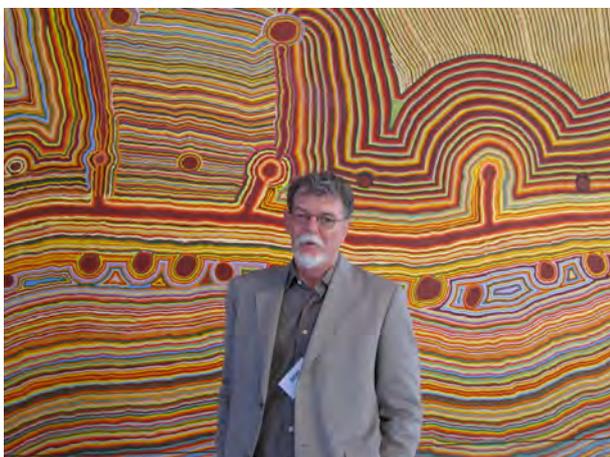


Figure 1: Mike at the National Museum of Australia with the Great Sandy Desert painting: ‘Martumili Ngurra’ 2009 by the Martumili artists, Parnngurr, Western Australia.



Figure 2: Mike with ‘A portrait of Mike Smith’ 2013 by Jo Bertini.

and Chris Turney. The speakers discussed the questioning, theorising, arguing and the digging that led to the development of desert archaeology in Australia.

Philip Jones chaired a session on 'A stratigraphy of an archaeologist'. Mike's colleagues and collaborators, Peter Veth, Dick Kimber and Anne McConnell, reflected on the projects that informed Mike's knowledge and understanding of Australia's human past to create a picture of the evolution of 'The Compleat Archeologist'. Douglas Multa Tjupurula, a traditional owner of the Ikuntji-Haasts Bluff community in the Cleland Hills, central Australia, where Mike has spent much productive time, was also hoping to contribute to this session, but was unable to attend on the day. His contribution would have exemplified Mike's long-term skills and success in communicating with indigenous communities and traditional land-owners, and involving them in research operations and outcomes.

A third session, on Mike's career in museums, was chaired by Libby Robin, joined by speakers Jay Arthur, Allan Whiting, Diana James and Tom Griffiths. The focus was on how Mike brought Australia's (and later the world's) deserts into the museum setting. This phase of Mike's career extended his reach and his travels, the latter by camels and four-wheel drives, when he forged partnerships with artists and indigenous communities, and importantly, broadened his understanding - and that of the rest of us - of the deserts of the Southern Hemisphere. A highlight of this period of Mike's career was the NMA special exhibition 'Extremes - Survival in the great deserts of the Southern Hemisphere.'

These three symposia were interspersed with magnificent and colourful contributions from artists who have shared desert expeditions and excavations with Mike, including 'A portrait of Mike Smith' with distinctly quizzical camels by Jo Bertini, paintings by Mandy Martin and photographs by Peter Eve, plus a screening of the film 'Extremes', which compares three ways of desert living in the great deserts of the Southern Hemisphere: the southern African Namib, the Australian 'Red Centre', and the South American Atacama. In a quirky homage to Mike's forthcoming book 'The archaeology of Australia's deserts', Jo additionally presented a richly illustrated booklet 'The archaeology of Australia's desserts' by Mike Smith and friends, containing distinctive recipes concocted during digs at Puritjarra rock shelter and on camel treks and 4WD expeditions to Paraku (Lake Gregory, northern WA), the Simpson Desert and dusty places beyond. At this juncture, Peter Stanley quipped, 'So long as we can't now expect a book on "The Archaeology of Austria's deserts".'

The symposium concluded with an 'Open Mike' session in which the guest of honour led discussions with diverse colleagues whilst also lyrically recreating the twists and turns and driving forces of his career. Mike feels honoured to be a part of the first generation of *Australian-trained* archaeologists, and to work with the last Aboriginal people who grew up in the bush without engagement with whites. He highlighted the technological advances and scientific techniques that have enhanced modern archaeology, including radiocarbon and OSL dating, satellite phones, the internet and more, that enable us to really 'see' the world in a grain of sand. On this note, he warned that modern advancements mean we tend to miss nothing but bring the danger of finding nothing either! Sophisticated instruments are not crucial to understanding site stratigraphy; much can be done with a basic field assessment of sediments, their layers, interfaces and features. Mike drew corroborative comments from his teachers Jim Bowler and Isabel McBride who, likewise, saw the need for our scholarship to move beyond analysis and be put in order in time and space.

Mike reflected on the day's multi-dimensional revelations and suggested that the discipline of desert archaeology, with art, films, poetry and science so nicely represented, perhaps now needs a mature literature at this juncture, a novel that captures the grit and colour of the desert and field digs. He senses being drawn into the Dreaming - rather than merely analysing rock art, for example - being drawn into the landscape and have it refracted as you turn in different lights.



Figure 3: 'Open Mike' session at 'The Compleat Archaeologist' symposium.

‘What makes a compleat archaeologist?’ Mike sees himself as a ‘bridge between archaeologists and Quaternarists’. While recognising the fundamental importance of detailed site reports in our archaeological endeavours, he emphasised that the chase and discovery must not be lost in habitual detail, and that historical context, comparative work, connections and synthesis are required for new scientific understanding and a public national identity. Most importantly, Mike believes that mentors and co-workers make an archaeologist complete, the best being those who are intellectually and personally generous, who are good in the field, who are polymaths and humanists as well as scholars. Perhaps those who can make just desserts out amongst the sand dunes, a Pleistocene layer cake for example, are regarded as particularly valuable. Mike sees himself as a ‘tradesman archaeologist’; the fieldwork, travel, long red dirt tracks, camels, archaeological sites, and dissection of stratigraphy are central to his life and career, and he reflected that these aspects inspire a museum exhibition, drama and impact. He emphasised that one must love one’s field but one needs to realise that it is not a fixed edifice. There are diverse kinds of knowledge, diverse ways of knowing.

This stance of Mike’s has generated his profound contribution to our understanding and appreciation of the Indigenous history of Australia, our continent.

An audio-visual recording of the insightful and moving symposium and the outpouring of respect and appreciation for Mike conveyed throughout the day is available on the National Museum of Australia website at http://www.nma.gov.au/history/research/conferences_and_seminars/compleat_archaeologist#A_tribute_to_Dr_Mike_Smith_AM.

Part of Mark O’Connor’s poem ‘Desert Archaeology’ is online at http://www.nma.gov.au/history/research/conferences_and_seminars/compleat_archaeologist/postings/poem_about_mike/_recache.

A list of Mike Smith’s books and many other publications is available on the National Museum of Australia website, including his book ‘The Archaeology of Australia’s Deserts’, Cambridge University Press, 2013, ISBN 9780521407458 (hardback temporarily unavailable), Adobe eBook Reader (ISBN-13: 9781107302112); enquiries@cambridge.edu.au. This scholarly publication is a wealth of new environmental and archaeological data from recent decades of research in Australia’s deserts. It explores the Pleistocene settlement of Australia’s drylands, the formation of distinctive desert cultures, and the origins and development of the hunter-gatherer societies. The book interweaves a lively history of research with archaeological information within an interdisciplinary context of Earth sciences, anthropology, ecology and geography.

