Quaternary Australasia

The Newsletter of the Australasian Quaternary Association

Volume 15, No. 1
June 1997
ISSN 0811-0433

QUATERNARY AUSTRALASIA, VOL. 15/1, June 1997

Material for the next issue should reach the editor by **30th September 1997**:

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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.

COMMITTEE MEMBERS

QUATERNARY AUSTRALASIA, VOL. 15/1, June 1997

CONTENTS

EDITORIAL

Volume 15/1 ... is it really 8 years since I started this caper? Like all good things, it has to come to an end, and thanks to the enthusiasm of a younger Quaternarist, the next issue will come out courtesy of AQUA's new editor, Kate Harle. You will find her address and contact details in the front covers. Do get in touch with her and give her the support that any editor needs for a successful journal. If you forget the change the address, and copy arrives in my mail box, don't worry, I will pass it on.

The usual duty of an outgoing editor is to thank all the people who have assisted and supported the task of editing the journal. You will have all heard my praises for Colin Murray-Wallace and Maria Cotter. There are also all those regular contributors and reviewers who I have been able to rely on often at all-too-short notice. Thank you.

Now to this issue. Here we have the usual collection .. a couple of great looking meetings coming up, more publications for you to add to the list (apologies this time, the recent publications list is on the slight side ... I ran out of energy!), yet more email lists and web sites, and a new TL lab. Theme-wise, phytoliths, my favourite new(ish) palynomorph, is the flavour of the issue, with review, conference report and proposed research group all thanks to Diane Hart. The other big news is development of more electronic access to the Quaternary: a Quaternary Australasia home page on the web, with access to several of the more recent issues of *Quaternary Australasia*, the new and updated Australian Quaternary Data Archive (AQUADATA), and comments on the future of Quaternary data storage in Australia.

That's enough from me. All that remains is to welcome the new Committee, especially our new President, Paul Hesse, secretary, Damian Gore, and of course the new editor, Kate Harle. Their names and contact addresses are in the from covers of this issue.

Bill Boyd, Editor

AQUA

AUSTRALASIAN QUATERNARY ASSOCIATION

Treasurer's report for 1996

Financially, AQUA has had a successful year.

Income from subscriptions has been higher, although there has been a considerable drop in student membership. Income from investments are considerably higher than 1995 due to funds being transferred to higher interest bearing accounts. A refund from the Taxation Office has been received for the witholding tax the Association was charged in 1995.

Printing and postage costs, as always, are the major items of expenditure. The low postage costs for 1996 are due to only one payment for posting *Quaternary Australasia*; the costs for the December issue will appear in 1997.

The association is in a secure financial situation with prospects for a successful 1997 with adequate funds available to support the bi-annual conference at Lake Eyre.

Christine Kenyon,
Honorary Treasurer, AQUA

Statement of receipts and payments from 31 December 1994 to 31 December 1995

	1995	1996
Uncommitted balance brought forward from 1994 (CR)	25,564.35	25,702.10
Add receipts		
Personal subscriptions (full)	2,802.08	3,087.60
(concession)	605.00	340.00
Institutional subscriptions	509.48	499.83
Bank Melbourne Interest	589.20	1,670.82
Commonwealth Bank	232.73	65.00
Nerriga conference	235.40	
Tax TFN refund		285.30
Refund Southcombe Lodge		80.00
	4,973 89	6,028.55
Deduct payments		

Printing costs	2,087.90	2,157.05
Postage costs	1,407.95	354.60
Department of Geography, University Melbourne (Stationary)	47.00	
Bank and Govt. charges	45.20	79.42
Biodiversity Council support	420.00	
Conference support	500.00	500.00
Government withholding tax	285.30	
Southcombe Lodge		100.00
Sundries	42.79	69.40
Refund from Southcombe Lodge		10.00
4,8636.14	3,238.43	

Excess receipts over payments	+137.75	+2,790.12
Uncommitted balance at end of 1995 (CR)	25,702.10	28,492.22
Investments		
1 month	2,084.53	2,174.60
12 months	10,204.48	10,923.60
6 months	10,000.00	10,855.06
Commonwealth Bank Balance	3,413.09	4,538.96
TOTAL ASSETS (CR)	25,702.10	28,492.22

Signed:

C. Kenyon, Honorary Treasurer, AQUA

1996 AQUA Lake Eyre Field Trip

It appears that the participants of this trip enjoyed themselves so much that none have had the energy left to send a report in ... perhaps next issue? Suffice to say that everyone I have talked to who was there seems to enjoy themselves thoroughly. To fill the reportless void, here at least is a group photo, culled from Kate Harle's holiday snaps (thank you, Kate), to prove they really were there.

FORTHCOMING MEETING

CLIMATES OF THE PAST

6th Annual CLIP Meeting
Cairns and Townsville, Australia
27 September - 4 October 1997

Organised by UNESCO and the International Union of Geological Sciences, in collaboration of the Australian Institute of Marine Science.

In this the International Year of the Coral Reef, as declared by ICLARM, the 6th annual CLIP meeting will be held adjacent to Australia's Great Barrier Reef, and hosted by the Australian Institute of Marine Science.

The starting point will be in Cairns. From Cairns organised high-speed catamaran tours will be run to the outer barrier reef (Agincourt Reef) and to a mid-shelf reef (Michaelmas Cay). Snorkeling equipment will be provided and SCUBA equipment can be rented by accredited divers. This will be followed by introductory presentations (Monday 29th September) on the past climatic history of tropical Australasia, with emphasis on the nearshore and reefal history. On Monday afternoon participants will travel by bus to the rainforests of the Atherton Tableland and on Tuesday visit the volcanic crater lakes that have provided much of the terrestrial record of climatic change. The bus will continue with additional stops to Townsville.

The principal scientific sessions (Thursday 2nd and Friday 3rd October) will be held at the Australian Institute of Marine Science (AIMS) at Cape Cleveland, 45 km south of Townsville. These scientific sessions will contain oral contributions and discussions on climatic changes and variability of the past several glacial/interglacial cycles. Within this framework, contributions on both local examples, continental-scale records or global syntheses are welcome. Saturday 4 October will be devoted to specialist and business meetings (e.g. CLIMEX, the climatic extremes project).

