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Quaternary Australasia

The Newsletter of the Australasian Quaternary Association

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Material for the next issue should reach the editor by **30th April 1999 (papers)** and **30th May 199 (other)**.

The **Australasian Quaternary Association (AQUA)** is an informal grouping of people interested in the manifold phenomena of the Quaternary. It seeks to encourage research by younger workers in particular, to promote scientific communication between Australia and New Zealand, and to inform members of current research and publications. It holds biennial meetings and publishes the journal *Quaternary Australasia* twice a year. *Quaternary Australasia* is edited by Kate Harle. The annual subscription is $A20 or $10 for students, unemployed or retired persons. President is Dr Paul Hesse, School of Earth Sciences, Macquarie University. An application form for membership can be obtained from Dr Geoff Hope (address and contact details below). Members joining after September gain membership for the following year. Existing members will be sent a reminder in December.

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Outgoing President
Ian Thomas

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Adelaide - Vic Gostin & Peter Gell
James Cook - any volunteers?
La Trobe - Bert Roberts
Macquarie - Paul Hesse & Damian Gore
Melbourne - Ian Thomas & Christine Kenyon
Monash - Patrick Moss
Newcastle - Stuart Pearson
New England - Bob Haworth
New South Wales - Scott Mooney
South Pacific - Marie Ferland
Sydney - Stephen Gale
Tasmania - Leanne Armand?
Western Australia - Liz Pickett?
Wollongong - Maria Coleman

New Zealand: Jamie Schulmeister

General: Colin Murray-Wallace, Bill Boyd, Peter Kershaw

The campus representatives were nominated at Fraser Islande principally to transfer information to/from local members. Institutions not represented can contact Paul Hesse to be included. Individuals who don't want to be included can contact Paul Hesse to be removed from the list by nominating someone else.

Cover Illustration - Strangler Fig, Fraser Island drawn by Vic Gostin during the 1998 AQUA meeting

Editorial

A Summer Solstice miracle

Firstly, I must apologise to you all for the tardiness of this issue. I can only plead extreme preoccupation with a two volume purple tome which is now, at LONG LAST, handed in!! Yes folks, dubbed by some rather rude individuals at Monash the "Christmas Miracle", my thesis has finally been submitted! Eight and a half years and several calamitous incidences after I first peered down the microscope at Lake Wangoom mud, I finally managed to wrench my fingers off the keyboard, stop tinkering and hit the print button! Of course, the only way to celebrate this event was to fly down to Melbourne, pour myself a glass of fine red and toss someone into Kershaw's pool. Thankyou, Dr D'Costa, for obliging! Thankyou Dr Brown, for so ably assisting and thankyou Peter for the musical accompaniment, which I will not forget and will one day pay back in kind!

Anyway, enough of that. On with the issue – which I will henceforth think of as being fashionably late.

There are two papers in this issue, both by students. One of these, by Matthew Cupper, is a refereed version of an award winning paper he gave at the 1998 AQUA meeting. Congratulations Matthew! It is on Casuarinaceae/ Chenopodiaceae pollen ratios and soil salinisation in the Murray - Darling Basin. The other is a review written by Helen McGregor and her supervisor Mike Gagan. It links with a research report they wrote on new research into the Western Pacific warm pool using coralline palaeoclimatic records.

Also in this issue are various bits of Quaternary news, including some good news on journal subscriptions, a report on the status of the Quaternary database by Tim Barrows (the IT editor) and Geoff Hunt, new publications (not many people have sent me their lists!), another excellent report by Geoff on the last AQUA meeting (with photos by Maureen Longmore) and of course, Paul's presidential words. Also in this issue, is a report by Albert Goede on the demise of Quaternary studies at Hobart.

Well that is it from me on this issue. Once again, my apologies for the tardiness!
I look forward to your input to the next issue (see front cover for deadlines).

Kate Harle
Editor

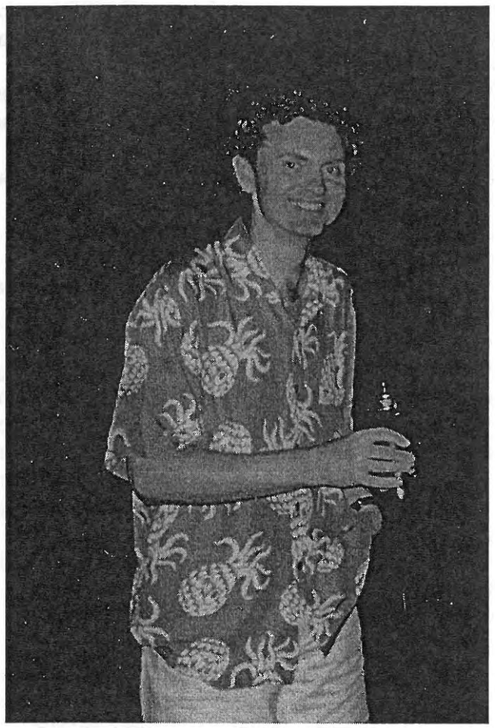
AQUA Early Subscription Prize

Christine is tearing her hair out over late subscriptions which trickle in throughout the year. In an attempt to encourage you all to get your membership subscriptions in early, AQUA is offering an encouragement prize. Those who pay their 1999 subscription within 6 weeks of the due date will be placed in a draw for a book voucher from their nominated store - $50.00 if a full member or $25.00 if a concession member.

So get you subscriptions in EARLY!!

We're back!

Back again for another stint in the AQUA equivalent of the Oval Office. Along with Chris Kenyon as treasurer, Geoff Hope as membership secretary and Kate Harle as editor of QA, the new position of conference secretary was filled by Simon Haberle to complete the front bench.



Clearly this news says something about the mood of the AQUA conference at Fraser Island that the attendees were sufficiently relaxed to give us the chance to do it all again. Despite the cursing and confusion which preceded the conference (on my part) the event itself went smoothly and without undue trouble. Perhaps the projection facilities were primitive, but that is also a tradition of AQUA conferences. Under the cramped and steamy conditions an attentive audience were treated to a program of very high quality presentations, especially those of the student participants. Of course the point of going to Fraser Island was to see the island, its geomorphology and ecology and the palaeoecological sites. Maureen Longmore, with the assistance of Bill Ward, took the group on a tour of several of her sites. One can only marvel at her fortitude in continuing to work under such tough field conditions, being forced to work in isolated lakes surrounded by lush vegetation off the tourist paths.

After some toing and froing before, during and after the meeting, the next AQUA conference will be held in Victoria in February 2001. Dates and venues will be advised early next year but you can pencil it in your new millennial planners now especially in this year of the INQUA conference. In fact, consider it your duty!

The other major decision of the AGM was to vote for incorporation of AQUA. This step has some legal implications (safeguards) for the office holders of the association and the only significant expense should be in the auditing of the accounts. We hope that it will not at all change the way in which AQUA operates.

In this issue there is an announcement of the Postgraduate Student Travel Prize for 1999. The response to this offer of free money last year was disappointing. I hope that all postgraduate students will consider applying for this prize,

Yours Quaternarily

Paul Hesse

Forthcoming conferences & meetings

General events

INQUA, XV International Congress, "The Environmental Background to Hominid Evolution in Africa",
(3-11 August 1999)
Durban, South Africa
Contact: Conference Secretariat
Conference Africa
PO Box 1722
Parklands, 2121
Johannesburg, South Africa
Ph: +27-11-447-8143
email: cafrica@iafrica.com
website: http://inqua.nlh.no/congress/congress.html

27th Annual Conference of the Australian Map Circle, "Mapping a Path Across the Mellennia"
(5-8 April 1999)
Uni Queensland & Dept Natural Resources, Queensland.
Contact: Richard Miller
e-mail: L.Isdale@ uq.net.au
web: http://www.lib.unimelb.edu.au/collections/maps/amc.htm

Joint Conference of NZ Geographical Society and Institute of Australian Geographers: "2001 – A Spatial Odyssey"
(30 Jan - 2 Feb, 2001)
Univ Otago, Dunedin NZ.
e-mail: geography@otago.ac.nz

Archaeology

32nd Annual Chacmool Conference. "Indigenous People and Archaeology: Honouring the Past, Discussing the Present, Building for the Future"
(11-14 November 1999)
Calgary, Alberta, Canada.
Contact: 1999 Chacmool Conference,
Department of Archaeology,
University of Calgary, Calgary, Alberta,
T2N 1N4, Canada.
Ph: (403) 220-7120
e-mail: chacmool@ucalgary.ca
Website: http://www.ucalgary.ca/UofC/faculties/SS/ARKY/chacmool.html

`Continental shelves in the Quaternary' 4th Annual Conference
International Geological Correlation Programme (IGCP) Project No. 396

(28 July - 2 August 1999)

University of Capetown, Capetown, South Africa

We are pleased to announce the fourth annual conference of IGCP 396 in CapeTown, South Africa. It will consist of oral and poster paper sessions, two full-day field excursions, various business meetings and a half-day workshop. The timing will allow delegates to proceed immediately after closure to attend the 15th INQUA Congress in Durban. IGCP 396 is a 5-year project currently in its third year. This is the fourth annual conference following Sydney in 1996, Durham in 1997 and Goa in 1998. Topics to be covered -

Geochemistry of sediments
Global and regional perspectives
Palaeoceanography
Marine geotechnics
Dating shelf sequences and land-sea correlation
Non-living resources
Seismic stratigraphy
Modelling
Shelf processes
Record of coral reefs
Record of continental palaeohydrology
Migration of flora and fauna
Environmental management of marine mining

Contact: Associate Professor Mike Meadows
Department of Environmental and Geographical Science,
University of Cape Town,
Rondebosch 7701, South Africa.
Ph: (27) 21 650 2873
Fax: (27) 21 650 3791
e-mail: meadows@enviro.uct.ac.za
website: http://www2.env.uea.ac.uk/gmmc/igcp/goa/igcp98.html

Geochronology

Australian Institute of Nuclear Science & Engineering and Australian Nuclear Science & Technology Organsiation

2nd QUATERNARY DATING WORKSHOP

AINSE Theatre, Lucas Heights, Sydney
Thursday 8 & Friday 9 April 1999

Workshop topics include:

Pb-210 & Cs-137 dating
Optical stimulated luminescence
Stable isotopes
TIMS U-series dating
AMS/C-14 chemistry
AMS/Be-10 dating
Dating of hominids using ESR and U-series
Thermoluminescence-dating
Amino acid racemisation
U/Th dating
AMS measurement techniques
C-14 in soils
C-14/classical & calibration

Invited speakers

Invitations have been extended to a number of speakers who are eminent in their field of interest. These include:
David Price, University of Wollongong
Deba Banerjee, University of Wollongong
Colin Murray-Wallace, University of Wollongong
Malcolm McCulloch, Australian National University
John Head, University of Wollongong
Mike Barbetti, University of Sydney
Rainer Grün, Australian National University

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Registration for the Workshop and payment of the workshop activities fees must be received by AINSE no later than **12 March 1999.**

Workshop activities fees:

Delegates from AINSE member organisations	$50
Delegates from non-AINSE member organisations	$80
Students (subsidised)	$30

The workshop activities fees include: Teas, Workshop dinner 8 April, and the Workshop handbook.