QA

Australian Archaeological Association Conference 2012 - ‘Science and Archaeology’, Wollongong NSW, 9-13 December 2012

Caroline Spry^a and Jacqueline Tumney^a

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The 35th Annual Conference of the Australian Archaeological Association (AAA) was held on 9-13 December 2012 at the Novotel Wollongong Northbeach. Hosted by the Centre for Archaeological Science, School of Earth and Environmental Sciences, University of Wollongong, the conference theme, ‘Science and Archaeology’, aimed to reflect and embrace the interdisciplinary diversity of archaeology, with a special focus on the role of science in archaeology, the development and applications of scientific

techniques to particular archaeological questions, and the interface between the sciences and the humanities in archaeology. Almost 500 delegates attended the conference, including 31 international visitors from countries including Canada, the Czech Republic, England, Egypt, India, Italy, New Zealand, South Africa and the USA. Four concurrent sessions were delivered on each of the four days of presentations, bracketed in the morning and afternoon by a phenomenal seven plenary speakers.

Conference activities commenced before the official welcome event on Sunday evening, with a pre-conference tour on Saturday to see rock art and meet contemporary Dharawal artists in the newly designated Dharawal National Park. Two workshops on facial approximation were held by Susan Hayes, a facial anthropologist who has recently worked on the face of *Homo floresiensis* (the Hobbit). The Saturday workshop focused on 3D facial approximation, and participants used clay to recreate the underlying anatomy, skin and facial features of an adult male of possible Egyptian population affinity (Figure 1). The second workshop, on Sunday afternoon, was an introduction to 2D facial reconstruction, where participants learned how to use basic drawing skills to approximate the facial appearance of *Homo floresiensis*. A Curriculum Vitae (CV) workshop was also held on Sunday afternoon, which provided an opportunity for delegates, particularly recent graduates, to prepare or revamp their CVs for prospective employment opportunities in the archaeology industry. The official conference program commenced on Sunday evening, with welcome drinks at the Novotel. Conference delegates had an opportunity to catch up with old and new acquaintances, and Mike Morwood launched the 'Companion to Rock Art', edited by Jo McDonald and Peter Veth.

Peter Hiscock, newly appointed Tom Austen Brown Professor of Australian Archaeology at the University of Sydney, was the first plenary speaker. His presentation, 'Yours in science: cultural evolution and

evolvability in Australia and the Old World', discussed the transition of *Homo sapiens* to modernity, and the challenges faced by archaeologists attempting to interpret cumulative, incremental cultural change.

Jo McDonald and Alistair Paterson chaired the 'Science and rock art' session, in which presenters discussed recent developments in pXRF analysis of rock art, the use of LA-ICP-MS to source ochre used in rock art, radiocarbon dating of rock art pigments, and more. Lithic analysts also demonstrated an interest in pXRF, as discussed in the 'Scientific approaches to lithic analysis' session. Experimental manufacture and use of stone technology was a common theme in this session. In another session, 'Beyond ions and eons: nuclear and synchrotron characterisation of archaeological and palaeontological materials', presenters discussed the characterisation of archaeological ceramics and the new neutron imaging station DINGO at the ANSTO Neutron Facility; the investigation of archaeological and historical objects by neutron diffraction; elemental characterisation through k0-Neutron Activation Analysis; and non-invasive x-ray analysis of hominin remains.

The first of four AACAI (Australian Association of Consulting Archaeologists Inc.) sessions was delivered during the morning, and other papers during the first day covered topics as diverse as archaeological photography, monitoring site subsidence, cultural heritage management, stone artefact refitting, subsurface



Figure 1: Conference delegates reconstruct the face of an adult male of possible Egyptian population affinity (photos: Elspeth Hayes).

investigation techniques and forensic archaeology. The latter session provided an appropriate lead-in to the second plenary presentation, by Lisa Matisoo-Smith, Professor of Biological Anthropology in the Department of Anatomy at the University of Otago, New Zealand. Lisa's paper, 'Using DNA in archaeology', discussed some of the pros and cons of using DNA to address archaeological and anthropological questions. The day concluded with 'Meet the graduates', an opportunity for recent archaeology graduates to meet potential employers from the consulting, industry, heritage, government and education sectors.

Tuesday commenced with a plenary presentation by Professor Tim Flannery, 'The Future Eaters hypothesis of megafaunal extinction: is it now a theory?', which considered whether the hypothesis that Australia's megafauna became extinct soon after human arrival as a result of hunting should now be accepted as a theory in light of recent evidence from Lynch's Crater in north-east Queensland. Perhaps not surprisingly, the paper provoked an animated discussion during the ensuing question time. This presentation was followed by a session on 'The archaeology of Lake Mungo: capturing the people behind the science' (chaired by Nicola Stern, Jacqui Tumney and Caroline Spry). This session provided an update of ongoing, multidisciplinary work in the Willandra Lakes region World Heritage Area. Presenters discussed new approaches to the investigation of surface stone artefact scatters using refitting studies or detailed technological analysis in combination with high-resolution surface mapping and GIS; new chronostratigraphic data for the Mungo lunette; the results of the first systematic survey of the Mungo lunette; new archaeomagnetic analyses of hearths versus natural fires; and the results of an ongoing study of MtDNA signatures of Aboriginal people in the Darling River region. Max Aubert chaired an afternoon session on 'Isotopic and elemental analyses in archaeology', which included papers on fish otolith geochemistry at Lake Mungo; analysis of bone collagen and incremental dentine isotopic analysis to understand short-term changes in the diet and physiology of Great Irish Famine victims; the relatively less destructive technique of laser ablation depth profiling of U-series and Sr isotopes in human fossils; multi-element ICP-MS characterisation of sediments from northeast Thailand to identify human activity; and the results of elemental analysis of 1st millennium moulded and coreformed glass from BC Gordion, Anatolia.

Concurrent sessions included 'The archaeology of Australian indigenous stone arrangements', 'Residue and use-wear analysis of archaeological artefacts' and 'Scientific analysis of human remains in the Asia-Pacific region'. The question of megafauna extinction was taken up by a number of papers in the session on

'Fauna, flora and human-environment interactions'. The day ended with a plenary presentation by Julia Lee-Thorp, University Lecturer in Bioarchaeology and Professor of Archaeological Science at the University of Oxford: 'What's new in early hominin diets? (Or, what have we learnt about early hominin dietary ecology and lifeways from biogeochemistry)'. Julia discussed recent isotopic studies in east Africa and beyond, which suggest greater australopith dietary breadth than previously thought.