Accommodation and meals: In hotels in Cairns, Yungaburra (Atherton Tableland) Townsville and three nights at AIMS.

Fees and costs: Registration is free for active CLIP members. For other scientists the registration fee is US$150; and for accompanying members the fee is US$300. The actual, but subsidized total costs that all participants will need to contribute to hotel accommodation, reef tours, bus transport is the equivalent of about US$600. Payment of accompanying members registration and other non-CLIP registration fees: 11 July 1997. For registration, please return the following information to Allan Chivas by fax, mail or e-mail: name, address, fax no., e-mail, arrival date, departure date, title of abstract of presented paper.

Publication: Participants are encouraged to bring to the meeting in September full manuscripts for publication by an international journal, subject to normal peer-review processes. Receipt of abstracts: 11 July 1997.

Send replies or enquiries to:

Prof. A.R. Chivas
School of Geosciences
University of Wollongong
Wollongong NSW 2522
Tel: 042 213841
Fax: 042 214250
E-mail: allan_chivas@uow.edu.au

Organising Committee: Prof. Allan Chivas (University of Wollongong), Dr Peter Isdale (AIMS), Prof. Peter Kershaw (Monash University), Prof. Peter Davies (University of Sydney).

CLIMATES OF THE PAST

FORTHCOMING MEETING

PHYTOLITH WORKSHOP

A 3 day Phytolith Workshop is to be held at Macquarie University, North Ryde, Sydney, early in February 1998

Topics which might be discussed include:

Extraction techniques (plants and sediments)
Microscopy (optical, SEM, TEM)
Analysis of data
Recent areas of research including carbon dating, oxygen isotopes, trace elements
Archaeological and paleoenvironmental research areas
Soil processes and phytoliths
Phytolith systematics

If you are interested in attending and/or giving a short paper, please contact the organizer. Please suggest topics which are of interest to you which might be included in the program, and tell us if you would be interested in a more extended program to include field techniques, hands-on experience etc.

Further details and expressions of interest to:

Dr Diane Hart
or
Dr Geoff Humphreys
School of Earth Sciences
Macquarie University
North Ryde, N.S.W. 2119
Australia
Tel: (02) 9869 2300/(02) 9850 7990
Fax: (02) 9868 3990/(02) 9850 8420
Email: dhart@magna.com.au
ghumphre@ocs1.ocs.mq.edu.au

PHYTOLITH WORKSHOP

FORTHCOMING MEETING

XV INQUA CONGRESS 1999

3 - 11 August 1999
Durban, South Africa

The Congress will open with a one-day symposium devoted to the Congress theme: "Environmental background to hominid evolution in Africa". Thereafter symposia and workshops will address key issues in Quaternary studies including glaciation, palaeohydrology, loess, neotectonics, palaeoclimate, palaeopedology, tephrochronology, human palaeoecology, terrestrial carbon, shorelines, vegetation history and stratigraphy. A range of pre- and post-congress excursions is offered to important sites in Southern Africa countries.

The first circular and pre-registration forms are available on the Congress Internet Homepage at :

inqua.geoscience.org.za.

Alternatively, the circular may be obtained from:

Mrs E Aucamp,
PO Box 798, Silverton,
Pretoria 0001, South Africa.
Fax +27-12-8411221
e-mail: eaucamp@geoscience.org.za

For further info, please contact:

The Secretary-General,
PO Box 61,
Cape Town 800, South Africa.
Fax: +27-21-246716
e-mail: mavery@samuseum.ac.za

XV INQUA CONGRESS

CONFERENCE AND MEETING NEWS

July 1997 **VIII Pacific Science Inter-Congress: Islands in the Pacific Century**, Suva, Fiji Islands. Contact: Secretariat, VIII Pacific Science Inter-Congress, c/- School of Pure and Applied Sciences, The University of the South Pacific, PO Box 1168, Suva, Fiji Islands. Phone: 679 313 900 ext 2691 or 2430; Fax: 679 302 548; E-mail: pas@usp.ac.fj

July 1997 **Glaciers of the Southern Hemisphere**, Melbourne, Australia. Sponsors: International Association of Hydrological Sciences & International Association of Meteorology and Atmospheric Sciences. Contact A.G. Fountain, U.S. Geological Survey, PO Box 25046 MS-412, Denver CO 80225, USA; Phone: 303 236 5025; Fax: 303 236 5034; E-mail: andrew@usgs.gov

7-11 July 1997 **Geological Processes in the Regolith, Short course**, Perth, Australia. Contact: Mrs Bernadette Kovacs, CRCLEME, Faculty of Applied Science, University of Canberra, P.O. Box 1, Belconnen, A.C.T. 2616, Australia. Phone: 06 201 5453; fax: 06 210 5728; E-mail: kovacs@science.canberra.edu.au

14-18 July 1997 **International Symposium on Antartica and Global Change**, Hobart Australia. Contact: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, United Kingdom; Phone: 44-1223 355974; Fax: 44-1223-336543; E-mail: 100751.1667@compuserve.com

20-24 July 1997 **Second Annual Meeting of the International Geological Correlation Programme (IGCP) Project no. 396 'Continental Shelves in the Quaternary'**, University of Durham, UK. Contacts: Mrs Alexandra Barfield, E-mail: a.m.barfield@durham. ac.uk; Fax: 44-191-3742456; Dr Wyss Yim (e-mail: wwsyim@hkucc.hku.hk), Prof. Peter Davies (E-mail: pjd@es.su.os.au); WWW: http://www2.env.uea.ac.uk/gmmc/index.html

19-24 August 1997 **Regional Perspectives on 20th Century Environmental Change**, St. John's, Canada. Contact: John D. Jacobs and Trevor Bell, Department of Geography, Memorial University of Newfoundland, Canada. E-mail: jjacobs@morgan.ucs.mun. ca or tbell@morgan.ucs.mun.ca; WWW: http://www.mun.ca/geog/