Web site: http://home.ansto.gov.au/ainse/2ndquat.html

The 9th International Conference on Luminescence and Electron Spin Resonance Dating (LED99)
(6-10 September 1999)
Complesso Monumentale del San Michele a Ripa, Rome
Email: b.fersini@flashnet.it
website: http://www.mater.unimi.it/LED99

8th International Conference On Accelerator Mass Spectrometry
(13 - 17 September)
VERA Laboratory, Universitaet Wien, Vienna, Austria.
Contact: Gabriele Kratschmann
Ph: +43 1 40480-700
Fax: +43 1 4076200
e-mail: gabikra@pap.univie.ac.at

Geomorphology

Loessfest '99 - Loess: characterization, stratigraphy, climate and societal significance
(25 March - 1 April 1999)
Bonn and Heidelberg, Germany.
Contact: Prof. Dr. Ludwig Zoeller
e-mail: zoeller@slide.giub.uni-bonn.de
Website: http://org.nlh.no/inqua/commpl/lf2c-ult.html

The 8th International Symposium on the Interactions between Sediments and Water
(13-17 September 1999)
Beijing, China
Contact: Prof. Jingsheng CHEN
Dept of Urban & Environmental Sciences
Peking University, Beijing, China
Email: jsc@urbanms.urban.pku.edu.cn

International Geographical Union Commission on Land Degradation and Desertification Meeting,
(20-28 September 1999)
Perth, WA,
Contact: A/Prof Arthur Conacher
Dept of Geography
University of Western Australia
Nedlands, WA 6907
Ph: 08 9380 2705
email: ajconach@gis.uwa.edu.au

4th Australian Regolith Conference Regolith '99 – Regolith understanding for Industry, CRCLEME
(21 - 24 November 1999)
Adelaide SA
Contact: Aust Convention & Travel Services, Canberra.

8th International Symposium on Landslides
(26 - 30 June 2000)
Cardiff School of Engineering, Cardiff, Wales.
e-mail: SummersC@Cardiff.ac.uk
website: http://www.king.ac.uk/~ce_s011/isl8-000.htm

5th International Conference on Geomorphology
(23 - 28 Augus 2001)
International Association of Geomorphologists
Chuo University, Tokyo, Japan.
e-mail: 5icg@aptech.co.jp
website: http://wwwsoc.nacsis.ac.jp/jgu/

Micro and Macro Fossils

Second International Limno-Geology Conference
(25 - 29 May 1999)
Brest, France
Contact: Jean-Jacques Tiercelin,
Directeur de Recherche au CNRS,
UMR 6538
"Domaines Oceaniques",
CNRS URA 1278, Groupe Riftogenese Est-Afrique, Universite de Bretagne Occidentale, Departement des Sciences de la Terre, 6, Av Le Gorgeu, 29285 Brest - France,
Ph: 33 (0)298 49 87 59
e-mail: tiercelin@univ-brest.fr
Website: http://www-sdt.univ-brest.fr/~lenn

10th International Palynological Congress (IPC)
(24-30 June 2000)
Nanjing, China.
Contact: Secretary of the Organizing Committee for 10th International Palynological Conference,
Nanjing Institute of Geology and Palaeontology, Academia Sinica,
39 East Beijing Road, Nanjing, 210008,
People's Republic of China
website: http://geo.arizona.edu/palynology/ifps.html

Sixth Quadrennial Conference of the International Organization of Paleobotany (IOPC IV - 2000)
(30 July - 3 August 2000)
Qinhuangdao, Hebei, China.
Contact: Prof. Lujun Liu,
Secretary-General of IOPC-VI Organising Committee, Nanjing Institute of Geology and Palaentology, Academia Sinica, 39 East Beijing Road, Nanjing 210008, PR China,
Ph: +86-25-6637 208
Fax: +86-25-3357 026
e-mail: paleobot@public1.ptt.js.cn

Oceanography

4th International Conference on Asian Marine Geology "Asian Marine Geology in the 21st Century"
(10 - 14 October 1999)
Institute of Oceanology, Chinese Academy of Sciences, and others, Qingdao, China.
e-mail: zhujc@ms.qdio.ac.cn

Stable Isotopes

A forum on: Isotopes in Palaeoclimate Research
(28 April 1999)
Leicester University in association with the NERC Isotope Geosciences Laboratory (British Geological Survey)
contact: Melanie Leng
NERC Isotope Geosciences Laboratory, British Geological Survey, Keyworth, Nottingham. NG12 5GG UK.
e-mail: m.leng@nigl.nerc.ac.uk
website: http://qra.org.uk/NERC%20isotope.htm

CAVEPS 99

Conference on Australasian Vertebrate Evolution, Palaeontology and Systematics
6 - 7 April 1999
and
SYMPOSIUM
on Palaeontology, biogeography and Evolution of Rodents of Australia and South-East Asia
8- 10 April 1999

will be held at The University of New South Wales

Details: M.L. Augee, Biological Science, UNSW, Sydney NSW 2052
Or see the Website: http://bioscience.babs.unsw.edu.au/CAVEPS/homepage.htm

The 1998 Biennial conference at Fraser Island

by Geoff Hunt

Archaeology and Natural History,
RSPAS
Australian National University
Canberra, ACT 0200
Australia

Time for another AQUA meeting and about 35 Quaternarists headed for the east coast and Fraser Island. Here a number of people including Bill Ward and Maureen Longmore have spent many years in fieldwork looking at the dunes, soils and lakes. It seemed a hard task to match the standard of the Lake Eyre trip (QA vol. 15(2)) but it proved to be another excellent conference.

The meeting was held over four days with a single day field trip on the second and was followed by a two day trip up to the north end of the island. Sessions were thematically arranged and the standard of presentations uniformly high. The long lunch break and early close allowed time for relaxation, exploration or individual discussion. In overview the conference highlighted the continuing problems of gaining adequate chronological control for sites, the need to be very careful in correlating environmental changes to particular (global) events and the rise in the use of delta13C and other chemical signals to extract environmental conditions. The use of multiple techniques to date sites is already showing its utility with several mentioned showing discrepancies which will require further study.

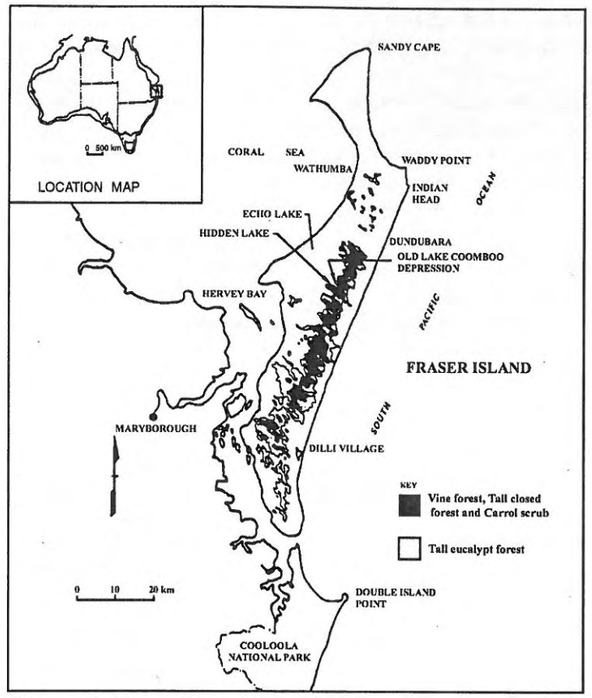


Figure 1: Fraser Island showing forest types and localities (after Longmore, 1997).

The setting was Dilli Village (Fig 1) - cabins, hall/dining area/kitchen complex and camping area run by Queensland National Parks. After a mix up in booking the majority stayed in cabins and only a small number camped out on the grassy bank between the main block and the beach. Inland was the mixed vegetation of the island proper and a foot track allowed access up through to Lake Boomanjin and thence onwards. A blowout could be accessed from the track and it was a worthwhile visit to stand on this large patch of mobile sand amidst the forested dune peaks. The beach was a rather interesting locale, as it constituted the main access way to and from the barge crossing. With a speed limit of 80 km/h and a steady stream of vehicles during daylight hours it did not suggest itself as a peaceful spot to lie in the sun. But just north at the next creek a small pool held waterlilies, which bloomed while the sun shone. All in all a very pleasant spot to spend a week.

Fraser Island - the largest sand island in the world and home to the most genetically pure strain of dingoes. There are plenty of warnings about the 'friendly' nature of the dingoes. Watching Warwick Dyson running along the shore with two attendant companions produced two possible

but opposite impressions; man's best friends or predators looking for a meal. In our short stay there was plenty of evidence as to the pressure of human activity. Bill Ward indicated that there was marked deterioration in the time since he began his fieldwork. New building work is underway in Eurong and Happy Valley to cater for the new generation of visitors looking for greater creature comforts. The eastern beach on a holiday week is not a peaceful secluded location. On the other hand the end of sand mining, listing the island as a world heritage area and the efforts to minimise impact are good first steps. A departure survey suggests that in future there may be days of park closure and restrictions of numbers. All in all Fraser Island forms a small example of the situation facing the rest of Australasia. And it is certainly still easy to find places where the natural beauty of the island remains untouched and unpopulated.

The majority of those attending arrived during Sunday and an informal welcoming pasta dinner was had over the odd wine. A bit moist - the tail end of two months of indifferent weather - but conditions improved for the rest of the stay.

MONDAY

A late start and the first session dealt with human impacts on Australasian environments. Christine Kenyon led off with a pollen record from Lake Nuga Nuga in central Queensland covering the period of European influence. Not much modification noted in the pollen record and unchanged sedimentation rates suggests that material stripped under accelerated erosion is being redeposited close to source. Mark Horrocks provided an account of pollen research on Great Barrier Island near Auckland. This work favours the hypothesis of Late rather than the Early settlement of Polynesians in New Zealand. Kate Harle came next with a display of the long vegetation record that has been extracted from Lake Wangoom and its revised chronology. Kate's work has led her to question the practice of correlation of Australian records to overseas chronologies. Maria Coleman gave a progress report about her chronological and stratigraphic research on the river systems in the dunefields of northeastern South Australia. Before lunch a brief description of posters was provided by the authors or their proxies.

Lunch was pita bread (part of a vast haul which emptied the shelves of Dalby's supermarket) sandwiches and a fruit platter had out on the grass. This became the fashion for those days with seminars. Some then enjoyed a swim in the very convenient swimming hole behind the beach foredune. A large goanna was a common sight clinging to a convenient tree and the pandanus provided an exotic shade. A resident tortoise and numerous small fish could be spied swimming in the dark tannin-stained water.

The afternoon session focussed on Fraser Island and Maureen Longmore gave a description of the palaeoecological record of the island from the long records of the perched lake systems. These waterbodies are only possible due to the aquitard effect of the clay-rich B horizon in the dune soil profile. Maureen has extrapolated from the available chronological data that some may be as old as 600 ka. The sediments and pollen carry a record of progressive desiccation and vegetation change over the last 350 ka. David Wheeler talked of his analysis of the carbon and nitrogen content of a core taken from the Old Lake Coomboo Depression which, along with a sedimentological analysis, provides a record of past climatic conditions. Bill Ward finished the day with a somewhat interrupted account of many years research about the island. His interests are geomorphological and soil based and in this he eventually became interested in the use of pumice as a stratigraphic marker.