Dr Zenobia Jacobs, an ARC Queen Elizabeth II Fellow in the Centre for Archaeological Science, University of Wollongong, began the third day of proceedings with a plenary presentation on 'Timing is everything: opening the "black box" of OSL dating in archaeological contexts', discussing some of the basic principles of single grain OSL dating. The presentation highlighted a number of case studies, including recent work at Pinnacle Point in South Africa, which reveal some of the key issues in assessing the reliability of OSL age estimates for archaeological sites with varying sedimentary and geographical settings. Following this, Bo Li chaired a session on 'Scientific dating in archaeology', in which presenters discussed the updated SHCal13 radiocarbon calibration dataset and new measurements from New Zealand kauri for the Younger Dryas; the micro-radiocarbon analysis process at ANSTO; new approaches to radiocarbon dating of bone from warm and arid environments involving screening of bone using %N and the dating of amino acids using ninhydrin; AMS dating of plant residues of a known age on replicated stone artefacts; the impact of variability in C14 measurements on determining ΔR ; and recent applications of U-series dating, IRSL dating of K-feldspar and thermoluminescence dating.

DNA, stable isotope analysis and issues of scale were among the topics taken up in a session on palaeoecology, followed by a specific session on archaeobotany. Collaborative work between Australian and Chilean archaeologists was highlighted in a session on the 'Prehistory of the Atacama Desert', while work in the Pilbara, including the Hamersley Plateau, was covered in two sessions, chaired by Oliver Brown and Michael Slack. In the session 'Beyond dichotomy: the structure of archaeological knowledge in Australia' (chaired by Michael Lever), the theoretical archaeologists demonstrated that they can also be technologically savvy, with one of the papers being delivered via Skype. Mark Collard, who holds the Canada Research Chair in Human Evolutionary Studies and is Professor of Archaeology and Biological Anthropology at Simon Fraser University, British Columbia, Canada, gave a plenary presentation in the afternoon on 'Population size, environment, and technological evolution in small-scale societies', which outlined the theory that

underpins the population-size hypothesis, and the impact of a number of recent analyses of ethnographic data on this hypothesis. The poster session was held at the end of the day and was followed by ‘Wednesday night in the Gong!’, a tour of Wollongong’s nightclubs and bars.

The final day of the conference thus began with sore heads for some, and with a plenary presentation by Curtis Marean, Professor in the School of Human Evolution and Social Change at Arizona State University, and Associate Director of the Institute of Human Origins. Curtis’s paper, ‘Survivors on the edge of the sea: using a transdisciplinary approach to develop the palaeoscape of early modern humans’, argued that only a transdisciplinary approach can unravel the complexities of people’s past lifeways, and demonstrated the successful application of this approach to a recent environmental reconstruction of Pinnacle Point.

Ingrid Ward chaired a morning session on ‘Approaches to coastal and marine archaeology’, during which presenters discussed the study potential of submerged landscapes of the Australian continental shelf;

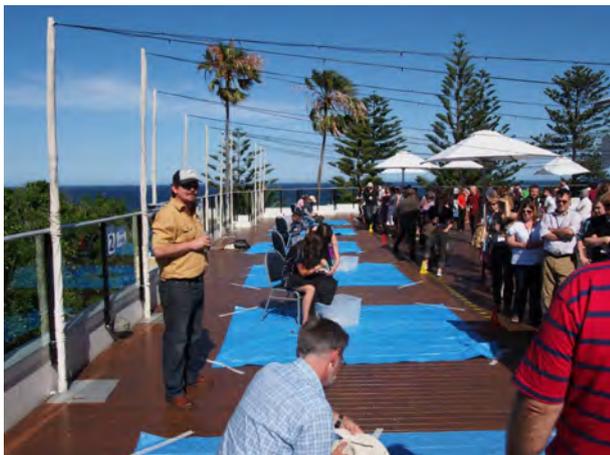


Figure 2: Archaeologists try their hand at replicating an Acheulian hand-axe. Top: the Novotel’s Illawara Deck has never seen a competition like this before! Bottom: a hand-axe nearing completion (photos: Brent Koppel).

recent results of The Australian Historic Shipwreck Preservation Project 2012; application of ROVs (remote operated vehicles) to heritage management and underwater imaging in Australia; use of magnetic susceptibility to identify frequency of visitation to shell mounds on Mornington Island; and new shell mound dates from the Weipa region in far north Queensland. The use of GIS-based modelling and a number of new database initiatives were highlighted in Ian Johnson’s ‘Digital archaeology: after 40 years, is it still new?’ session, and the conference program was rounded off with a session on the taphonomy of zooarchaeological assemblages and the final AACAI session covering ‘The Murray and other SE Australian river systems’. The final afternoon involved a special plenary session entitled ‘Tales from the trenches: doing science, acting human’. This involved a more light-hearted view of the serious job of archaeological fieldwork, and included short tales of cooking competitions, snakes, conversation and naughty behaviour. A knapping competition followed the sessions, where participants attempted to create hand-axes using traditional stone knapping techniques, resulting in a mixture of fine hand-axe specimens and some sad lumps of flaked stone (Figure 2).

The conference dinner wrapped up five enjoyable and stimulating days of sessions, workshops and social activities, with many people kicking on at the after-party until the small hours of the morning. We would like to extend a special thank-you to Mr Roy (Dootch) Kennedy for his official Welcome to Country, and to all of those delegates who made #AAA35 available to the Twittersphere. We also thank the conference organisers, Richard Fullagar and Bert Roberts, and all conference volunteers, for putting on another excellent conference, and look forward to attending the next one in Coffs Harbour (#AAA36) later this year.

QA

ARC results

Congratulations to the latest recipients of the recently announced Future and Laureate Fellowships, and Linkage grants. Here is a summary of those projects related to Quaternary research, including archaeology.

DISCOVERY PROJECTS

The University of New South Wales

DP130104156

Turney, Prof Chris S; Meissner, Dr Katrin J; Grierson, A/Prof Pauline F

Reconstructing changes in atmospheric circulation over the mid-latitudes of the Southern Hemisphere during the past 3000 years

\$470,000, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

The climate of the mid-latitudes of the southern hemisphere is of global significance and yet past changes have proved difficult to reconstruct due to the dearth of records. Working across the Southern Ocean region using tree rings, lake sediments and ice cores, the project will produce the first comprehensive reconstruction spanning the last 3000 years.

The University of Sydney

DP130101268

Betts, A/Prof Alison V; Grenet, Prof Frantz; Yagodin, Prof Vadim N

Kingship, art and cult practice: decoding symbolism in an ancient Central Asian royal city

\$304,000, ARCHAEOLOGY

Hidden in the elaborate imagery of the richly ornamented 'Ceremonial Complex' recently uncovered at the ancient 'Royal City' of Kazakly-yatkan in Uzbekistan is a wealth of symbolism relating to cult, kingship and the divine. The study of this magnificent corpus has broad relevance for the history of all the lands across the ancient Persian world.

University of Wollongong

DP130104023

Nanson, Prof Gerald C; Fink, Dr David; Fujioka, Dr Toshiyuki; Huang, Prof He Q

Anabranching rivers: the arteries of arid Australia

\$380,000, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

Multi-channel (anabranching) rivers are prevalent among the world's largest rivers and span vast areas of arid Australia, yet no comprehensive explanation exists for how or why they occur. This study determines why rivers anabranch, why Australia has them

in such abundance, and how best to manage them for agricultural production and conservation.