28 August - 2nd September **7th International Symposium on Palaeolimnology**, Heiligkreuztal, Germany. Contact: J. Merkt, Niedersächsisches Landesamt für Bodenforschung, P.O. Box 510153, D-30631 Hannover, Germany. Phone: +49 511 643 3611 / 3570; fax: +49 511 643 3667; E-mail: merkt@gate1.bgr.d400.de

28 August - 3 September 1997 **IV International Conference on Geomorphology**, Bologna, Italy. Contact: IV International Conference on Geomorphology, Planning Congressi s.r.l., Via Crociali 2, 1-40138 Bologna, Italy. Phone: 39-51-302980; Fax: 39-51-309477; E-mail: michele.galatin@planning.in.et.it

2-4 September 1997 **Archaeological Sciences '97.** Durham, UK. Contact: Andrew Millard, Department of Archaeology, University of Durham, South Road, Durham, DH1 3LE, England. Phone: 0191 374 3625; Fax: 0191 374 3619; E-mail: A.R.Millard@Durham.ac.uk.

8-12 September 1997 **Fifth International Carbon Dioxide Conference**, Queensland Australia. Sponsor: CSIRO Australia. Contact: Carbon Dioxide Conference Secretariat, CSIRO Division of Atmospheric Research PMB #1, Apendale, 3195, Victoria, Australia. Phone: 61-3-9239-4661; Fax: 61-3-9239-4444; E-mail: pnh@dar.csiro.au

10-13 September 1997 **Metals in Antiquity**, Harvard University, USA. Contact: Suzanne Young, Archaeometry Laboratories, Harvard University, Peabody Museum, 11 Divinity Avenue, Cambridge MA 02138, USA. Phone: +1 617 495 4388; fax: +1 617 495 8925; E-mail: SYoung@ FAS.Harvard.Edu

12-14 September 1997 **RECOVERIES '97, The final meeting of the UNESCO IGCP Project 335 "Biotic Recoveries from Mass Extinctions"**, Prague, Czech Republic. Contact: Petra Hovorkova, Recoveries '97, Eurocongress Centre, Budejovicka 15, CZ 140 00 Praha 4, Czeck Republic Email: recovery@gli.cas. cz

12-14 September 1997 **Rocky Mountain Cell, Friends of the Pleistocene Field Trip**, Aspen, Glenwood Springs and Rifle, Colorado, USA. Contact: Jim McCalpin,

GEO-HAZ Co. Fax 970-577-0041; E-mail: mccalpin@geohaz.com; http:// www.geohaz.com/geohaz

16-20 September 1997 **The History of Mediterranean Populations: Anthropological, Archaeological and Demographic Aspects: Associazione Antropologica Italiana XIIth Congress**, Palermo, Italy. Contact: Associazione Antropologica Italiana XIIth Congress, Scientific Secretariat, Prof. B. Chiarelli, Via del Proconsolo 12, 50122 Firenze, Italy. Fax: 055-283358; E-mail: antropos@cesit1.unifi.it

20-21 September 1997 **Canadian Geomorphological Research Group Workshop on Geophysical Techniques in Geomorphic Research**, Queen's University, Kingston, Ontario, Canada. Contact: Robert Gilbert, Department of Geography, Queen's University, Kingston ON K7L 3N6 Canada. Phone: 613 545 6034; Fax: 613 545 6122; E-mail: Gilbertr@qsilver. queensu.ca

22-27 September 1997 **6th International Conference on Fluvial Sedimento-logy**, University of Capetown, Capetown, South Africa. Contact: The Conference Organiser, 6 ICFS, Postgraduate Conference Division, UCT Medical School, Observatory 7925, South Africa or Contact Mrs Sally Elliot, Phone: + 27 21 406 6911 or 4066381; Fax: + 27 21 448 6263; E-mail: sally@medicine.uct.ac.za

27 September - 4 October 1997 **Climates of the Past: 6th Annual CLIP Meeting,** Cairns and Townsville, Australia. Contact: Prof. A.R. Chivas, School of Geosciences, University of Wollongong, Wollongong NSW 2522, Australia. Phone: 042 213841; Fax: 042 214250; E-mail: allan_chivas@uow.edu.au

4-5 October 1997 **Fourth Annual Meeting of the Midwest Bioarcheo-logy & Forensic Anthropology Association**, Loyola University Chicago, USA. Contact: Dr. Anne Grauer, Department of Sociology & Anthropology, Loyola University Chicago, 6525 N. Sheridan Road, Chicago, IL 60626, USA.

12-16 October 1997 **Second International Conference on Isotopes**, Sydney, Australia. Contact: Mrs Margaret Lanigan, Conference Overload (Australia) Pty Ltd, P.O. Box 1325, Crows Nest, N.S.W. 2065, Australia. Phone: 61 (0)2 9439 8220; Fax: 61 (0)2 9439 6561.

16-17 October 1997 **Second Conference on Nuclear Science and Engineering in Australia**, Sydney, Australia. Contact: The Conference Manager -- ANA 97, Conference Overload (Australia) Pty Ltd, P.O. Box 505, Crows Nest, N.S.W. 2065, Australia. Phone: (02) 9437 4879; Fax (02) 9439 6561.