That evening we ate roast dinner outside in balmy conditions. A noteworthy astronomical event was underway unnoticed overhead reaching its culmination on the Sunday night. For Jupiter would then pass behind the moon.

TUESDAY

On this day a field trip visited some of the sites of interest on the island. A carefully planned schedule allowed the group to cover a fair amount of ground. The island provides an interesting palaeoecological and palaeoenvironmental record of the last 600 ka. After a run up the east coast on the beach 'highway' we headed inland from Happy Valley for a first stop in the rainforest on the more recent sands. The development of the soil profile through time and the gradual leaching of nutrients depauperates the system till with very deep soils

Hidden Lake, Fraser Island **Photo: M. Longmore**

AQUArites on the banks of Hidden Lake
Photo: M. Longmore

the nutrient layer is so far beneath the surface only a low woodland can exist. The rainforest is found in a narrow strip in the centre of the island (lengthways) running parallel to and inland from the eastern coast (Fig 1). At this spot towering kauri pines (*Agathis robusta*) were interspersed by abundant palms (Piccabeen - *Archontophoenix cunninghamiana*). Also large Satinay trees (*Syncarpia hillii*), brush box (*Lophostemon confertus*) and a noticeable strangler fig presence. Climbing westward onto a higher level we entered Carrol scrub (*Backhousia myrtifolia*). Part of the research Maureen has been involved in has been to determine whether the model of vegetation succession - pioneering communities progressing through to a climax vegetation and thence into regressive forms as soil profiles developed - was valid. We stopped at the research hut above Lake Coomboo for morning tea before walking through a mix of sclerophyll forest and *Banksia* woodland to a site above Hidden Lake (Fig 1). Here a team overseen by Bill Ward had augured down through the soil profile to reveal the change from darker grey upper A1 horizon, white A2 and then orangey to brown B horizon.

Some of the group headed for the enticing water of Hidden Lake after Maureen had finished describing the features of this beautiful spot tucked in the valley with eucalypt forest and rainforest. Misfortune befell Caroline Lehmann whose glasses fell into the lake which, at 8 m deep, thermally stratified, tannin darkened and floored by soft ooze, were then an irrecoverable artefact for future discovery. Lunch back at the hut on a hot sunny afternoon and some took this opportunity for a dip in Lake Coomboo. Next stop was Old Lake Coomboo Depression (Fig 1) which Maureen believes to be as old as 600 ka. It is ephemeral and currently dry with a ringing growth of new trees and

reeds surrounding a grassy flat. A core showed the organic rich ooze (or oozo in the local parlance) comprising the upper sediment. A large beach ridge bounded the northwest end of the depression and the whole Coomboo lakes region was probably at one time a much larger lake. A long drive northwestward brought us to Echo Lake (Fig 1) close to the west coast which at present is a dry depression floored in cracking clays and reeds. This has only been analysed recently and the lake is again thought to be very old. A young fire scar showed the impact of burning on the heath with banksias and grass trees setting forth new green growth.

Back across the width of the island southeastwards led through another patch of rainforest, this with more abundant Araucarian trees (hoop pine - *Araucaria cunninghamii*). A look over the expanse of Knifeblade blowout showed the landforms of mobile sand before we pushed on the last distance to the beach. A few stopped at the wreck of the Maheno apparently responsible for bringing one of Paul Hesse's ancestors across from NZ. Finally we stopped at a good exposure showing a buried soil profile with A1 and A2 horizons now underlying the yellower fresh dune

Knifeblade blowout, Fraser Island **Photo: M. Longmore**

sand. Abundant aboriginal stone tools were scattered over the site.

Dinner that night was Mexican with burritos and a delightful chilli sauce, tomatoes, lettuce and cheese. Being inside we did not notice the continued stealthy convergence overhead.

WEDNESDAY

In the morning Simon Haberle ran a workshop for those interested in PSIMPOLL, a computer application used for pollen data. The first session of talks was on the Australasian tropics and opened by Sander Van Der Kaars. He described a pollen record from a lake in northern Sulawesi and another in west Java which seemed to agree with the former. Apparently the tropical rainforest is not a permanent feature of the Indonesian maritime continent through time, giving way to savannah conditions in the LGM. Simon Haberle reviewed the record of pollen sites in New Guinea and the western Pacific to see if a charcoal record could detect phases of increased burning associated with climatic events such as the El Niño fires of 97-98. A regional pattern was seen which is also correlated with changes in Chile for the last 5 ka. Helen McGregor then provided a talk on the use of coral records, both isotopic and fluorescence, to test a model explaining the West Pacific Warm Pool's temperature maximum of 32C. Finally Allan Chivas described the history and current state of research in the large Gulf of Carpentaria project.

Chief cooks and bottle washers - Dilli Village, Fraser Island
Photo courtesy of M. Longmore

After lunch it was a session on coastal and arid environments. Victor Gostin led with a joint paper (with Alan Brenchley) about a series of lakes in the Robe district and how they provided an interesting environmental story including dating the Holocene sea level rise. Longyin Li continued in a

Two keen meeting participants

similar vein with a study of terraces in Anderson Inlet in east Victoria. Matthew Cupper, in a talk that won him the prize for the best talk by an Hons student, outlined vegetation change in the semiarid western plains of southwest NSW. Some intriguing ideas about the nature of aboriginal and environment interaction. Paul Hesse concluded both the session and his open ended research on whether Australia was windier in the LGM. Apparently not - and this actually conforms to similar findings in other localities.

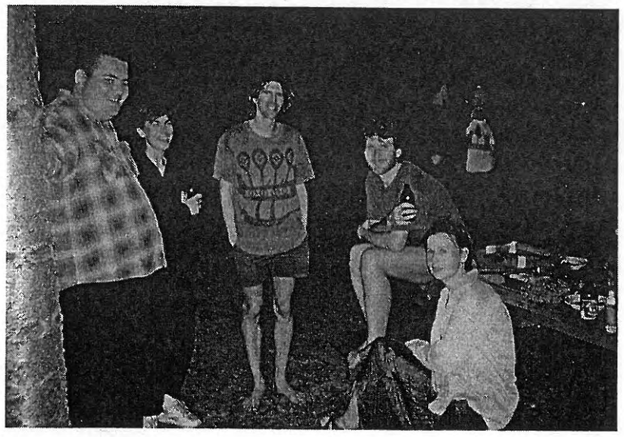
Dinner was a BBQ held outdoors on a balmy night. On the grass a nocturnal thick knee roamed in search of insects. Careful arrangement of the tables was done for aesthetic purposes and then it was time to eat. Overhead the moon was waxing and Jupiter drawing ever nearer.

THURSDAY

The first session on a glorious sunny day was on long-term environmental change. Geoff Hunt led off with a history of the development of the modern estimate for the age of the earth and the influence of key characters from USA in the developing science of geomorphology in Australia. Paul Hesse (for Kerrie Tomkins) described the evolution of drainage systems in the Macquarie valley. A changeover in sedimentation pattern occurs from Pliocene coarse vertically aggrading to Pleistocene fine laterally meandering. Pyramo Marianelli discussed the record of change from his analysis of speleothems from Naracoorte Caves. A 200 ky decline of organic acids from 480 ka is suggested to relate to decline in organic content of the overlying soils.

The middle session was titled 'temperate Australia - the fringe of leaves'. Nick Porch gave an account of beetles and their use in palaeoenvironmental reconstruction. He finished with his PhD research on beetle remains in Spring Ck, western Victoria and Pulbeena Swamp, Tasmania and the preliminary interpretations. Warwick Dyson talked of the issue of modern eucalypt pollen transport. At two sites in Tasmania the expected rapid drop off of Eucalyptus pollen in open terrain at short distance from the edge of woodland was found. Chris Turney talked of an analysis of carbon isotopes in leaves from sites in NZ. A complex procedure enabled the palaeoclimatic conclusion that one site in the North Island showed no significant difference in atmospheric moisture during the LGM while a South Island site was notably more arid. This perhaps related to the steep SST gradient between the sites.

The final session of the conference continued the theme of the previous one and Janelle Stevenson began with a pollen record from two sites in New Caledonia. Records show continual forest cover with no change through the LGM but a fire related disturbance 16-12 ka. This is quite a contrast to the Indonesian record already mentioned. A vegetation change awaited human arrival at around 2-3 ka. Ellyn Cook gave an account of her PhD work at Lakes Bolac and Turangmoroke. Undertaking a combined human and environmental record she already had a preliminary pollen based vegetation record from the LGM to present and a knowledge of the occupation periods. John Hellstrom in the lucky last talk (and



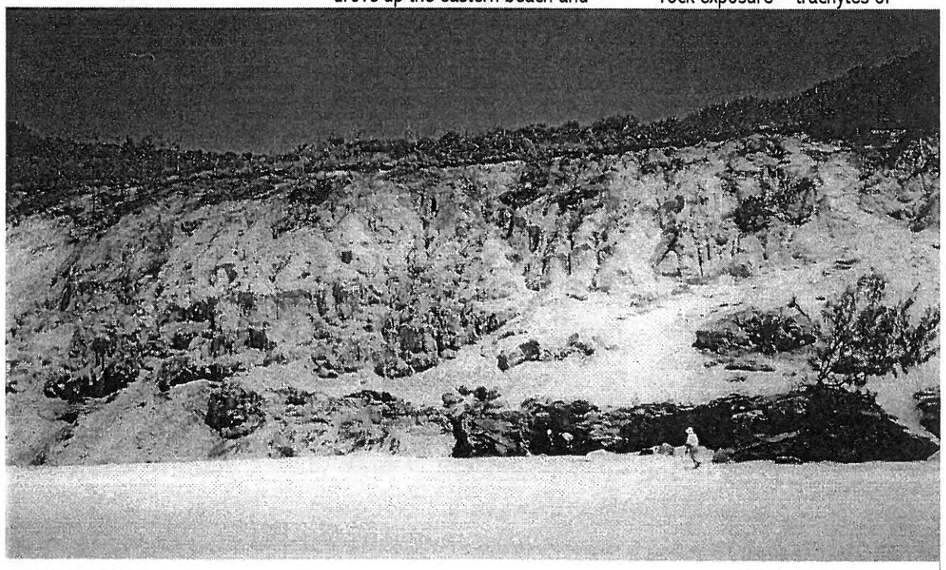
The conference dinner **Photo: M. Longmore**

it was as he won the other student prize for a presentation) reviewed some of the work he had been up to in his recently submitted PhD thesis. Caving under Mt Arthur in northwest Nelson, NZ, he cored flowstones from which a palaeoenvironmental record could be derived in this significantly biodiverse region.

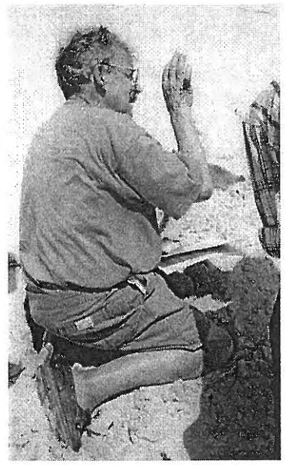
The AGM or perhaps BGM was a cheerful affair helped along by it being the end of the proceedings and free beer. There was little change in the office holders apart from Simon Haberle undertaking the new position of Conference Secretary. Simon gets to organise the next AQUA meeting in an as yet to be finalised locality. A special event was the handing out of Fraser Island College certificates by Bill Ward and Maureen Longmore (members of the College) to all successful graduands. Maureen was then awarded a higher degree. A motion proposing incorporation of AQUA was passed by the members.