Monash University

DP130102514

David, Dr Bruno (DORA)

Before, during and after Lapita: 5000 years of cultural continuity and transformation at Caution Bay, southern Papua New Guinea

\$760,000, ARCHAEOLOGY

Australia's closest Indigenous neighbours in southern Papua New Guinea have long been thought to have been in contact with long-distance seafarers only in the last 2000 years. This project will document recent archaeological findings that are causing a radical rethink of ancestral connections between Australia and southern Papua New Guinea.

The University of Melbourne

DP130101610

Gleadow, Prof Andrew J; Kohn, Prof Barry P; Foster, Prof David A

Geodynamics and continental extension in the East African Rift System: origin and evolution of the Turkana Depression in northern Kenya

\$420,000, GEOLOGY

The Lake Turkana region in northern Kenya, famous for its fossil evidence of human origins, occupies a critical position within the Great Rift Valley of East Africa. This project seeks to explain how this complex region evolved and also the dynamic earth processes responsible for its formation between two great uplifted domes in Ethiopia and Kenya.

DP130100517

Phillips, A/Prof David; Jourdan, Dr Fred; Honda, Dr Masahiko; McDougall, Prof Ian; McInnes, Prof Brent I

Development of new and high precision noble gas techniques for dating Quaternary volcanic rocks and surfaces: a Thermochronology and Noble Gas Geochronology and Geochemistry

\$370,000, GEOLOGY

This project will calibrate noble gas dating methods, providing powerful tools for dating young volcanic rocks, eroded or buried surfaces and glacier/ice retreat. This research has considerable social, national and economic benefits for research training, volcanic hazard assessment, landscape evolution, paleoclimate change and mineral exploration.

DP130101829

Woodhead, Prof Jonathan D (DORA); Drysdale, Dr Russell N

The Australian expression of the Pliocene warm period, an analog for future greenhouse conditions

\$890,000, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

Records of the planet's response to past climate are important for predicting the future under conditions of global warming. This project will assemble one such record but, in contrast to much existing data, it emphasises the palaeoclimate of southern Australia through a time interval widely regarded as an analog for our climate in the year 2100.

James Cook University

DP130100334

Bird, Prof Michael I; Ridd, Prof Peter V; Ulm, Dr Sean G; Roberts, Prof Richard G; Lawes, Prof Michael J; Luly, Dr Jonathan G; Hutley, A/Prof Lindsay B

What is 'natural'? Locating and deciphering pre-human records of vegetation from northern Australian savannahs

\$190,000, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

The nature and magnitude of the environmental impact of human colonisation of Australia are fundamental issues in Australian prehistory and ecology. The project will locate and develop archives of environmental change from sinkholes in the Northern Territory that date back to the Last interglacial - a period which had a similar climate to the present day, but was before humans arrived.

The University of Adelaide

DP130103842

Bradshaw, Prof Corey J; Brook, Prof Barry W

Generalised methods for testing extinction dynamics across geological, near and modern time scales

\$515,000, EVOLUTIONARY BIOLOGY

The record of extinctions over deep time is patchy and incomplete, yet we must use it to determine how major changes in past environments have shaped life on Earth today. The project will develop cutting-edge mathematical tools to determine the patterns of extinctions and speciation over geological time to help predict our uncertain environmental future.

DP130104227

Wilkinson, Prof Michael J; Breen, Dr James M; Higham, Dr Thomas F; Pinhasi, Dr Ron

Reconstructing wheat evolution using ancient DNA

\$443,000, CROP AND PASTURE PRODUCTION

The domestication of wild grasses by farmers was a step change in human history; it led to the emergence of modern cereals and with them, western civilisation.

This project will apply modern DNA sequencing methods to 5000-year-old cereal seeds to reconstruct the history of wheat, barley and other crops, and identify lost ancient forms and diversity.

Curtin University of Technology

DP130100577

Grice, Prof Kliti (DORA); Summons, Prof Roger E

Tackling the resurgences of life, advanced dating tools of oils by sophisticated molecular and isotopic analyses from major geological events

\$710,000, GEOCHEMISTRY

Evidence of Earth's biogeochemical evolution is uniquely recorded in sediments and petroleum, as are the mechanisms of life's recovery from mass extinction caused by past catastrophes. Pioneering ageing techniques will be tested on ancient sediments, low temperature mineral fabrics and petroleum leading to the exploration of new energy sources.

The University of Western Australia

DP130100802

Veth, Prof Peter M (DORA); Paterson, Prof Alistair G; Basgall, Prof Mark E; Zeanah, Prof David W; Manne, Dr Tiina; Placzek, Dr Christa; Coddling, Dr Brian F; Souter, Ms Corioli A

The Barrow Island archaeology project: the dynamism of maritime societies in northern Australia

\$1,175,000, ARCHAEOLOGY

This project will study human occupation from exceptionally rich sites on Barrow Island, located off north-west Australia, profiling a continuous reliance on coastal resources until isolation. Whaling and pearling started in the nineteenth century using Indigenous labourers after a 7,000 year gap in human occupation.

DECRA's**Deakin University**

DE130101453

Porch, Dr Nicholas A

Developing predictions of extinction risk for tropical arthropods in the face of global environmental change

\$364,015, ZOOLOGY

Developing knowledge of the characteristics that make species especially at risk of extinction is critical in order to limit the extent of future biodiversity losses. This project uses the fossil record of extinctions on islands in order to develop a better understanding of the processes that drive species to extinction.

The University of New South Wales

DE130100663

McGregor, Dr Shayne

Understanding the termination of El Nino-Southern Oscillation events

\$375,000, OCEANOGRAPHY

Australia's climate is extreme, with significant drought and flooding events driven by cycles of the El Nino-Southern Oscillation (ENSO). This study will improve our understanding of the termination of ENSO events and lead to better inter-seasonal climate forecasting, aiding the sectors reliant on accurate climate prediction.

University of Wollongong

DE130101560

Brumm, Dr Adam R

A world of its own: earliest human occupation of the Maros karsts in Southwest Sulawesi, Indonesia

\$372,600, ARCHAEOLOGY

Excavations at Leang Burung 2, a rockshelter on the Indonesian island of Sulawesi, yielded evidence for the initial arrival of modern humans and underlying deposits containing primitive stone tools from earlier inhabitants. This project aims to recover further evidence of early modern humans at the site and the identity of the earlier toolmakers.

DE130100068

Mackay, Dr Alexander C

Dwellers on the threshold: the evolution of human behavioural complexity in peripheral regions of southern Africa

\$344,120, ARCHAEOLOGY

This project will clarify the causes and contexts under which *Homo sapiens* evolved and began to display our species-defining behavioural complexity through an analysis of archaeological sites located on the fringes of southern Africa's arid interior. The project will significantly enhance understandings of the behavioural evolution of our species.

La Trobe University

DE130101816

Garvey, Dr Jillian M

Palaeoenvironments and human adaptation in the late quaternary of the semi-arid Murray River valley, north-western Victoria

\$348,088, ARCHAEOLOGY

This project involves a multidisciplinary approach to investigating Indigenous settlement and subsistence strategies along the Murray River in northwest Victoria during the last Ice Age. It will examine the palaeoecology and palaeoenvironment of the region,

with particular focus on how people and animals responded to climatic variability.