26-31 October 1997 **Annual Meeting of the Soil Science Society of America (SSSA)**, Anaheim, California, USA. Contact: Headquarters Office of the American Society of Agronomy. Phone: 608) 273-8080; E-mail: kschlesinger@ agronomy.org; WWW: http://www. agronomy.org/olr/index.html or http:// www.soils.org/divs/s9/

16-19 November 1997 **Symposium on Palynostratigraphy at Low Latitudes**, Venezuela. Contact: Laurent de Verteuil, Geological Services Laboratory, Petrotrin Ltd., Pointe-a-Pierre, Trinidad,West Indies. Phone: (809) 658-4200/10/20/30 Ex. 2317; fax: (809) 658-3074; E-mail: devert@ petrotrin.com

17-18 November 1997 **DNA Forensics Science, Evidence, and Future Prospects.** Virginia, U.S.A. Contact: Cambridge Healthtech Institute, 1037 Chestnut Street, Newton Upper Falls, MA 02164, USA. Phone. 617-630-1300; Fax: 617-630-1325; e-mail: chi@healthtech.com; http://www.healthtech.com/conferences/

5-8 January 1998 **Environmental Change in the Tropics and Subtropics**, **Session in the Annual Conference of the Royal Geo-graphical Society/Institute of British Geographers**, Kingston University, London, Britain. Contact: Dr Jane A. Entwistle, School of Geography, Kingston University, Penrhyn Road, Kingston-Upon-Thames, Surrey, KT1 2EE, Britain. E-mail: j.entwistle@kingston.ac.uk; phone: 0181 - 547 - 2000 Ex:2552; Fax: 0181 - 547 - 7497; WWW: http://www.king.ac.uk/geog/ home.html

27 April - 1 May, 1998 **31st International Symposium on Archaeometry**, Budapest, Hungary. Contact: Katalin T. Biro, Hungarian National Museum, Dept. of Information, H-1450 Budapest, Pf. 124. Hungary. Fax: (36)-1-2101 338; E-mail: h5852tbi@ella.hu; WWW: http://origo.hnm.hu/ametry.

17-19 August 1998 **Geological Society of Malaysia Ninth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA '98)**, Kuala Lumpur, Malaysia. Contact: Organising Secretary, GEOSEA '98. E-mail: geologi@po.jaring. my

23-29 August 1998 **International Council for Archaeozoology 8th International Congress**, University of Victoria, Victoria, British Columbia, Canada. Contact: ICAZ98, Conference Management, Division of Continuing Studies, University of Victoria, University Centre 2nd. Floor, Room A277, Box 3030, Victoria, BC, Canada, V8W 3N6. Fax: 1-250-721-8774; E-mail: ICAZ98@uvcs.uvic. ca

31 August - 5 September **6th International Congress on Aerobiology**, Perguia, Italy. Contact: Unbria Congressi, via C.Caporali, 19, I-06123 Perugia, Italy. Phone: +39-75-573093 / 5722512; Fax: +39-75-5722512.

21-25 September 1998 **8th Congress of the International Association of Engineering Geology: Engineering Geology, A Global View from the Pacific Rim**, Vancouver, British Columbia, Canada. Contact: Ms. Kim Meidal, Secretariat, 8th Congress IAEG, c/o BC Hydro, 6911 Southpoint Drive, Burnaby, BC, Canada, V3N 4X8, Canada. Phone: (604)528-2421; Fax (604)528-2558; e-mail: kim.meidal@bchydro.bc.ca; WWW: http://www.bchydro.bc.ca/ bchydro/IAEG/ IAEG98.html

June 1999 **19th Pacific Science Congress**, Sydney.

3-11 August 1999, **XV INQUA Congress**, Durban, South Africa. Contact: Mrs E. Aucamp, PO Box 798, Silverton, Pretoria 0001, South Africa. Fax +27-12-8411221; e-mail: eaucamp@geoscience.org. za

CONFERENCE AND MEETING NEWS

CONFERENCE REPORTS

FIRST EUROPEAN MEETING ON PHYTOLITH RESEARCH, MADRID, SPAIN

23-26 SEPTEMBER 1996

Diane Hart
School of Earth Science,
Macquarie University, Australia

The First European Meeting on Phytolith Research was held in Madrid, Spain, on the 23-26 September 1996. The Meeting attracted over 60 participants from some 19 countries, including 3 from Australia. This was the historical first meeting of a young Society (formed in 1992) and gave researchers from all over the globe a chance to meet, discuss and learn more about phytoliths.

Personally, I found it wonderful to be among people who actually know what phytoliths are! Usually, when asked my area of research, I need to spend some time assuring the questioner that, yes, plants do concentrate silica in and between their cells as opal, and yes, these microscopic particles are found in amazing abundance in many sediments, where they are deposited after the plant dies. Having long been convinced, from a pedologists point of view, that phytoliths are a very important soil constituent which, ultimately, will tell us much about the soil they are found in, it was with some eagerness that I attended this meeting of what I hoped to be similarly enthused people.

And I was not disappointed. There were four well-attended Sessions dealing with *Phytoliths and Soils*, *Phytoliths and Plants*, *Phytoliths and Archaeology* and *Phytoliths and Palaeoecology*. Australian participants presented 2 papers in the *Phytoliths and Soils* Session ("Phytoliths and fire in the Sydney Basin, NSW, Australia", D.M. Hart, and "The mobility of phytoliths in soils: pedological considerations", D.M. Hart and G.S. Humphreys). Both of these papers dealt with phytolith mobility and their use in process studies. Other papers in this Session examined the use of phytoliths as tracers of weathering processes; phytoliths from soils in different landscapes; phytoliths in paleosols; phytoliths from loess in Central Asia and from soils in France, East Africa, Argentina, Mexico and Russia. Several Russian delegates gave papers discussing the distribution of phytoliths in Eastern European soils and their use in paleaoenvironmental work. Interestingly, what emerges from these papers on distribution and from others which examined distribution in natural soils, is that the simple falling off of phytolith content with depth through the A horizon is often not seen. The graphs in these papers show accumulation at depths throughout the A; at the base of the E in a podzol (Australia), in the E of a Taiga soil, a bulge at 8 cm depth in a Russian soil and at the base of the A12 in a coffee growing soil from central Mexico. The understanding of the processes leading to these distributions require a concerted research effort.

The *Phytoliths in Plants* Session looked at the morphology of phytoliths in banana, gymnosperms, grasses and cereals, monocot groups and East African plants. Several papers from England and Canada were botanical in nature, examining the deposition of silica in detail (gymnosperms) or the occurrence of silica throughout several groups and their uses in monocot systematics. Other papers were centered on reference collections for a variety of regions and vegetation communities.