We all trouped outside for the group photograph and an unlucky neighbour was soon festooned by over half a dozen cameras. Drinks were held in the open before setting down to a meal in which Gill Atkin and Kay Dancey had outdone all previous efforts. Three curries, rice and salads preceded the big finale of tiramisu (thanks to the 'new line' marscapone cheese in the Dalby Coles!). Plenty of red and white wine to wash it all down. Discussion continued long into the night and entailed a fairly slow start to departures the following morning. The moon was bright, three-quarters full and Jupiter closing fast – a pity we were all off the island before the final spectacle.

The post-conference fieldtrip was led by Bill and Maureen and had a total of 10 participants. It was held in a fairly leisurely fashion and was designed to show some of the stratigraphic and geomorphic features on the northern end of the island. On Friday the group drove up the eastern beach and then crossed the island to the western coast via the Woralie Rd. Here Bill gave an interpretation of the exposures found along the coast north to near Wathumba (Fig 1). On the return the tide was too high to cross one creek and they resorted to a road which proved somewhat difficult. Getting bogged they were rescued by an enthusiastic group of 4WDers whose idea of fun was more in the vein of the driving experience than the natural surroundings. That fortunately permitted them to reach Dundubara (Fig 1) where they had booked for the night. Saturday morning for some was a walk to the Wungul sandblow and for others a conscience-driven trip to the Polling Station at Eurong. The Earth Sciences group from ANU headed for home. The sandblow was quite spectacular and in the low points there were significant amounts of aboriginal tool flakes. In the afternoon they drove north to Indian Head with views across to Waddy Point (Fig 1). These points are sites of hard rock exposure – trachytes of



West coast dunes **Photo: M. Longmore**



Bill Ward in his element
Phto: M. Longmore

middle Tertiary age. Saturday night was passed again at Dundubara before driving off the island. Those accompanying Bill travelled down the Rainbow and Caloola beaches. A rare calcarenite formed one of the interesting features of this journey. For more information reference should be made to Bill Ward's field notes.

Thanks to the organising committee for another excellent meeting; Christine Kenyon on finances and accommodation, Paul for conference program and abstracts, Maureen and Bill for leading the fieldtrips and Gill Atkin and Kay Dancey for catering and culinary expertise, and all for an enormous amount of mostly unseen hard work. Never a smooth run during the lead up, it all seems to work out effectively and without trouble in the end.

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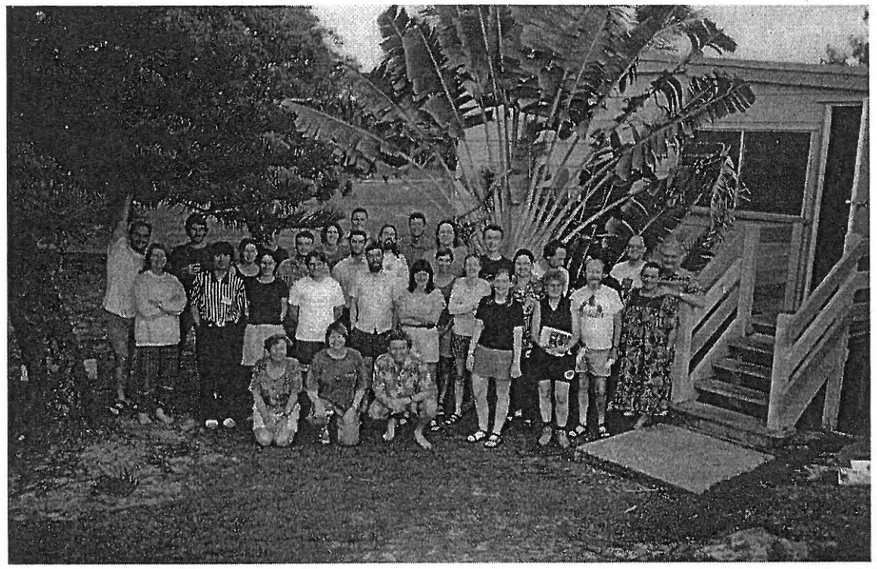


Most of the participants of the 1998 AQUA Field Conference, Dilli Village, Fraser Island

Reports on conferences and workshops are an extremely useful way of keeping those unable to attend in touch with the activities of the Quaternary community in this region! So next time you attend a conference or workshop keep this in mind and please send in a short report to QA.

New Research into Coralline palaeoclimatic Records from the Western Pacific Warm Pool, Papua New Guinea.

By H. McGregor and M. Gagan

Environmental Processes Group
Research School of Earth Sciences
The Australian National University
Canberra ACT 0200

The ocean water surrounding Papua New Guinea, the "Western Pacific Warm Pool" (WPWP), is the warmest on Earth. It is the driving-force for atmospheric circulation in the Indo-Pacific tropics and is thought to have a key role in El Niño - Southern Oscillation (ENSO) events. Changes in atmospheric circulation caused by future greenhouse warming of the WPWP are likely to alter monsoonal rainfall patterns, having far-reaching impacts on society. Unfortunately however, instrumental climatic records from the WPWP are limited to the last few decades, making it difficult to validate current climate models and predict possible consequences of future warming in this climatically significant region (see McGregor and Gagan, this issue for full discussion).

Massive, hard, scleractinian corals such as *Porites sp.* have been used successfully in recent times to obtain high resolution proxy records of sea surface temperature (SST) and rainfall dynamics (Cole *et al.*, 1993). These records are obtained by measuring geochemical tracers (Sr/Ca and O isotope ratios) and UV fluorescent banding in the corals (Beck *et al.*, 1992; *Cole et al.*, 1993). As part of Project TROPICS (Tropical River-Ocean Processes In Coastal Settings, conducted by the Australian Institute of Marine Science, Townsville), several >1m modern *Porites lutea* (pers. comm. J. True 1999) and *Diploastrea heliopora* coral cores have been collected from Blup Blup, Koil and Muschu Islands, within the flood plume of the Sepik River, Papua New Guinea (PNG) (Figure 1). Here, ENSO and changes in the WPWP are manifested by a cooling of SST and a sharp reduction in rainfall. Thus, this study aims to extend back the instrumental climate records of the WPWP using modern PNG corals. *Diploastrea* coral is characterised by a low, rounded shape and 10mm diameter, convex corallites. To date, climatic records have never been extracted from this species. *Diploastrea* grows at approximately 5 mm/year compared with approximately 15 mm/year for *Porites* lutea, therefore, *Diploastrea* has the potential to provide a much longer record for the same length of core. *Diploastrea* was collected from the same locations as *Porites lutea* in PNG with the view of calibrating proxy records contained within them and thus extending climatic records further back in time.

Fossil Corals

Fossil coral cores of *Porites sp.* and *Diploastrea* were also collected from Koil and Muschu Islands with expected mid-Holocene ages (Figure 1). During this time, the PNG climate was thought to have been wetter and warmer than today (Chappell, 1991; Hope, 1983). The WPWP was also thought to be warmer than present (Barash and Kuptsov, 1997) and ENSO may have existed during this time period (McGlone et al., 1992)(see McGregor and Gagan this issue for full discussion). However, its existence and nature, especially in the western Pacific are yet to be verified. Was ENSO more frequent or variable

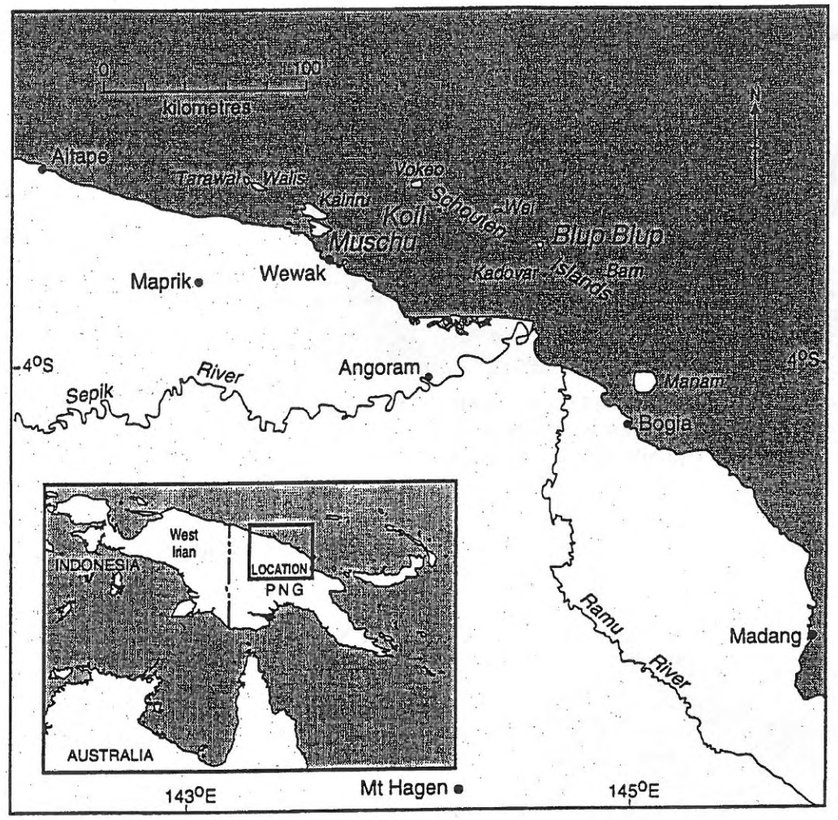


Figure 1: Location of coral collection sites. Modern corals were collected from Blup Blup Island. Fossil and modern corals were collected from Muschu and Koil Islands.

under the different mid-Holocene background conditions?

Using the mid-Holocene period as a relative global warming analogue, it should also be possible to test the Thermostat Hypothesis, that is that SST in the WPWP has a theoretical maximum of 32□C (Ramanathan and Collins, 1991). If mean palaeotemperatures recorded in the corals are greater than 30□C then this has serious implications for the Thermostat Hypothesis and the ability of the atmosphere to regulate the SST of the ocean. Conversely, if palaeo-temperatures are less than 32□C, then the Thermostat Hypothesis may prove to be valid and accommodation of additional heat would remain as an outstanding issue.

At Muschu Island, fossil corals were collected from two different sites. At the first site, Rubiew Bay, corals were exposed at high tide (Figure 2). The Muschu Islanders claim that the corals were exposed as a result of a tsunami in the 1930's. A the second site, Morock Bay, fossil corals were only just exposed at low tide. Due to the differences in elevation of the corals it is believed that the corals are of different ages, ca 6000 years and ca 3500 years for Rubiew and Morock Bays respectively. A further aim of this study will therefore be to compare the long-term climate variations recorded in the corals as the overall climate cooled to present-day conditions.