The University of Melbourne

DE130100668

Gergis, Dr Joelle

The further back we look, the further forward we can see: 1,000 years of past climate to help predict future climate change in Australia

\$351,805, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

Reconstructing 1,000 years of Australia's past climate will greatly extend our understanding of natural climate variability currently estimated from weather observations. For the first time, Australian climate variations over the last millennium will be used to assess the accuracy of climate model simulations for our region.

James Cook University

DE130100295

English, Dr Nathan B

Forecasting the future of flood and drought in Australia using multi-century tree-ring and isotope chronologies from the tropics

\$373,679, PHYSICAL GEOGRAPHY AND ENVIRONMENTAL GEOSCIENCE

The effects of El Nino on Australian floods and droughts in a globally changing climate is unclear because we lack long climate records from the past. This project will measure tree-ring and isotope records using kauri pine to advance our understanding of El Nino's effects on the frequency and intensity of drought and floods in Australia.

The University of Adelaide

DE130101133

Worthy, Dr Trevor H

Evolution, breeding biology and extinction of giant fowl in Australia and the Southwest Pacific

\$375,000, GEOLOGY

New investigation of the extinct giant flightless Australian mihirungs and similar giant fowl of Oceania by analysis of fossils will reveal their relationships and resolve the evolutionary history of fowl globally. This project will provide insight into breeding strategies of these fossil species and the causes and impacts of their extinction.

The Australian National University

DE130101703

Flexner, Dr James L

Mission archaeology and colonial encounters in Southern Vanuatu

\$350,505, ARCHAEOLOGY

The remains of Christian missions in southern Vanuatu are important heritage sites for local communities, and for their place in world history as part of one of the final frontiers of European colonialism. This project explores these sites to produce a new picture of everyday life that includes the perspectives of missionaries and native people.

DE130100153

Pryce, Dr Thomas O

Radiogenic bronze and the Indianisation of Southeast Asia

\$347,556, ARCHAEOLOGY

Intense South/Southeast Asian maritime activity began circa 2500 years ago, but the societies involved

and their motivation is unknown. Study of exchange networks in chemically distinctive bronzes related to early Buddhism and their likely production centre in eastern India will establish a sound economic basis underlying long-term cultural influence.

DE130100046

Reepmeyer, Dr Christian H

Foundations of Island Southeast Asian maritime interaction: unravelling cause and consequence for the transformation of past societies

\$374,575, ARCHAEOLOGY

The successful spread of Neolithic innovations across the world was one of the most important transformations in human history. This project combines the geochemical and technological analysis of stone tools to track the evolution of maritime colonisation in Island Southeast Asia, the foundation for the success of agriculture in this region.

QA

Announcing SHAPE: Southern Hemisphere Assessment of Palaeoenvironments

Andrew Lorrey^a, Helen Bostock^a, Steven Phipps^b and Jessica Reeves^c

^a National Institute of Water and Atmospheric Research, Wellington, New Zealand

^b Climate Change Research Centre, Faculty of Science, University of New South Wales, Sydney, Australia

^c Science, Information Technology and Engineering, University of Ballarat, Ballarat, Australia

We are proud to announce the successor of the AUS-INTIMATE initiative, which ran for two successive INQUA inter-congress periods from 2003 to 2011, and culminated in the upcoming AUS-INTIMATE special issue in Quaternary Science Reviews.

SHAPE (Southern Hemisphere Assessment of Palaeoenvironments; INQUA PALCOMM project #1302) will start in 2013 and continue until the next INQUA Congress in Japan in 2015. SHAPE will carry forward the goals of AUS-INTIMATE, such as the production of high resolution palaeoclimate records during the Late Quaternary. However, it will have a wider spatial scope, incorporating New Zealand, Australia, the Pacific Islands, South America, South Africa, Antarctica and the Southern Ocean. There will also be a stronger emphasis on climate modelling, data-model integration, development of new research tools and training activities for early career researchers.

SHAPE will support two existing INQUA International Focus Groups: CELL-50K (Calibrating Environmental Leads and Lags over the last 50 ka) and ACER (Abrupt Climate Changes and Environmental Responses). Thus, the timescale of the project extends back to 50-60 ka (the limit of radiocarbon dating).

The main objectives of SHAPE are to:

- generate defensible chronologies for SH proxy records
- refine and extend regional climate event stratigraphies
- provide robust interpretations of proxies (qualitative and quantitative)
- generate regional reconstructions of past environmental and climatic change (temporal-geographic syntheses)
- integrate the results into a hemispheric-wide story for key time slices, highlighting the changes and testing hypotheses for their causes

- conduct new climate model simulations for key periods
- integrate proxies with climate model simulations
- train the next generation of Quaternary scientists in key techniques.

Suites of quantitative and qualitative marine and terrestrial climate reconstructions will underpin transects from the tropics to the mid- and high-latitudes, illustrating changes in currents, fronts and temperature gradients. Like the goals of AUS-INTIMATE, the SHAPE project will highlight the timing of critical changes, and identify synchronous versus asynchronous changes in climate.

However, unlike INTIMATE, there will be a larger focus on using these proxy-based reconstructions to compare with climate model simulations to determine distinct circulation and climate modes of the past. SHAPE will aim to reconstruct atmospheric and oceanic circulation patterns for several critical periods in the Late Quaternary (including 32 ka, 21 ka, 6 ka) to improve our understanding of Southern Hemisphere climate and environmental changes. These reconstructions will be compared to the PMIP3 (Paleoclimate Modelling Intercomparison Project) and CMIP5 multi-model ensemble for these same time periods and a transient simulation for the last 8 ka. Integration with climate model simulations will also help us to formulate new hypotheses about triggers of climate change, climate dynamics, and mechanisms of inter-hemispheric climate teleconnections.

We encourage you to attend the SHAPE meetings and workshops over the next few years. SHAPE welcomes participation from early career researchers as well as established Quaternary scientists. There is a small amount of financial support for early career researchers to attend the SHAPE meetings listed below.

- At Geosciences New Zealand Conference in November 2013, there will be a geochronology session covering the last 50 ka.
- The INQUA-ECR meeting in Wollongong, Australia, in December 2013 will allow young researchers to present their work from specific regions. SHAPE will support this by providing travel support, mentoring in authorship of publications, and training on tools and model use within a SHAPE session.
- AQUA in Mildura in July 2014 will be a joint meeting with CELL-50K.

Training will be a key SHAPE activity. It will focus on using new tools designed for palaeoclimate research. We will utilise the Past Interpretation of Climate Tool (PICT), currently under development to generate targets for Southern Hemisphere circulation patterns based on Australasian data, and other areas of the Southern Hemisphere, to assist in interpreting hydroclimatic and circulation conditions linked to a wide array of climate drivers. Proxy reconstructions and understanding of local responses to circulation changes will also help improve the interpretation of proxy data.

Expertise and assembly of proxy data for different subregions of the Southern Hemisphere will be underpinned by existing and new INTIMATE 'groups'. The work within each subregion, much like in the previous AUS-INTIMATE project, will be coordinated by steering committee members who will also be responsible for the exchange of information during hemisphere-wide integrations.