The practical application of phytoliths to archaeological problems was the focus of a number of papers from diverse locations. Irwin Rovner, well-known for his papers in the 70's which re-examined the use of phytoliths in archaeological research, in a paper which looked at phytolith analysis of the micro-ecology of small hunter-gatherer sites in the Eastern USA, commented that if pollen fails, call in the phytolith expert. Phytolith analysis is often used only when there is an absence of pollen data, but has been shown to present a powerful source of data. He advocates using both pollen and phytoliths to maximize the information gained. This sentiment was echoed by other researchers who showed that diet can be reconstructed from human and mammoth teeth scrapings, flint, bone and groundstone tools, and that evidence of plant use in many different locations can be deduced from phytoliths.

The *Phytoliths in Palaeoecology* Session was equally as diverse. The reconstruction of African tropical grassland history during the late Holocene utilizing phytolith assemblages from lakes showed arid and wet phases. The presence of phytoliths

from herbaceous plants of the steppe in soils under burial mounds in a forested region in the northern Caucasus showed that the nomadic tribes of the 7-5th century BC settled during a short period of aridization and deforestation. Shifts towards aridity in climate in Ethiopia were demonstrated by the distribution of panicoid phytoliths during a wetter period, and the shift to chloridoid phytoliths with a decrease in tree phytoliths during the arid. Similarly, seasonal climatic changes over 150,000 years in the loess plateau of China were examined using phytolith assemblages. And in the geochemical area, oxygen-isotope variation in the phytoliths of C3 and C4 grasses is being used to look at the growing conditions for plants in the prairie of North America.

Each participant went away with a grass phytolith pin, a colour photograph of the delegates and a list of new colleagues which should go a long way to alleviating feelings of isolation. The diversity of papers given at the meeting, some of which will be published in the *Journal of Quaternary Research*, illustrates the growing importance of phytolith studies in many fields, an importance which we in Australia cannot afford to under-estimate. The Second International Phytolith Meeting will be held in Aix-en-Provence, France, on August 27-29 1998, just after the 16th International Soil Science Meeting in Montpellier and before the 8th V.M. Goldschmidt Conference in Toulouse. By interposing the Phytolith Meeting between these two meetings, it is hoped that many soil scientists and geochemists will be attracted to the Phytolith Meeting as well as archaeologists, palaeoecologists, botanists and, of course, Quaternarists! A workshop for phytolith researchers is planned for early next year in Sydney - see the notice in this Newsletter.

If you would like further information on phytoliths, The Society for Phytolith Research, The Phytolitherian (the Bulletin of the Society) and internet groups, please contact me:

Diane Hart
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Macquarie University
North Ryde, NSW, Australia

e-mail: dhart@magna.com.au

FIRST EUROPEAN MEETING ON PHYTOLITH RESEARCH, MADRID, SPAIN

NOTICE
PHYTOLITH RESEARCHERS

PHYTOLITH RESEARCHERS IN AUSTRALIA AND NEW ZEALAND (AND NEARBY?)

Here is an important message from Diane Hart: I have started a list of the above. Please send me your name, address, e-mail, telephone and fax number, and area of interest. Also, try to get others who might not be on the phy-talk e-mail list to add their names. We need to get vocal, assist each other, find people with like interests. Many of us cannot afford to travel overseas to conferences and meetings and we need to find out what we can attend closer at hand, etc.

For further details and inclusion in the list, please contact:

Diane Hart

School of Earth Sciences
Macquarie University
North Ryde, NSW, Australia

e-mail: dhart@magna.com.au

AUSTRALASIAN PHYTOLITH GROUP

NOTICE

LUMINESCENCE DATING LABORATORY VICTORIA UNIVERSITY, WELLINGTON

Jamie Schulmeister is very pleased to announce the 'birth' of a new luminescence dating facility in Australasia. Victoria University, Wellington, has taken delivery of a Riso automated TL/OSL machine and is in the final stages of completing the new luminescence laboratory.

The lab will be run on a semi-commercial basis like the University of Wollongong; expect prices to be roughly comparable to those offered by Wollongong. It will be possible to undertake three separate forms of luminescence dating (occasionally on the same sample!). These will be infrared stimulated luminescence (IRSL), optically stimulated luminescence (OSL) and thermoluminescence (TL). There will be a specialisation in fine fraction luminescence (8-12 μm) rather than the coarse fraction technique (90-120 μm) most commonly employed in Australia. This will make the new facility ideal for those interested in dating parnas, loess, lunettes and the like. The lab should be open for commercial samples by the end of the year. The facilities will also be available on a cost of chemicals only basis to graduate students for DIY work and the staff may be interested in collaborative work.

Olav Lian, who is a recent graduate of the University of Western Ontario, will be starting a PDF at the end of May to establish the facility. Olav has worked with David Huntley (one of the originators of OSL) at Simon Fraser for about a decade. Among his specialities is the optical dating of peats. In addition to expertise in luminescence dating, Olav adds to the developing strand of glacial geomorphological and glacial geological interest at Victoria University.

For further information and/or to go on the new labs mailing list please contact:

Jamie Shulmeister
Research School of Earth Sciences
Victoria University
P.O. Box 600
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Editor: M.L. Augee

Papers arising from a symposium held at Wellington Caves, December 1995

Published by: Linean Society of N.S.W.
Publication details: 1 March 1997
328 pages

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PUBLICATION NOTICE

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Radiocarbon is rolling back its subscription prices for individual subscribers to 1988 prices! Effective 13 January, subscriptions to the current volume (Vol. 38) are reduced from $85 to $55/year for new subscribers. All individual subscriptions to Volume 39 will also be at $55/year. Volume 38 includes the abstracts of the 7th International Conference on Accelerator Mass Spectroscopy, a special-topic issue on Soils Dating edited by Doug Harkness and Peter Becker-Heidmann, and a special-topic issue on Oceans edited by Ellen Druffel, Ann McNichol, and Warren Beck. Individual subscriptions to *Radiocarbon* include the triennial conference proceedings issue from the international radiocarbon conferences too. (The next one is scheduled for Volume 40, 1998).