Coral Fluorescence

Fluorescent data from inshore *Porites sp.* corals from the Great Barrier Reef, Australia, have been used as a proxy for coastal rainfall (Isdale, 1984). Fluorescing fulvic acids incorporated in the coral skeleton reflect riverine inputs into the marine environment and in turn are a proxy for rainfall (Isdale, 1984). At present, fluorescence is measured in corals directly using a fluorometer, however Digital Image Analysis (DIA) is proposed as an alternative. Here, with DIA the grey level of an image of

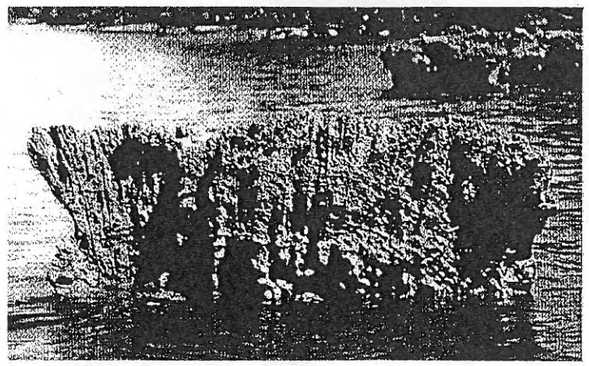
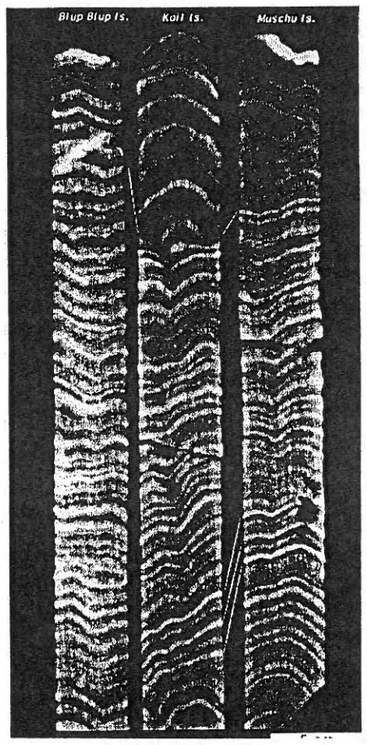


Figure 2: Fossil coral from Rubiew Ray, Muschu Island. Note the semi-circular growth bands preserved in this coral. The coral is approximately 1.7 m high with about 0.7 m exposed above the water level.

fluorescence in a coral is measured and the intensity of the signal is a direct measurement of fluorescence. DIA is a cheap and rapid alternative to measuring fluorescence on a fluorometer and if set up correctly would facilitate fast acquisition of fluorescence data from a large number of corals.



Preliminary examination of the PNG coral cores shows that all modern *Porites lutea* cores display impressive UV fluorescent banding (Figure 3). The wetter season is clearly defined in the image as bright banding and it appears that fluorescence can be correlated between locations (Figure 3). This indicates that it is possible to define the Sepik River flood plume and thus a rainfall signal. Initial inspection of the fossil corals also shows preservation of fluorescent banding. Initial work to calibrate the DIA method of measuring fluorescence has been successful. This has resulted in three semi-quantitative rainfall records produced for the Blup Blup Island and Muschu Island corals.

Figure 3: Fluorescent banding (bright bands) preserved in modern corals from Blup Blup, Koil and Muschu Islands. Lines between cores indicate fluorescent bands that possibly represent synchronous events.

Future Work

Work on the PNG corals is in its early stages. Future work will involve dating the fossil corals, measuring coral density to assess coral growth effects, using oxygen isotopes and Sr/Ca ratios in fossil and modern corals to obtain a temperature signal and to calibrate *Diploastrea*. These data will be used to attempt to answer some of the questions outlined above.

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Demise of Quaternary Studies at Hobart

by Albert Goede

Quaternary studies have been part of the curriculum of physical geography courses of the School of Geography & Environmental Studies, University of Tasmania, since about 1972 when Dr Eric Colhoun joined the staff. With the voluntary early retirement of Albert Goede in November 1997 the third year course in Quaternary Studies (16.67 % weight), which had been running for a number of years, has been terminated. The course not only served undergraduates from our own school but had also attracted students from the Schools of Earth and Plant Science. It had an enrolment of 19 in its final year.

With the introduction into the University of an interdisciplinary course in "Natural Environment & Wilderness Management" the School considered it appropriate to replace the Quaternary course with one in "Conservation Geomorphology" (12.5 % eight). Dr Kate Brown, formerly from Monash University, was appointed in early 1998 to teach the new course. Dr Guus van de Geer, who used to maintain a research interest in palynology, also left the School during the course of 1997. As well, David Hannan, who used to lecture on aspects of the Quaternary as part of a geomorphology course at the Launceston Campus of the University has also opted for voluntary early retirement in late 1997. David has been involved in glacial studies in the Mersey Valley and Central Plateau in northern Tasmania.

Albert Goede remains attached to The School as an Honorary Associate and is very keen to maintain a research interest in the Quaternary, especially in relation to Tasmania. He would like to be involved as an associate investigator in any Quaternary research projects in Tasmania. In the case of speleothem research he has a much wider interest, being already involved in work in South Australia and New South Wales as an associate supervisor of Jol Desmarchelier who is enrolled for a PhD project on speleothems in southeastern Australia. Albert's e-mail address is still: Albert.Goede@utas.edu.au

If you have anything to contribute to this section please send it in. After all, what better way to advertise your activities to the Australasian Quaternary community.

Another Quaternary Data Archive:
Another chapter in the story....

by Tim Barrows *
(Information Technology Editor)
and Geoff Hunt**

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Quaternary Databases
As we enter the last year of the century (well, second last) and attempt to expunge the millennium bug from our operating systems, the number and variety of Quaternary databases grows. The latest issue of the PAGES newsletter (Vol.6 No. 2 December 1998) focussed specifically on palaeodata and databases. The PAGES steering committee stressed the need for continued reliable storage of palaeoclimatic information. The issue also presented new databases from China and Germany together with data archiving efforts from IMAGES and PALICLAS.

What's New?
The last 6 months have seen the addition of a number of new data sets to AQUADATA. Included amongst these is a New Zealand speleothem record from John Hellstrom and colleagues (Quaternary Research, 50:167-178). This record shows that the potential of speleothems to provide quality data on terrestrial climate change. Stable isotope analysis together with an accurate U/Th TIMS chronology, provides some surprising insights into the elevation of the treeline and even the latitude of the Subtropical Front nearby.

Over one thousand browsers have now visited the Australian Quaternary Homepage and the number continues to double every 6 months. The majority of users are students, including some of secondary level. New additions during the last 6 months to the AQUA homepage include the AQUA resources page and the AQUA employment billboard. The resources page will contain supplementary material submitted to *Quaternary Australasia* including the fossil pollen extraction manual introduced later in this issue. The employment billboard provides an opportunity for Quaternarists to advertise their services or those out of work to advertise their skills. Post-doctoral fellowships and scholarships can also be advertised here.

CLIMANZ IV maps
The latest addition to the AQUADATA web-page is the first instalment in the series of maps produced by the CLIMANZ IV (1996) conference <http://rses.anu.edu.au/envgeo/AQUADATA/archive.html>. These maps will be followed by the Proceedings and explanatory notes at a later date. The next issue of QA will contain copies of these maps.

The CLIMANZ conferences are valuable due to their multi-disciplinary approach to palaeoclimatic mapping. Since CLIMAP, there have been few opportunities to bring together Australia's widespread research community to provide a synthesis of current knowledge. In particular, CLIMANZ brings together researchers working on the same area and time period but in different disciplines (e.g. geomorphology vs palynology) using vastly different techniques. The correspondence, or lack thereof, between different techniques leads to debate which can ultimately resolve new regional perspectives or identify gaps in knowledge.

CLIMANZ IV was important in that it saw the marriage of a palaeoclimatic database (QUATDB) with a conference setting. The idea was to provide a repository for the information used to derive the maps, so that the maps could be updated at future meetings. This also provides the opportunity to reinterpret the evidence as ideas, methodologies and dating techniques evolve. The relationship between database and conference is still in its infancy, as <5% of the primary data used to derive the maps was stored in QUATDB and the vast bulk of that was marine data. The concept of preserving data derived from research projects is still slow to catch on in the Australian Quaternary community.

CLIMANZ represents the only unanimous Quaternary effort to map Australia's palaeoclimates across a series of time-slices. Australia still lags behind many other nations in producing syntheses of its Quaternary research. Many maps appearing in the literature today are merely redrawn from earlier attempts and frequently not updated with the latest research. The construction of detailed maps makes the important step of acknowledging external users of Quaternary research outside the field of palaeodata gathering. The best known of these users are the GCM modellers who seek verification of their models through comparison with palaeodata compilations on a continental scale. Maps also provide a window through which other scientists, politicians and the wider public can see progress in the understanding of the long-term climate evolution of Australia. This knowledge can then be applied to a broader range of disciplines.

The CLIMANZ IV maps represent the first update of the original maps which are approaching 20 years of age, but the future of the CLIMANZ concept looks uncertain. The discontinuation of the QUATDB project means the conference/database link may be severed, but AQUADATA can serve as a storehouse for the data produced at further meetings. Its unclear what form the next meeting will take and what its objectives will be. An international link with PAGES may combine the objectives of CLIMANZ with those of BIOME and PEP II, providing a more focussed mapping initiative. Regardless of such changes, CLIMANZ should never be permitted to lose its distinctive Australian flavour, particularly the emphasis on the wetting/drying cycles and trends which have been so important in shaping our modern landscape and biogeography.

If you have something that you feel would be suitable for this column, whether it be comments or information about new programs, useful web sites, databases, your views on any of these, or anything at all to do with the information technology revolution and its application to Quaternary Research then please do not hesitate to send it to Tim who is the Information Technology Editor for QA. Tim would also be overjoyed to receive any data you have for the AQUADATA database!

**Tim Barrows
Research School of Earth Sciences
Australian National University
Canberra, ACT 0200
Australia**

Congratulations

Congratulations to Geoff Hope on his recent promotion to Professor in the Quaternary Research Centre, A.N.H. Research School of Pacific and Asian Studies, Australian National University.

Congratulations also to Colin Murray-Wallace on his promotion to Associate Professor in the School of Geosciences, University of Wollongong!

A belated congratulations to Dr Albert Goede on being awarded his PhD in May last year. The abstract of his thesis, "Quaternary Studies of Caves and Coasts", is given in the publication section.

Positions available

Postdoctoral Guest Scientist at Jena, Germany
The Palaeoclimatology group at the Max Planck Institute for Biogeochemistry, Jena has the opportunity to support a postdoctoral guest scientist for 6-8 months (Jan-Aug 1999) with a research focus on the use of physical data to reconstruct hydrological (lake-level) changes for the Australian region during the past 30 ka. The research work will contribute to the ongoing construction of the IGBP sponsored Global Lake Status Data Base. During the visit the scientist will be provided with training in the construction of lake status data bases and their application in climate modelling, and will help to create a regional data base for Australia. Fluent English is essential.

Enquiries (fax or email) about this opportunity should be mailed to Philipp Hoelzmann as soon as possible.
Max Planck Institut für Biogeochemie, P.O. Box 10 01 64, DE-07701 Jena, Germany (tel. +49 3641 64 3778, fax +49 3641 64 3778, philipp.hoelzmann@bgc-jena.mpg.de)

Senior Lecturer/Lecturer in Physical Geography
The University of Newcastle is offering a position of senior Lecturer/Lecturere in Physical Geography in the Department of Geography and Environmental Science (Position No. A17/99).