As with INTIMATE, we encourage you all to participate in this new project. Please contact Andrew Lorrey (a.lorrey@niwa.co.nz) or Steven Phipps (s.phipps@unsw.edu.au) for further details about SHAPE and how you can get involved.

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THOMAS RONALD PATON

(12 November 1929 – 3 December 2012)

Martin Williams^a and Paul Hesse^b

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Associate Professor Ron Paton, who died recently aged 83, was an inspired teacher and an original thinker whose ideas continue to resonate. He is best known internationally for his three ground-breaking books: 'The Formation of Soil Material' (1978), 'Perspectives on a Dynamic Earth' (1986) and 'Soils: A new global view' (1995), the latter volume jointly with his former postgraduates Dr Geoff Humphreys and Dr Peter Mitchell. Stemming from his strong background in geology and soil science, he had an uncanny ability to discern where others had failed to observe and understand the interactions between geomorphic processes, biological activity and geological context in the formation of Australian soils and landscapes. He was an energetic proponent of field-based teaching and his iconoclastic approach provoked, enthused and stimulated some brilliant Honours and postgraduate students in the School of Earth Sciences at Macquarie University in Sydney during the 20 years he taught there between 1970 and 1982, and again from 1987 until his retirement in 1995.

Ron graduated with First Class Honours in geology from Durham University in 1951, studied soil science at Oxford as a postgraduate with Professor E.W. Russell, while attached to the New Zealand Soil Survey (1951-53), and a decade later completed a MSc in agriculture at Durham University (1962). During 1953-59, he was Senior Research Officer with the Colonial Research Service attached to the North Borneo (Sabah) Agricultural Department. He became Assistant Director of the Inter-African Pedological Service based in the former Belgian Congo (1959-61), gaining an impressive first hand knowledge of tropical soils and land use. During 1961-66, he was Research Scientist with the CSIRO Division of Soils in Queensland, at a time when Australia led the world in field-based soil science. He moved to the University of Sussex in 1966, becoming Reader and Chairman of Geography, and returned to Australia in 1970, joining the youthfully exuberant School of Earth Sciences at Macquarie University, where he taught until 1982. Perhaps his finest teaching contribution was the first year undergraduate course Planet Earth, which

attracted up to 500 students, many from outside the earth sciences, and became the impetus for his 1986 book 'Perspectives on a Dynamic Earth'. This course demanded input from many of his colleagues, and was centred upon intensive teaching of small tutorial groups – very stimulating for all of us and very labour intensive!

The hot wet tropics continued to exert their siren call. During 1982-87, Ron was seconded as Professorial Fellow from the Department of Agriculture, University of Queensland, in order to be Project Leader of the visionary Thai-Australian Project at Prince of Songkla University (PSU) in Haityia, Thailand. The primary aim of the PSU Project was to develop in an integrated way the physical and human capacities for teaching and research within the Faculty of Natural Resources. The adjective 'integrated' was always an important part of Ron's thinking and vocabulary.

Ron returned to Macquarie University in 1987 and continued to teach until his retirement in 1995, when he was 65. During these years, he worked on 'the book' (always pronounced to rhyme with boot), 'Soils: A new global view', with Geoff Humphreys and Peter Mitchell. The idea of the book had been in gestation for at least a decade and the completion of the manuscript in 1994 was something of a statement to the pedological community at the end of his career. The book incorporates aspects of geology, tectonics, Quaternary history, geomorphology and biology into traditional pedology, which Ron saw as moribund and stultified by lack of engagement with these other branches of science. The book was rewarded with the Grove Karl Gilbert Award by the Association of American Geographers in 1999.

After his retirement, a little slowed by his health, he continued to write with Geoff Humphreys until 2007. Geoff's premature death that year saddened all who knew him, and deprived Ron of the intellectual stimulus on which he thrived. He put away his pen. He is survived by his wife Eleanor, son Jim, daughters Anna and Helen, six grandchildren and three great grandchildren.

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Australia's fossil heritage: a catalogue of important Australian fossil sites by the Australian Heritage Council

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reviewed by Jillian Garvey^a

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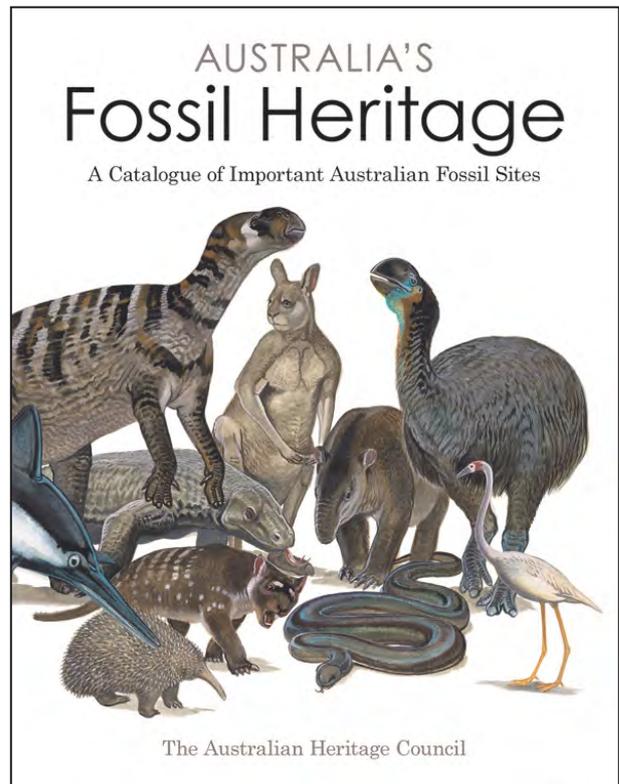
In 2004, the Australian Heritage Council developed The National Heritage List to identify sites of outstanding cultural and natural heritage value. To increase the number of fossil localities listed for their natural heritage value, the Australian Heritage Council is presently developing a framework to better assess these sites for nomination. This book developed from part of that process.

To help facilitate such a list, palaeontologists from each of Australia's state and territory museums were asked to identify ten sites from their region, and three outstanding sites from across Australia, for comparison. These included a broad range of 78 sites representing a diversity of fossil types, including terrestrial and aquatic vertebrates, plant material, and ichno or trace fossils.

For each site, several attributes were included. These included aspects that one would expect, such as scientific importance and research potential; fossil significance; taphonomy and site condition; comparison with other sites; and key references. Additional criteria that were fairly unusual were requests for palaeontologists to comment on the stories and dioramic potential of the locality. These reports were then edited to help account for the various interpretations of the guidelines and combined to form this publication.

The book's introduction highlights the need to remember that an important distinction needs to be made between those sites that are important from a heritage versus future scientific value, with the former having already contributed greatly to our understanding of past biota and ecology. The latter includes sites that provide scope for future research potential. And although this book was published in 2012, this list was compiled between 2006 and 2007, meaning prominent new localities may be absent.

The volume is divided into the various state and territories, with a small map of the particular region with its sites on the first page of each section. The description



of each site includes several categories: an overview; scientific and research potential; fossil significance; taphonomy and condition of the site/fossils; comparison with similar sites in Australia; and stories. Whilst these headings are provided for each locality, there is a large discrepancy in the detail and information provided, some of which is likely to reflect the information available and personal interpretation. Many of the entries are accompanied by photos of either the locality or fossil material.