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RADIOCARBON

QUATERNARY E-MAIL LISTS, INTERNET PAGES & ELECTRONIC JOURNALS

In the last issue of *Quaternary Australasia*, it was suggested that this column looked like becoming a regular feature, and the list below confirms that. While I know that it is possible to get much more complete lists by going straight to the web, it is helpful to have somewhere to start. Perhaps this is the place. So here we go. The following is the usual mixed bag, some obviously Australasian, but not so. Apologies for any overlaps with earlier lists (I have listed the addresses previously published as the end for reference). Also, if you have a favourite web site or e-mail list that everyone should know about, please get in touch a.s.a.p. for inclusion in the next issue.

Geographie Physique et Quaternaire
http://www.lemig.umontreal.ca/gpq/rgpq.htm

Take a minute to scan the content of the current issue of GpQ then visit the web site (http://www.lemig.umontreal.ca/gpq/rgpq.htm) and better, subscribe and send manuscripts to this not-for-profit scientific journal supported by the Canadian Association for Quaternary Studies (CANQUA) and by the Quebec Association for Quaternary Studies (AQQUA).

***

OCR Carbon Dating procedure
http://members.aol.com/dsfrink/ocr/ocrpage.htm

You may have used or heard of the OCR Carbon Dating procedure. However, because this is a new procedure for dating organic carbon, some have not yet been exposed to it. In the attempt to increase the dissemination of this information, and to increase discussions of the procedure, a web page has been developed containing publications, current data, and other information on the OCR procedure. The address is: http://members.aol.com/dsfrink/ocr/ocrpage.htm

***

List-server dedicated to Australian Archaeology
AUSARCH-L

Announcing a new list-server dedicated to Australian Archaeology. The purpose of the list server is to facilitate communications about all shades of Australian archaeology (prehistoric, historic, maritime, etc). The list server operates as a mail room when you want to pass on information to all subscribers to the list. As with list servers on other themes messages might contain questions to other subscribers, presentations of information, or discussions of results. To subscribe to the list, send the message <SUBSCRIBE AUSARCH-L your name> to: listproc@listproc.anu.edu.au Replace 'your name' with your real name (up to four words). Listproc gets your email address from the From: header in your message. Please do not add any other text to the message. If you do you will still be subscribed but will receive an additional message reporting an error because the list server will not understand the first word of additional text. This commonly happens if you automatically send a 'signature' with your email. If this happens to you ignore the error message. That is the procedure for subscribing only. Please do not send messages to this address. If you want to send a message to the list address it to <AUSARCH-L@listproc.anu.edu.au>
Anyone can subscribe to the list and send messages to it. Please pass this message on to anyone you think might be interested in the list. The 'owners' of AUSARCH-L are: Peter Hiscock (ANU - peter.hiscock @anu.edu.au), Peter Veth (JCU - Peter. Veth@jcu.edu.au), and David Roe (JCU - David.Roe@jcu.edu.au). Please contact one of them if you have problems with the list.

***

Archaeology World
http://artalpha.anu.edu.au/
web/arc/arcworld.htm

Just an address ... try it and see what you find!

***

Elevation and bathymetric data
http://www.ngdc.noaa.gov/
mgg/global/seltopo.html

The National Oceanographic and Atmospheric people have a data set of 5 minute elevations for the whole world -- this includes bathymetric data ... good for palaeosea-level estimates. You can select your area of interest by coordinates and download a matrix of values. If you can apply estimates of sea-levels at the sites for the time period you want you can calculate which areas were above sea level. The address is: http://www.ngdc.noaa.gov/mgg/global/seltopo.html

***

Sheffield University Graduate Journal of Archaeology
http://www.shef.ac.uk/
uni/union/susoc/assem/

Hello! The long-awaited second issue of *assemblage*, the Sheffield graduate journal of archaeology, is now online at http://www.shef.ac.uk/uni/union/susoc/assem/ (or http://www.shef.ac.uk/~assem/). And when you're there, check out assemblage-info http://www.shef.ac.uk/~assem/2info.html dedicated to providing a constantly updated information service for the archaeological community at large and postgraduate students in particular, currently listing details of 126 funding sources, 59 conferences and links to 149 online archaeological bibliographies! The info pages also offer a short selection of genuinely useful links and cool archaeological web sites and coming soon will be info on academic jobs, a news clippings service and schedules for archaeological TV programmes.

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CSIRO Publishing Electronic Journals
http://www.publish.csiro.au/
journals/electronic.html

CSIRO Publishing, the Australian scientific and technical journal publisher, has recently introduced limited-time free electronic access to eight scholarly journals (Adobe Acrobat [.pdf] format only). The journals cover the fields of botany, agriculture, physics, zoology, soil research, plant physiology, and wildlife research. 1997 issues only are available at this time. In the next few months, five more journals are scheduled to come online, and all will be freely accessible at the site during 1997.

After this, access will be restricted to subscribers.

***

Quaternary email list
quaternary@morgan.ucs.mun.ca

Just a reminder -- the archives for this list are at http://www.mun.ca/lists/quaternary To subscribe to the list, send the message <subscribe quaternary your name> to listserv@morgan.ucs.mun.ca

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BUGS database
ftp.shef.ac.uk\pub\uni\projects\bugs

A draft of the BUGS database, which includes the greater part of the North European Lateglacial and Holocene record, is available from the Sheffield ftp site <ftp.shef.ac.uk> at \pub\uni\projects\bugs. This can either be downloaded as an Access file (bugs.mdb) plus the spread sheets (*.xls) for Excel, or in compiled form as discs 1-8. Please note that for reasons known only to Access, disc 5 contains 1.75mb of data and so you will have to download to a hard drive. Any problems contact in the first instance Phil Buckland (the programmer) at Umea <phpbud96@student.umu.se>. Data entry will continue and so updates will be available progressively. In addition, keys to the British beetle fauna by Pete Skidmore are also being tried out on this system.

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Evolutionary Theory email list
http://www.esosoft.com/evolution/

Thom Quinn would like to inform everyone here that there is a new mailing list for the discussion of Evolutionary Theory. Although there are many such lists that exist for biology, most of them are aimed at a very specific subset of specialists. The new list is designed for broad, inter-discipline discussions on evolutionary topics. It would be an excellent resource for professionals to gather information about advances outside their normal scope (i.e. it will allow fossil hunters to talk to gene splicers). This site should not be used for the evolution/creation debate! The easiest way to subscribe to this mailing list is to just visit the website and fill out the "quick form" right at the site. Point your browsers at http://www.esosoft.com/ evolution/ to join the list.