Applicants should possess a PhD degree in a relevant field and research expertise and teaching experience in the fields of geomorphology, climatology, hydrology, soils or geographic information systems.

Candidates applying for Senior Lecturer should have an established record of publication at international level and success in obtaining nationally competitive grants.

Further information: Contact Professor Eric Colhoun on telephone (02) 4921 5082 or email ggeac@cc.newcastle.edu.au

Applications close: 15 March 1999

Journal news

Nature is offering reduced price online subscription for students in Australia and New Zealand. Students taking up this offer will be able to access Nature's internet site at http://www.nature.com and have access to every piece of information read in the printed journal, plus the online Nature Debates; Nature Science Update; Feature of the week; Web matters; and full access to employment opportunities worldwide!

The subscription rate is Aus$100 a year, compared to a regular student subscription to Nature of Aus$375.

If you are interested send an email to nature@macmillan.com.au, or a fax to: +61 (03)9825 1111.

Quaternary International offers reduced subscriptions (US$77 yr) to members of Quaternary associations, such as AQUA. You need to show proof of your membership.

New Holocene editor
Ian Goodwin has recently been appointed Associate Editor of the Holocene journal late last Year. He is responsible for Southern Hemisphere papers. He has told me that the editors of Holocene would like to encourage more Southern Hemisphere papers, so now seems like a good time to work up those papers for submission.

Grants

American Association of University Women, Charles and June Ross International Fellowship
This fellowship is open to women scientists (natural and physical sciences) who are Australian citizens and who have graduated from an Australian university. This endowment is administered by the American Association of University Women (AAUW).

The fellowship is for full-time graduate or post-graduate study or research in the United States for one academic year. Fellowship stipend: Approximately US$15,400. The fellowship is awarded each year (deadline for applications is December 1st). The applicant must belong to the Australian Federation of University Women (or AAUW) and intend to return to Australia to pursue her professional career.

For more information contact:
Prof. June R.P. Ross,
Dept. of Biology, Western Washington University,
Bellingham, WA., 98825-9160, U.S.A..,
phone: (360) 650-3634.
Fax: (360) 650-3148.
E-mail: rossjrp@cc.wwu.edu

Claude C. Albirtton Jr. Scholarship 1999
This scholarship is being made available by the Geological Society of America, Archaeological Geology Division. It is intended to support the field and/or laboratory research of a graduate student pursuing a Masters or Doctoral degree. The research must involve interdisciplinary archaeology-earth sciences concepts and methods. Specific disciplines/ subdisciplines and geographic areas are open, but can include geomorphology, pedology, sedimentology, archaeometry, stratigraphy, peleontology, zooarchaeology, and archaeological materials characterization.

Applications will be accepted from students currently enrolled in a graduate program. Residents of the US and foreign countries are eligible. Membership in the GSA and the Archaeological Geology division are not required.
Applications close May 31st, 1999.
For more information contact John P. Albanese
Awards committee chair
PO Box 1397
Casper, WY 82602-1397
Albanes@trib.com

Australasian Quaternary Association

Student Travel Prizes 1999

Postgraduate Travel Prize

This prize is to support a student currently enrolled in a postgraduate degree in Australia, New Zealand, Papua New Guinea or the University of the South Pacific in the field of Quaternary studies, and who is a member of AQUA, to attend an international conference at which they will present results of their research. Students who plan to attend the INQUA Congress in South Africa in August 1999 are particularly encouraged to apply. The intention is that attendance at the conference and the presentation should enhance the student's career and Quaternary studies in Australasia. The successful applicant will be expected to submit a report on the conference for publication in the society journal, Quaternary Australasia.

The value of the award is A$1000. Two awards may be made in 1999.

Applications

Applications must be made on the official application form, which is available from the President of AQUA (Dr Paul Hesse) and on the AQUA web-site (http://rses.anu.edu.au/envgeo/AQUADATA/quataust.html#HOME).

Applications will be accepted up until April 31st 1999 for conferences held up to March 2000.

Complete applications should be sent to Dr Paul Hesse, Department of Physical Geography, Macquarie University, Sydney, NSW 2109, Australia.
Ph. 02 9850 8384, Fax 02 9850 8420, e-mail phesse@laurel.ocs.mq.edu.au

Thesis Abstracts

Quaternary Studies of Caves and Coasts

by Albert Goede
School of Geography & Environmental Studies, University of Tasmania

Albert Goede has recently completed a PhD on the topic "Quaternary Studies of Caves and Coasts". The thesis consists of a review of thirty papers published on the two themes during the last twenty years. The degree was awarded in May, 1998 and will be formally conferred at a degree ceremony in Hobart on December 15, 1998.

Abstract
The contents of this volume are not a PhD thesis in the conventional sense in that they do not represent a single major research theme. When the author approached the Higher Degree Committee of the University of Tasmania with the view of counting twenty-nine published papers towards a higher degree, he was instructed to enroll for a research higher degree (PhD) and to present a thesis not only containing the publications but critically reviewing them in the form of a thesis to be completed over a period of not less than one year.

The thesis thus comprises a review of twenty-nine published papers on a common theme of "Quaternary Studies of Caves and Coasts". Most papers are concerned with aspects of cave sediments but some are focused on the sedimentary history of coasts. For the sake of completeness it was found necessary to include one paper submitted for publication but not yet published as well as some unpublished data.

Studies of caves commenced with an investigation of bone-rich deposits, many of which contained remains of Pleistocene megafauna. The thesis concentrates on aspects of stratigraphy, dating and interpretation of depositional environments. Discovery of an archaeological site led to the realisation that interior valleys of Tasmania had been colonised by aborigines during the Last Glacial.

Later studies concentrated on the use of speleothems as an information source on past climates and environments and used analysis of stable isotope ratios and minor element concentrations to study temporal variations. The study commenced with a detailed analysis of the isotopic composition of recipitation and seepage waters - a vital prerequisite. Oxygen isotope composition of Tasmanian speleothems was found to be not directly controlled by temperature but by the isotopic composition of winter precipitation. It is best interpreted as a proxy for mean winter temperature. Carbon isotope variations are regarded as due predominantly to variations in plant productivity and appear to be partly controlled by the precessional cycle.

Studies of minor element variations were focused on magnesium and strontium with preliminary investigation of uranium and bromine. Strontium isotope analysis was used to show that some of the strontium was derived from a non-limestone source - probably wind-borne dust derived from continental shelf areas when sealevels were low. The magnitude of the dating peak (h3) in electron spin resonance spectra was found to be strongly correlated with carbon isotope ratios and concentrations of uranium, magnesium and bromine. The signal has considerable potential as an indicator of changes in vegetation productivity and/or fire frequency.

Coastal studies commenced with electron spin resonance analysis of marine gastropod shell from midden sites in sea caves at Klasies River Mouth, South Africa where the technique was developed as a relative dating method in good agreement with the cultural and stratigraphic sequence of the sites.

Use of the method continued on coastal deposits in western Victoria, Tasmania and the Bass Strait Islands where it was calibrated against other dating methods especially amino acid racemisation dating carried out by Dr Colin Murray-Wallace. The Bass Strait study revealed that King and Flinders Islands had been tectonically uplifted during the Quaternary as was Tasmania, but uplift began earlier and had ceased 125.000 years ago.

Age determination is a vital part of Quaternary studies and is reviewed in a separate chapter. Improvements in dating techniques and calibration during the review period are discussed and earlier age estimates have been updated.

Recent Publications

Goede, A., McCulloch, M., McDermott, F., Hawkesworth, C., 1998. Aeolian contribution to strontium and strontium isotope variations in a Tasmanian speleothem. *Chemical Geology* 149, 37-50.

Goodwin, I. D., 1998. Did changes in Antarctic ice volume influence Late Holocene sea-level lowering? *Quaternary Science Reviews* 17, 319-332.

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Tropical climate variability and the role of the Western Pacific Warm Pool : a review paper

by H. McGregor and M. Gagan

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Abstract

The "Western Pacific Warm Pool" (WPWP) is the warmest body of ocean water on Earth. By definition the WPWP has a sea surface temperature (SST) of > 29°C (McPhaden and Picaut, 1990) with the maximum temperature 'limited' to 32°C (Ramanathan and Collins, 1991; Waliser and Graham, 1993). The Warm Pool usually sits off the north coast of Papua New Guinea (PNG). The WPWP is the driving-force for atmospheric circulation in the Indo-Pacific tropics and is thought to play a key role in El Niño - Southern Oscillation (ENSO) events. However relatively little is known about this important water mass, both past and present. This paper presents a review of what is known and unknown.

El Niño-Southern Oscillation and the Role of the Western Pacific Warm Pool

Under normal conditions trade winds converge and rise above the WPWP, increasing local cloudiness and generating high rainfall, and form the ascending arm of the atmospheric circulation system which extends across the Pacific (Philander, 1983). Cool dry air, having travelled at altitude from the west, descends in the sub-tropical, south-eastern Pacific (Philander, 1983). During an ENSO event the WPWP and associated atmospheric convergence zone is displaced, with the WPWP migrating east of the dateline (180°) (McPhaden and Picaut, 1990).

ENSO is responsible for the 2-10 year climatic fluctuations observed in the Pacific and produces climatic impacts around the world due to atmospheric teleconnections (Enfield, 1989). ENSO is defined as an anomalous warming of the sea surface in the equatorial Pacific (El Niño) combined with large scale fluctuations in atmospheric pressure (Southern Oscillation). Positive SST anomalies are observed in the eastern Pacific due to the depression of the thermocline by equatorial-bound Kelvin waves, which suppress upwelling of cold water (Ramage, 1986). These Kelvin waves are thought to be generated by the breakdown of wind fields converging in the western Pacific. The breakdown in wind fields in turn facilitates the migration of the WPWP and associated atmospheric circulation towards the dateline (Philander, 1998), resulting in a negative SST anomaly in the western Pacific results. The Southern Oscillation is a measure of changes in atmospheric pressure reflecting the displacement of the atmospheric circulation system in response to changes in SST.

Thermostat Hypothesis

From observations during the 1986/87 ENSO event, Ramanathan and Collins (1991) proposed the Thermostat Hypothesis for the WPWP to explain the annual average temperature of 29-30°C and a theoretical SST maximum of 32°C. The main features of this hypothesis are summarised in Figure 1. In general, in the warmest parts of the oceans, incoming solar radiation causes increased SSTs and therefore evaporation of the warmed water (Ramanathan and Collins, 1991). The heat trapped in atmospheric water vapour increases at a greater rate than the heating of the sea surface (the so called 'super-greenhouse effect') and leads to the production of anvil cirrus clouds (Ramanathan and Collins, 1991). These highly reflective clouds block the incoming solar radiation and are thought to act as a 'thermostat' on future SST increases. Cirrus cloud production, particularly in the WPWP region, releases latent heat to high atmospheric levels of the global atmospheric circulation system (Waliser and Graham, 1993). Thus via ocean-atmosphere coupling, small changes in SST in the WPWP influence climate on a much larger scale.