One of the main highlights of the volume is the seven wonderful and extremely detailed, interpretative, reconstructive colour double page and front cover paintings by renowned wildlife and palaeoartist Peter Schouten. They provide a wonderful interpretation of how some of the sites may have looked in the past, allowing the reader to appreciate the wide diversity of fossil sites that we have in Australia.

There are 78 separate entries representing vertebrate, ichnofossils (trace fossils) and plant fossil localities across mainland Australia and Tasmania. In some cases, several localities have been combined to represent a single entry, or the entry describes fossils from several areas of an expansive outcrop or fossil provenance, such as the ichnofossils from the Late Ordovician Tumlagooda Sandstone, Kalbarri and Murchison River Gorge areas in Western Australia.

Many of the sites that have been included in this catalogue are important from a taxonomic perspective, while some assist in worldwide geological age correlation and the distribution of faunal zones. Numerous localities also provide significant information regarding palaeoenvironment and palaeoecological reconstruction.

Included in this volume are many well known Australian sites including: the highly contentious Late Pleistocene megafauna and archaeological site of Cuddie Springs in western New South Wales; the first new 'golden spike' or new period division in the geological time scale for 122 years and the first for the Southern Hemisphere, the Ediacaran site in the Flinders Ranges, South Australia; the Middle Devonian marine Gogo fauna from Fitzroy Crossing in Western Australia; the opalised vertebrate fossils from the Early Cretaceous of Lightning Ridge, New South Wales; the Late Cretaceous Lark Quarry dinosaur stampede footprints from Winton, Queensland; the Late Cretaceous dinosaurs and mammals from the Dinosaur Cove and Flat Rocks in Victoria; and Australia's two World Heritage-listed fossil localities of Riversleigh in Queensland and the Naracoorte Caves in South Australia.

Lesser publicly known localities that are discussed include many that are unique or significant on a national or international level, such as: the Early Jurassic Lune River plant fossils from Tasmania; the Early Cambrian Emu Bay Shale fauna from Kangaroo Island, South Australia; the Early Triassic amphibian and fish fossil site from The Crater at Rewan in Queensland; and Mira Marl, Giralia Anticline in Western Australia, which is significant as it is the only place in Australia where the K/T boundary or the end of the Cretaceous mass extinction event (which included the dinosaurs) is exposed.

The catalogue highlights the broad range and wide diversity of fossil sites in Australia. Examples of such sites include: Green Waterhole Cave in South Australia's Mt Gambier region, where people must dive 15 metres below the surface to collect Pleistocene mammals and birds, and the Darwin meteorite crater in western Tasmania, which was the result of a

meteorite impact approximately 816 000 years ago that spread fragments of melted rock or 'Darwin glass' across an area of 400 kilometres.

Also included are sites that are under threat, such as the vertebrate material from the Early Palaeogene (Palaeocene-Eocene) of the Redbank Plains Formation on the outskirts of western Brisbane, which is being impacted by urban development. Here the local council has reserved a small pocket of the outcrop for a proposed conservation area. Another site included in the catalogue that has suffered vandalism is the Cretaceous dinosaur trackways in the Broome Sandstone. Here, in 1996, a footprint belonging to a carnivorous dinosaur was stolen from the coastline.

The weakest section is the 'Taphonomy and condition of the site/fossils'. This is rather a peculiar subheading in itself. Shortening it to the 'Taphonomy of the site/fossils' would be more appropriate. More information, where it is available of course, on the taphonomic or depositional history of the material would be beneficial. For example, whether the assemblage was the result of mass death, slow pit fall accumulation or natural death, and is autochthonous (died where it was found) or allochthonous (died elsewhere and was transported after death) would greatly help. Perhaps the scant amount of information provided highlights the lack of taphonomic research in Australia. If so, then this needs to be addressed in the relevant 'Scientific importance and research potential' section.

My main criticism of the book is that I would have liked a specific section on the research history of the site including its discovery, who initially excavated and worked on the material, as well as any subsequent research including PhD theses. Although it is possible to extrapolate such information from the references, a dedicated section would be very beneficial. Some contributors included this information; the entry on the Mount Howitt Devonian fossil fish site in Victoria and the Belmont Insect Beds in NSW are excellent examples. I further believe that including the relevant references at the end of either each individual site or at the end of each chapter would help narrow down the search for specific references. Otherwise, you need to work your way through the more than 30 pages of references and suggestions of further reading at the back.

Another beneficial addition would have been a section on the palaeoecology of the site. This would have provided important information concerning the possible palaeoenvironment at the time of deposition. This information could have either have been included in a separate section or combined with the taphonomy information.

It would have been helpful also if a map of Australia with the relevant sites indicated, as well as a key to the fossil type (vertebrate, plant or trace), was provided at the start of the book. The relevant geological age could also be incorporated. This would provide an excellent overview of the distribution of assemblages. Although such information can be gleaned from the Appendices, having this information at the beginning would greatly enhance the user friendliness of the book. Likewise, making the geological age and fossil site type easily identifiable on the contents page would also be advantageous. It would have been useful as well to indicate which sites have already been included on the National Heritage List, and when this occurred.

Besides the sites that have been deemed important enough to be included in this volume, it would be advantageous for the editors to have included a table of the other fossil localities in each state and territory, including their geological age and fossil type such as: the Triassic Blina Shale from Western Australia; the megafauna sites of Mowbray Swamp and Titan's Shelter in Tasmania and Lancefield in Victoria; the Early Carboniferous fish and inchofauna from Mansfield in Victoria; and the Devonian fish fauna from Eden in New South Wales.

Despite some of these shortcomings, the book is a simple and succinct introduction to those wanting a concise catalogue of Australia's important fossil sites. It is well presented with appropriate photos and illustrations to accompany the text. It is nice to see a book that not only includes well publicised and researched vertebrate localities, but also some of the lesser known vertebrate, plant and ichnofossil sites. Hopefully, scientists may be inspired to undertake new research at some of these places which have been somewhat neglected. Perfect examples would be the Devonian-aged Canowindra fossil fish site in New South Wales and the similar-aged Genoa River tetrapod footprint site in Victoria. It can only be hoped that the research behind the production of this catalogue means that more of these sites will soon be included on the Australian National Heritage List.

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Thesis abstracts

Dryland channel forms and processes: a whole catchment scale study of the Diamantina River, central Australia

Peter René Brunner (PhD)

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This thesis investigates dryland channel forms and processes along the Diamantina River, central Australia, at the catchment scale, an area of study that has received limited attention. It focuses on comparing morphological and hydrological characteristics associated with the dominant channel forms. The study utilised detailed field surveys to analysis of remotely sensed data. Approaches included empirical data collection through to computational modelling. The dominant channel forms were found to be contained within an inner floodplain (IFP), bounded by a non-channelized outer floodplain (OFP). Significant variations in sediment size and degree of mud aggregates were found between the channel forms. For all channel forms, downstream changes in bed sediment size were similar,

while cross-sectional geometry was found to be highly variable. For the Diamantina River, the anastomosing and meandering channels occupy more than 62% (by area) of the IFP at bankfull, the braided channel sections (17%); anabranches (13%); gully channels (5%) and inter-channel rill sections (3%). The braided channels were found not to fit criteria typically found for braided channels in other environments. Comparison of field survey and remotely sensed data demonstrated the untapped potential of SRTM data to investigate dryland channel forms. Use of HEC-RAS to analyse variations in flow transmission capacity highlighted that hydrology and hydraulics has a large influence on dryland channel forms.