***

Recent Titles on Oceania
http://coombs.anu.edu.au/
~marck/anhmpg.htm

Jeff Marck writes that he subscribes to a few electronic notification services and has loaded something over 1000 journal titles received from them for 1995 and 1996 into the Association for the Study of Austronesian Languages web site. Most titles concern Oceania but a few do not for some reason. All fields of study are included (geology, biology, etc.) and there are also titles from commercial, hobbiest and professional publications. They are available through the very bottom of the following page in the Austronesian On-Line web site: http://coombs.anu.edu.au/~marck/ anhmpg.htm which is the main "Bibliographies" page in the site. They are in Endnote-Refer Export format and can easily be converted to Shoebox or imported by most other bibliographic softwares. If you have no software for such things you can simply open the file in your word processor and search for ("Find"), e.g., "Samoa" or other places or topics.

***

Hong Kong University Earth Scienecs Department
http://www.hku.hk/earthsci/
rock.html

The Hong Kong University Earth Sciences Department has research programmes in the evolution of palaeoenvironment of the region; see <http://www.hku.hk/earthsci/ rock.html> You can also search HKU's library for related publications.

***

Bibliography of Canadian Geomorphology
http://geography.geog.uvic.ca/

Members may be interested to learn of the Canadian Geomorphology Research Group (CGRG) "Bibliography of Canadian Geomorphology". The bibliography contains over 4000 entries and can be searched over the internet using the CGRG search engine. While many aspects of Canadian geomorphology are included, a substantial proportion of the entries relate to the Quaternary geomorphology of

Canada. To search the bibliography, start at the CGRG home page address and go the "Bibliography" chapter: http://geography. geog.uvic.ca/dept/cgrg/cgrg.htm Authors are invited to submit citations of their publications for inclusion in the bibliography.

***

Quaternary Research Association http://www2.tcd.ie/QRA/meet.html

All of the Association's proposed activiities for 1997 are listed on the WWW under the QRA home page or at http://www2.tcd.ie/ QRA/meet.html

***

Cryostratigraphy Research Group http://www.cpes.sussex.ac.uk/crg/

The Cryostratigraphy Research Group (a fixed term research group of the QRA, affiliated with the British National Adhering Body of the International Permafrost Association) has a new web page accesible via the QRA page or at: http://www.cpes. sussex.ac.uk/crg/

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International Tree Ring Database http://tree.ltrr.arizona.edu/~grissino/henri.htm

Recent discussions about the "how long does wood last anyway?" parallel a discussion that took place on the ITRDB listserv (International Tree Ring Database). Among those discussions was a lengthy one on subfossil wood. The archives of the ITRDB listserv can be accessed via the "Ultimate tree-ring web page". It's a great resource -- check it out at: http://tree.ltrr. arizona.edu/~grissino/henri. htm

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Fish fossil web site http://atlas.otago.ac.nz:800/~foss/ICAZ/icaz.htm

That's it!

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Previous listed web sites and email lists

Quaternary Australasia 13/2 (1995)

Quaternary List: Canadian Research in Quaternary Science: QUATERNARY@morgan. ucs.mun.ca

Quaternary Research Association WWW Home Page and E-mail directory: http:// www2.tcd.ie/~pcoxon/qra.html; pcoxon@tcd.ie

Glacial Geology & Geomorphology: http:// ggg.qub.ac.uk/ggg

ARCLING: Language, Anthropology and Archaeology: ARCLING@listproc.anu.edu.au.

Phy-TalkPhytolith Research Discussion Group: phy-talk@vm1.spcs.umn.edu

Tropical Geomorphology Newsletter: http:// www.zikzak.net/tgn

Journal of Palaeolimnology: http://www. umanitoba.ca/geosci/PALEOLIM/jopl.html

World Palynology E-mail Directory on WWW: http://opal.geology.utoronto.ca:80/AASP/ aaspemail.html

Quaternary Australasia 14/1 (1996)

Earth & Planetary Sciences Letters: http:// www.elsevier.nl/locate/epsl

Quaternary Research Association WWW: http://www2.tcd.ie/~pcoxon/circ3.html

Irish Association for Quaternary Studies (IQUA) WWW: http://www2.tcd.ie/~fmitchll/ iqua.html

Quaternary Environmental Network WWW: http://www.soton.ac.uk/~tjms/adams1.html

INQUA Commission on Glaciation WWW: http://geology.wisc.edu/cog

Australian Archaeologists WWW Page: http://www.arts.su.edu.au/Arts/departs/archaeol/austarch.html

Geomorphlist: adgjl@ttacs.ttu.edu.

Association of Polish Geomorphologists: http://hum.amu.edu.pl/~sgp/welcome.html

Tropical Geomorphology Newsletter: http:// zikzak.net/tgn/issues/i16.html; http://zikzak.net/tgn/issues/i17.html; http://zikzak.net/tgn/issues/i118-19.html

Journal of Paleolimnology WWW home Page: http://www.umanitoba.ca/faculties/science/ geological_sciences/PALEOLIM/ jopl.html

Stable Isotope List: alini@moose.uvm.edu

Archaeobotany List: listproc@eng-h.gov.uk

Paleolimnology and Diatom WWW pages: http://www.indiana.edu/~diatom/paleo.html

Society for Archaeological Sciences SASnet Mailing List: listserver@relay.doit. wisc.edu

Colby College, Maine, Quaternary Web Page: http://www.colby.edu/geology/Quaternary. html

Pollen analysis software on WWW: http:// geology.wisc.edu/~maher/inqua.html; http://www-palecol.plantsci.cam.ac.uk/

Oak Ridge National Laboratory Distributed Active Archive Centre: http:// www-eosdis.ornl.gov