There is much controversy surrounding the 'thermostat' function of cirrus clouds. Evaporation, precipitation and locally diminished deep atmospheric convection have also been proposed as alternative mechanisms for limiting SST (Stephens and Slingo, 1992; Waliser, 1996; Waliser and Graham, 1993). It has also been suggested that cirrus cloud production is due to large scale

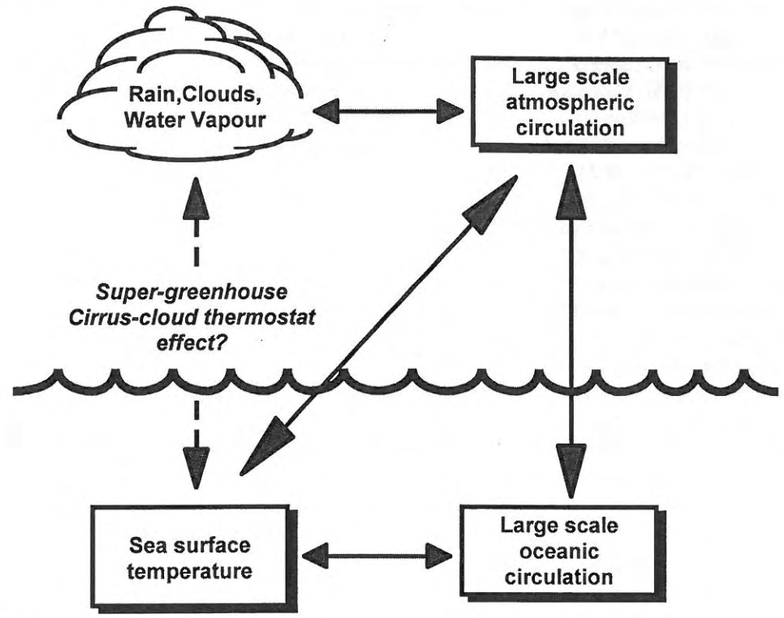

Figure 1: *The major components of the tropical ocean-atmosphere that may be linked by the cirrus-cloud thermostat effect described by the Thermostat Hypothesis. According to this Hypothesis sea surface temperature is regulated by the production of rain, cirrus clouds and water vapor which in turn relate heat to the larger scale atmospheric and oceanic circulation systems. Diagram after Lau et al(1994).*

atmospheric circulation (Fu *et al.*, 1992; Lau *et al.*, 1994).

Regardless of the mechanisms, the apparent limiting of SST is of fundamental importance to the global climatic system. Given the interaction between the WPWP, associated atmospheric circulation and ENSO, a change in one parameter, for example SST in the WPWP, can potentially have far reaching consequences for the whole system. The consequences of anthropogenically enhanced greenhouse warming on the SST 'thermostat' are unknown at this stage. Unfortunately, recent instrumental climatic records from the WPWP are limited to the last few decades making it difficult to validate current climate models and predict possible consequences of future warming in this significant region.

Western Pacific Warm Pool in the Past

Also unknown is whether or not ENSO and the SST 'thermostat' in the WPWP today existed under different climatic conditions in the past. The magnitude of oceanic and terrestrial cooling in the tropics around the time of the Last Glacial Maximum (LGM) is still a matter of considerable debate (Beck *et al.*, 1992; Beck *et al.*, 1997; CLIMAP *et al.*, 1981; Stute *et al.*, 1995; Thompson *et al.*, 1995). The reported magnitude of the cooling varies considerably, ranging +1° to -2°C from present (CLIMAP *et al.*, 1981) down to -5°C and -8°C from present (Beck *et al.*, 1992; Beck *et al.*, 1997; Stute *et al.*, 1995; Thompson *et al.*, 1995). Similar variations in reported magnitude of cooling during the LGM exist for the WPWP though comparatively little work has been conducted for this area and time period. Ohkouchi (1994) and Thurnell (1994) report WPWP SST temperatures 1.5°C and 2°C below present respectively. In contrast Patrick and Thurnell (1997) found cooling of 4°C below present for the western equatorial Pacific. Do these cooler temperatures at the LGM imply a contraction of the WPWP or a different climatic system operating in the tropics?

During the mid-Holocene, terrestrial records from PNG suggest that the climate was wetter and warmer than today (Chappell, 1991; Hope, 1983). Temperatures in the WPWP for the same time period may also have been warmer (Barash and Kuptsov, 1997). Based on oxygen-isotope measurements of planktonic foraminifera in deep sea cores from the western Pacific, (Martinez *et al.*, 1997) suggests the range of WPWP was expanding and contracting

throughout the Holocene. A high resolution coral record for the early Holocene shows seasonal variation in WPWP SST, though the 5-6 year record is not long enough to confirm the existence of ENSO (McCulloch *et al.*, 1996). Sediment deposits from coastal Peru indicates that ENSO existed during very late Pleistocene, the early and middle Holocene but was weak from 8000 to 5000 BP (Keefer *et al.*, 1998; Sandweiss *et al.*, 1996). Though how this result can be reconciling against temperatures of 6.5°C below present in the southwestern tropical Pacific is yet to be determined?

Although more SST information and high resolution data exist for the WPWP during the Holocene compared with the LGM there is still not enough to verify or quantify the existence and nature of ENSO. In addition, the data give no indication of the extent of variability of the SST in the WPWP. Finally, how do higher and lower average temperatures observed at various time periods in the past affect the SST 'thermostat' observed in the WPWP?

Conclusions and future research

The WPWP, the warmest body of water on Earth, plays a key role in controlling global climate. The breakdown in windfields that converge on the WPWP are thought to trigger ENSO events, which affect world climate via atmospheric teleconnections. The SST of the WPWP has a theoretical maximum 'limit' of 32°C however the mechanisms for enforcing such a 'limit' are controversial and not fully understood. The lack of recent instrumental records from the WPWP have made it difficult to validate current climatic models such as the Thermostat Hypothesis. Most of the existing palaeo-data are from the Holocene, though the resolution is not high enough to indicate the variability of the SST in the WPWP. Coral records from the WPWP to be produced in a new study will extend modern instrumental records to ascertain the variability of the WPWP under different background conditions, thus addressing some of the questions raised in this review.

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Casuarinaceae:Chenopodiaceae pollen ratios and soil salinization in the Murray-Darling Basin

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Abstract
This study investigated the palaeovegetation record preserved in small salt lake basins near the junction of the Murray and Darling River systems in southwestern New South Wales. Pollen evidence indicates that *Casuarina* woodlands have declined in the region since *c.* 4,500 years ago. At the same time, Chenopodiaceae proportions have increased, suggesting expansion of chenopod shrublands and understoreys. It is possible that these changes were caused by late Holocene soil salinization in the Lower Murray-Darling Basin. A steady decrease in the frequency or intensity of fire during the late Holocene may have been a consequence of the woodland contraction and increase of fire resistant chenopod shrublands.

Introduction

Changes in soil chemistry have recently been considered in palaeovegetation reconstructions. Thomas and Kirkpatrick (1996) and Longmore (1997) argued that soil podzolization on sandy coastal dunes may have caused a retrogressive succession from forest to sclerophyllous heath and scrub communities. Similarly, Ladd *et al.* (1992) suggested that *Allocasuarina* thrived during the early Holocene on calcareous coastal dunes until acidic soils developed, when they were replaced by *Eucalyptus*. Recently, Crowley (1994a, b) identified patterns in the proportions of Casuarinaceae and Chenopodiaceae in southeastern Australian pollen records, which she correlated with Late Quaternary soil salinization events. Crowley (1994a, b) argued that during phases of salinization, salt-tolerant chenopods increased as salt-intolerant *Casuarina* and *Allocasuarina* woodlands contracted. The Lower Murray-Darling Basin in southwestern New South Wales is a valid location to test Crowley's hypothesis. Salinization is a visible component of the landscape, with groundwater discharge basins prominent in areas of low relief. Additionally, the modern vegetation is primarily a mosaic of Chenopodiaceae and *Casuarina*.

Study region

The two lakes in this study, Warrananga and Tooperoopna salt lakes, are located to the northwest of the Murray and Darling Rivers in southwestern New South Wales (Fig. 1). This region is semi-arid and has a mean annual rainfall of 264.6 mm. There is a moisture deficit in all months, with a mean annual pan evaporation of 2081.9 mm (Bureau of Meteorology, 1998).

The salt lake basins probably have their origin as deflation hollows eroded during the last glacial maximum. With the onset of moister Holocene hydrologic regimes (Bowler *et al.*, 1976; Macumber, 1980) the basins became groundwater discharge and surface water accumulation sites, gradually filling with sediments since the mid-Holocene. Hydrologic conditions have cliffed the western lee margins of these basins and deflation has produced subdued clay dunes/lunettes on the eastern, down-wind shorelines.

Chenopodiaceae, particularly *Maireana pyramidata - M. sedifolia* low shrublands, dominate the present landscape. *Casuarina pauper - Alectryon oleifolius* subsp. *canescens* low open-woodlands and *Eucalyptus socialis - E. dumosa* tall shrublands vegetate the linear dunes. European impacts appear to have been less noticeable than in other areas of the Murray-Darling Basin. Land use around the salt lakes has predominantly been low-intensity sheep grazing, although small tracts have been cleared in recent decades for grain cropping.

Materials and Methods

Cores were taken from the centre of both salt lakes and nine surface samples were randomly collected from the top 0.5 cm of sediment beneath the halite crusts. Bulk organic carbon samples for AMS radiocarbon-14 dating were taken from the Warrananga cores at 41-46 cm and 73-78 cm depth and Tooperoopna cores at 40-50 cm and 85-90 cm depth. These samples were processed by Beta Analytic Inc., Miami, Florida.

Pollen was extracted from the sediment matrix using standard procedures (Hart, 1988). A minimum of 150 and an average of 200 pollen grains were counted for each sample unit. Carbonized particles were counted using the point-count method described by Clarke (1982). Counts for each pollen taxon were converted to percentages of the dryland pollen sum and presented in a resolved pollen diagram using TILIA and TILIA-GRAPH (Grimm, 1996). Data were analyzed statistically using the Pearson product-moment correlation coefficient (r) (Pearson, 1926) to identify significant correlations between variables.

Results

AMS radiocarbon-14 dates for the two salt lake sedimentary sequences suggest a late Holocene age for the sedimentary succession in both cores (Table 1). Simplified pollen diagrams (Figs 2a, b) indicate that members of the Casuarinaceae contributed the dominant tree pollen (~20 %) in the basal sample units of the two sedimentary sequences. Compared to modern samples, Chenopodiaceae representation was relatively low, at 30-40 %. For most of the upper part of the sequence, Casuarinaceae had a low representation. In the modern samples, Casuarinaceae records a 2 % abundance at Warrananga and 3 % at Tooperoopna. Chenopodiaceae increased through the sedimentary sequence, peaking at 76 % near the top of the Warrananga core. Surface samples indicate that Chenopodiaceae presently have a representation of 56 % at Warrananga and 53 % at Tooperoopna.

There were statistically significant negative correlations between Chenopodiaceae and Casuarinaceae pollen at Warrananga (r = -0.661, df = 13, P = < 0.01) and Tooperoopna (r = -0.511, df = 15, P = < 0.05) but no statistically significant correlations between the carbonized particle index and Casuarinaceae at either site.