CO₂ fluctuations in two Wombeyan caves and implications for speleothem growth

Lydia Belford (Honours)

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This study examines cave CO₂ values, distribution and the possible impacts on calcite deposition and growth in two caves in the Wombeyan Karst Conservation Reserve, south eastern N.S.W. Wombeyan cave CO₂ concentrations can be linked to the seasonal external temperatures which drive cave ventilation due to internal/external CO₂ concentration gradients. Secondly the spatial, distribution of CO_{2,cave} is intrinsically linked to the cave architecture and only can be demonstrated to increase systematically with distance from the entrance when the cave is a simple collapsed chamber with no constrictions. This study has highlighted the need for more research in this area and shown that sites in the Wombeyan Karst can provide the basis for future research.

Three dripwaters deposited in similar cave atmospheric conditions with differing seepage patterns and discharge characteristics were shown to produce calcite with greatly differing calcite fabrics. In conjunction with high frequency CO₂ monitoring it is recommended that dripwater analyses include δ¹³C and saturation indices analyses to help quantify calcite growth.

Anthropogenic impacts on cave CO₂ have been demonstrated during high visitation periods and are worth monitoring, especially when CO₂ base levels are seasonally elevated. The continuous CO₂ monitoring prior to, during and post high tourist visitation levels is seen to be important and deserves more intensive monitoring.

Late Holocene channel adjustment and discontinuity in the lower Macquarie River, central New South Wales

Zacchary Larkin (Honours)

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Downstream declines in discharge and stream power are inherent features of many Australian lowland rivers that experience channel breakdown and floodplain wetlands on their lower reaches. The Macquarie Marshes are an alluvial system of anastomosing and discontinuous channels with wetlands on the lower Macquarie River. While contemporary processes of avulsion in the system are relatively well understood, this research investigated mechanisms of channel discontinuity (i.e. channel breakdown and reformation) and channel adjustment in the southern Macquarie Marshes which have not been studied in detail in this type of system. Morphometric analysis of discontinuous reaches of the Macquarie River using digital terrain data derived from a light detection and ranging (LiDAR) survey was coupled with sedimentological analysis and optically stimulated luminescence (OSL) dating of a Late Holocene meander cut-off to determine the characteristics and timing of channel adjustment. Sinuosity declined from 1.6 to 1.28, channel depth declined from 2.49 m to 1.55 m downstream, and cross sectional area declined to <10 m² in the breakdown zone of each reach. Channel reformation occurs where floodplain gradients allow small tributaries to converge, increasing local stream power and

eventually reforming the trunk stream. Sediment deposited in the breakdown zone of each reach forms a lobe-shaped splay with a steepened downstream end, which can instigate knickpoint retreat and reconnection of reaches of the river. The mechanisms of channel discontinuity are controlled by intrinsic feedbacks and threshold exceedance. Evidence of a shift in the style of channel adjustment in the southern Marshes has also been observed. Levees that have developed over the top of ridge and swale, point bar topography, indicate a significant decline of lateral migration and a dominance of vertical accretion and associated periodic avulsion (i.e. a lower energy system). The cut-off was actively meandering and depositing bedload point bar deposits 0.989 ± 0.137 ka, before being overlain by progressively fining sediments as the process of cut-off abandonment progressed. This indicates that the shift to a lower energy system has occurred within the last ~1000 years and is unrelated to European settlement and disturbance in the catchment. The geomorphic model of Late Holocene evolution developed in this research may be applicable to other similar fluvial systems in dryland–lowland settings.

Sediment source contributions and downstream mixing in a rural catchment, Coolbaggie Creek, New South Wales

Adam Wethered (Honours)

School of Environmental Sciences, Macquarie University, Australia

Widespread land clearance and disturbance in Australian river catchments have led to an increase in sediment availability, mobilisation and delivery to tributary and trunk stream channels. Sediment supplied by major tributaries to the lower Macquarie River, in central New South Wales, is a critical factor for geomorphology and ecosystem health in the river and its floodplain wetlands. However, historical suspended sediment gauging data is rare and the little that is available shows consistently high turbidity levels in Coolbaggie Creek, the last major tributary in the catchment. This research investigated contemporary sediment sources and downstream sediment mixing in Coolbaggie Creek in order to understand the importance of catchment source types and connectivity on sediment dynamics. Fallout radionuclides (^{137}Cs and $^{210}\text{Pb}_{\text{ex}}$) and geochemical properties (e.g. manganese and sulphur) were used to characterise and trace key sediment source types in the system. Representative samples were taken of surface soils from various land use units across the catchment (e.g. forested and cleared surface sites), as well as sediment from sub-surface sources (e.g. channel banks and gullies). Fine-grained deposited sediment from reaches of Coolbaggie Creek was also sampled to enable proportional contributions of the source types to be determined with a mathematical mixing model.

Radionuclides were able to clearly discriminate between forested surface (^{137}Cs 11.28 ± 0.75 Bq/kg; $^{210}\text{Pb}_{\text{ex}}$ 181.87 ± 20.00 Bq/kg), cleared surface (^{137}Cs 3.21 ± 0.26 Bq/kg; $^{210}\text{Pb}_{\text{ex}}$ 29.59 ± 10.94 Bq/

kg) and sub-surface (^{137}Cs 1.45 ± 0.47 Bq/kg; $^{210}\text{Pb}_{\text{ex}}$ 4.67 ± 1.93 Bq/kg) sediment sources. Downstream hydrogeomorphic trends, radionuclide concentrations and mixing model results indicate that a rapid shift in dominant sediment source type occurs in the upper reaches of Coolbaggie Creek. Cleared surface areas account for 95% of fine sediment entering the channel in the uppermost reach, however, for the remaining ~50 km of the river, sub-surface (i.e. gully and bank) sediment accounts for 90 to 100% of sediment entering and being transported in the system. This shift in dominant source material coincided with a significant increase in channel cross-sectional area (from ~20 to >200 m²), highlighting the role of channel expansion and gullies in contributing sub-surface sediment to the system, and a lack of surface sediment supply to the channel. This also indicates a lack of lateral connectivity between topsoil and the trunk stream channel in all but the uppermost parts of the catchment. The significant enlargement and entrenchment of the channel downstream has also resulted in lateral disconnection between the channel and floodplain, while coarse sediment transfer is impeded by a sediment slug in the lower reaches. Altogether, these findings are important because they highlight the dominant source of suspended sediment entering the lower reaches of the Macquarie River from Coolbaggie Creek and have implications for water and land management. Gully and bank erosion control will help reduce the excess sediment supply and land degradation within the Coolbaggie Creek catchment.

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