Discussion

Casuarinaceae woodlands probably vegetated the region around the salt lakes in the mid-Holocene. The Casuarinaceae species is almost certain to have been *Casuarina pauper*, which forms an important element of the present vegetation around the salt lakes and is the only representative of the Casuarinaceae in far western New South Wales (Cunningham *et al.*, 1992). Relatively low Chenopodiaceae values indicate that chenopod shrublands had a much reduced cover compared to present. Chenopodiaceae pollen may have been derived from shrubs vegetating the margins of the salt lakes.

A marked decrease in *Casuarina* occurred after *c.* 4,500 years ago. This floristic transformation may have been due to climatic change or a change in the fire regime. Fires were possibly more prevalent in the ecosystem until *c.* 2,000 years ago, indicated by high carbonized particle indices. *Casuarina pauper* is fire-sensitive (Ladd, 1989) and lacks a soil seedbank (Auld, 1995). A switch to more frequent and intense fire regimes will cause local decline or extinction of the species. Another explanation for the decline of *Casuarina* may lie in increased salinization during the late Holocene. Chenopodiaceae increases in this phase are interpreted as salt-tolerant shrubs

***Table 1**: Radiocarbon dates for Warrananga and Tooperoopna sediment cores.*

Depth (cm)	Site	Conventional ^{14}C age* (years BP)	Laboratory Number
41-46	Warrananga	2,230 ± 50	Beta-120237
73-78	Warrananga	4,480 ± 50	Beta-120238
40-50	Tooperoopna	1,520 ± 50	Beta-120232
85-90	Tooperoopna	980 ± 50	Beta-120233

* Mean ± 1 σ uncertainty.

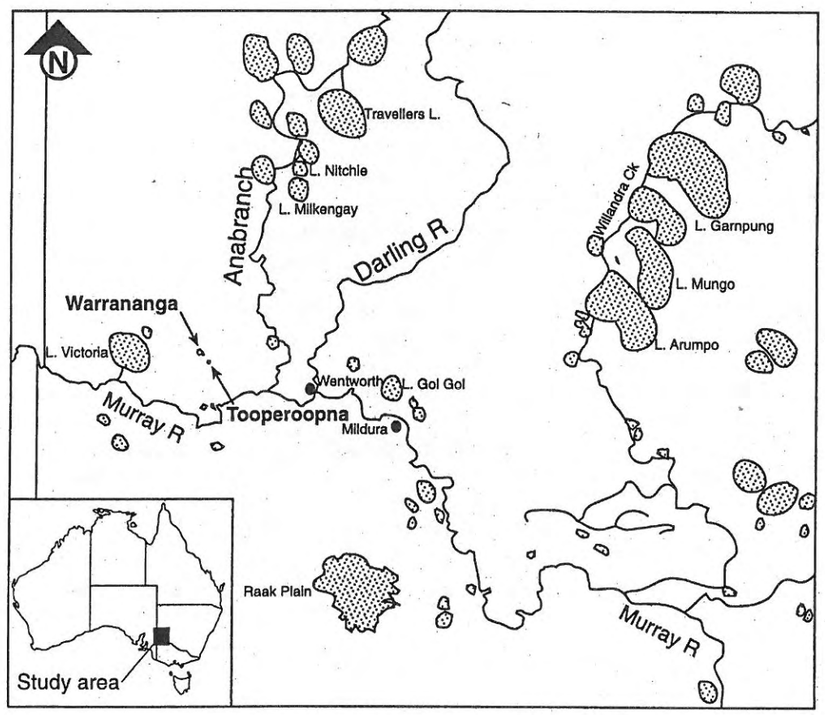
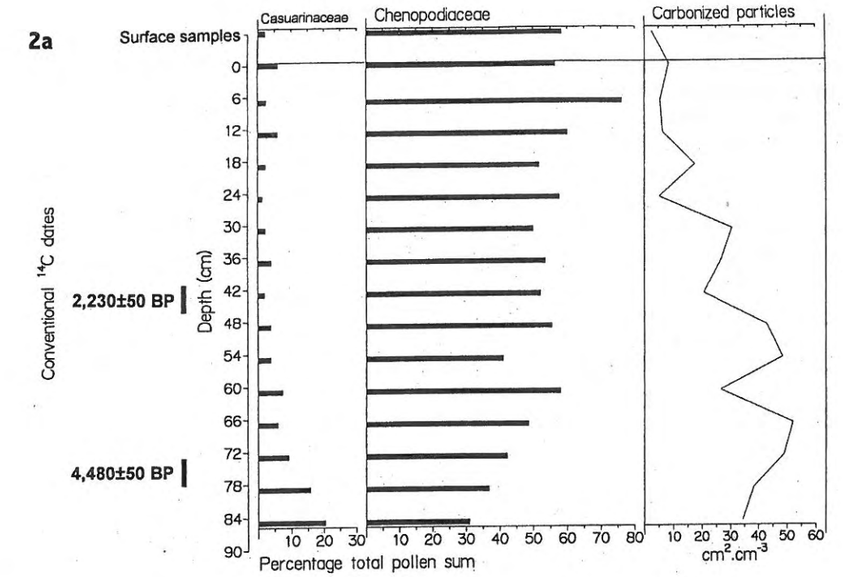


Figure 1: *map of southwestern New South Wales and northwestern Victoria showing the location of Warrananga and Tooperoopna salt lakes. (Adapted from Bowler and Magee, 1978).*

colonizing soils affected by salinization.

Death of *Casuarina* trees could have paralleled the expansion of chenopod shrublands. Casuarinaceae of arid environments develop extensive root systems. Osmotic balance and nitrogen-fixing, endosymbiotic actinomycetes are detrimentally affected by saline water tables rising into this root zone (National Research Council, 1984). Research indicates that *Casuarina pauper* seedlings are quite sensitive to salinized soils (El-Lakany and Luard, 1982; Clemens *et al.*, 1983). Alternatively, most local Chenopodiaceae taxa such as *Halosarcia*, *Atriplex* and *Maireana* are shallow-rooted halophytic shrubs that can tolerate soils with salt contents as high as 5,500 mg.l^{-1} TDS (Matters and Bozon, 1989; Allison *et al.*, 1992; Chaffey *et al.*, 1992; Glenn *et al.*, 1998; Ungar, 1998). The floristic changes in this region of southwestern New South Wales support the thesis of Crowley (1994a, b), who has pointed out that Chenopodiaceae have an inverse relationship with Casuarinaceae in many pollen diagrams from southern Australia, probably indicating soil salinization.

Soil salinization is caused by salt accumulating in the soil due to low rainfall infiltration (Lovering *et al.*, 1998) or salts from groundwater migrating to the surface through the capillary fringe (Macumber, 1990a, b). Rising groundwater must be expressed in other pollen studies from southeastern Australia, because aquifer recharge occurs on a regional scale. Many palaeoenvironmental studies indicate moister climatic conditions than present in southeastern Australia during the



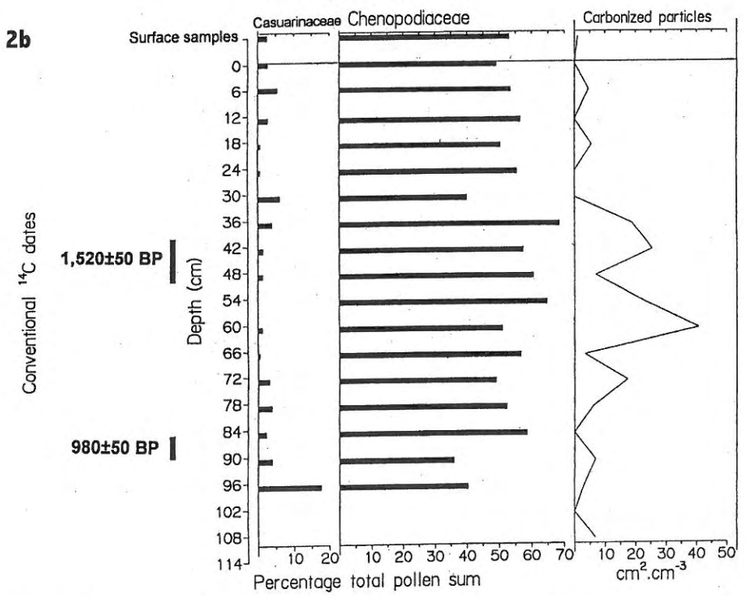


Figure 2: *Warranga (2a, top) and Tooperoopna (2b, bottom) salt lake pollen and carbonized particle diagrams*

mid-Holocene; either high water levels in lakes and swamps (Bowler *et al.*, 1976; Ross *et al.*, 1992; Luly, 1993), high-rainfall floristic associations (Hope, 1974; Ladd, 1979; Singh, 1981; Aitken and Kershaw, 1993; Lloyd and Kershaw, 1997) or increased alluvial erosion (Wasson, 1979).

Chenopodiaceae increases in the late Holocene (after *c.* 4,500 years ago) at Warrananga and Tooperoopna, whereas in most other studies the phase of greater moisture availability appears to be a mid-Holocene event.

Warrananga and Tooperoopna salt lakes are hundreds of kilometres from the aquifer recharge zone on the western slopes of the Great Divide, accounting for the time lag between phases with more efficient hydrologic regimes and rising groundwater (Bowler pers. comm.).

Soil salinization is likely to affect the landscape of the Murray-

Darling Basin in southwestern New South Wales well into the future. Groundwater in the region currently has salinities of 14,000–35,000 mg.l^{-1} TDS (Evans *et al.*, 1988) with present conditions affected by clearing of vegetation both locally (Brodie, 1998; Cook and Walker, 1992) and in highland catchments (Macumber, 1990a, b). Whereas groundwater recharge under mallee eucalypt vegetation naturally occurs at less than 0.1 mm per year, following clearing there is about a one hundred-fold increase in recharge rates (Cook and Walker, 1992). Cook and Walker (1992) predict that within 100 years of clearing, groundwater in southwestern New South Wales may rise at a rate of 20-40 mm per year, or 2-4 m per century. Of perhaps greater concern is the potential effect of clearing in the wider Murray-Darling Basin. If groundwater discharge basins in southwestern New South Wales take centuries or millennia to respond to distant aquifer recharge events, the region may not have experienced the full consequences of European settlement. Soil salinization inexorably alters the landscapes it infringes upon. Over 7,000 km^2 of land in southeastern Australia is already affected by dryland salinization, with a further 50,000 km^2 at risk (Gibson, 1997).

A subtle effect of the increase in Chenopodiaceae and decrease in *Casuarina* during the late Holocene may have been a reduction in the incidence or intensity of fire. This is probably due to poorly-flammable chenopod shrubs replacing grassy understoreys and annual and perennial chenopod shrublands displacing grasslands. Gill (1990) notes that mallee shrublands with chenopod understoreys are much less likely to burn than communities with abundant grass (*Triodia* and *Austrostipa*) cover. Contraction of *Casuarina* woodlands, producing a more open floristic structure, would have also reduced the flammability of the landscape.

Conclusion

Pollen evidence suggests that *Casuarina* woodlands have declined since *c.* 4,500 years ago in the region surrounding two small salt lake basins near the junction of the Murray and Darling Rivers. Chenopodiaceae proportions increased during this period, attributable to the expansion of chenopod shrublands and understoreys. A decrease in the incidence or intensity of fire during the late Holocene may have been a consequence of the woodland decline and expansion of poorly-flammable chenopod shrublands. It is possible that these floristic changes were caused by late Holocene soil salinization in the lower Murray-Darling Basin.

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