Geophemera On-line: http://ggg.qub.ac.uk/andy/ bgrg/geophem/index.htm

LITHICS-L: hjavis@acsu.buffalo.edu

AMQUA WWW Homepage and E-mail: http://cc.usu.edu/~Dkaufman/AMQUA.html

EQMal: Europeran Quaternary Malacologists: http://www.inter.nl.net/users/ Meijer.T/eqmal.html

Quaternary Australasia 14/2 (1996)

INQUA Commission on Glaciation: http:// www.emporia.edu/S/wwwearthsci/gage/glacier7.htm

Journal of Foraminiferal Research WWW Home page: http://superior.carleton.ca/~tpatters/ cushman/cushman.html

International Archaeometry Conference WWW Homepage: http://www.origo.hnm.hu/ ametry68/homep1.html

Society for Archaeological Sciences WWW pages: http://www.wisc.edu:/anthropology/sas/sas.htm; http://www/he.net~archaeol/ 9609/abstracts/dna.html; http://www.wisc.edu/ anthropology/sas/ARK96.htm;http://www.wisc.edu: 2874/anthropology/sas/isrwrk.htm

Provincial Museum of Alberts WWW Presentation: http://www.pma.edmonton.ab.ca

Emporia State University WWW Course: Ice Age Environments/Quaternary Geology; http:// www.emporia.edu/S/www/earthsci/ice/icehome.htm

C14 Dating Labs E-mail contact addresses:
Beta Analytic: beta@analytic.win.net
Illinois State Geological Survey (ISGS): jliu@ geoserv.isgs.uiuc.edu
Saskatchewan Research Council: campbell @src.sk. ca
University of Minnesota - AMS: haskell @maroon. tc.umn.edu
University of Waikato: ahogg@waikato. ac.nz or Thigham@waikato.ac.nz
University of Waterloo: http://www.science. uwaterloo.ca/~rkhmskrk or mepatton@ sciborg. uwaterloo.ca
UNLV, Las Vegas: Dr Herb Hass: haas@ snsc.dri. edu

QUATERNARY E-MAIL LISTS, INTERNET PAGES & ELECTRONIC JOURNALS

QUATERNARY AUSTRALASIA PAPERS

Paper: Quaternary Australasia 15/1 (1997)

PLANT OPAL PHYTOLITHS: AN AUSTRALIAN PERSPECTIVE

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Abstract

Phytolith research is taking off in Australia, as it is in the rest of the world. Australia has a history of pioneering research into biological silica but few scientists are familiar with the characteristics and possible uses of phytoliths in archaeology, palaeoecology, pedology and botany. Morphological keys for the identification of phytolith shapes are regional in application. Problems exist in separation techniques and in dealing with the multiplicity and redundancy of shapes. Users need to be aware of the processes which affect phytoliths as they pass from plant to litter, litter to soil and those which occur within the soil itself, in particular the variety of mechanisms leading to the mixing of phytolith assemblages in soils. In the future, uses for phytoliths might include employing non-shape attributes, such as occluded elements, to assist in identification of sediments, dating the occluded carbon within phytoliths, and using phytoliths to trace processes in soils and sediments.

Introduction

Opal phytoliths consist of hydrous silica ($SiO_2.nH_20$) which is often referred to as opal-A by mineralogists (Table 1). It is deposited within leaves, stems and roots of plants, though the reasons for this have not been firmly established. While it appears to be a requirement of all organisms, the presence of silica in plants may serve to provide support and to strengthen against disease, fungal attack and consumption by grazing higher animals. For example, plant opal appears in the fossil record in the lower to middle Eocene at the same time as the appearance of mammalian fossils with high-crowned teeth capable of grinding phytolith bearing plant matter (Stebbins 1981). It has also been suggested that the open structure of plant opal provides a storage site of other cations that plants can utilize when required (Drees *et al.* 1989).

Phytoliths are preserved in acidic soils and resist weathering, at least in the larger diameter size fractions. They have been identified in paleosols (e.g. Kurmann 1985), in dusts (e.g. Baker 1959a), in deep sea sediments (e.g. Kolbe 1957, Locker & Martini 1986) and in sedimentary rocks (e.g. Jones 1964). In this respect they compare favorably with pollen and spores which generally do not survive oxidizing environments.

The presence of opal phytoliths in living plants was discovered in the mid 19th century. One of the earliest to describe them was Ehrenberg, a German microbiologist, who was sent dust samples collected on the Beagle's sails by Charles Darwin (Darwin 1846). Despite this early start it was not until the 1950's and 1960's that considerable advances were made with substantial research efforts in Europe, North America and Australia. Recently, there has been considerable renewed interest in examining these small particles in both sediments and plants in the hope that they will shed light on a variety of problems in disciplines ranging from archaeology to medicine. The First European Meeting on Phytolith Research (held in Madrid, 1996; see elsewhere in this issue) attracted an attendance of delegates from 19 countries including Australia, and covered a diverse range of topics in archaeology and paleoenvironmental studies, as would be expected. It also included papers on phytolith distribution in soils and their importance in soil process, and on phytolith systematics. The recently formed Society for Phytolith Research has

a very wide membership of researchers reflecting diverse interests.

Table 1: Salient features of opal phytoliths

Item	Features
Synonyms	phytolitharia, plant opal, grass opal, opaline spicules, bioliths, opaline silica, phytolite (not to be confused with diatoms and sponge spicules)
Composition	opal-A, hydrous silica (SiO_2. n H_2O)
Impurities	Al, Fe, Ti, Mn, P, Cu, N, C and others
Mineral identification	Distinguished from soil silica polymorphs (quartz and opal-CT) especially in terms of: specific gravity (lower), refractive index (lower), impurities (higher), x-ray diffraction (diffuse, broad spectrum), delta values of isotopic oxygen (higher)
Biological identification	Distinguished from diatoms and sponge spicules (both opal-A) especially in terms of shape and surface morphology under light microscopy and SEM
Phytolith shape	Highly variable, ranging from solid polyhedral structures common in grasses to thin structures or loose aggregates both with or without fragile encrustations (many dicotyledons). Diatoms contain sieve pores regularly arranged along valve surfaces; sponge spicules are acicular with an axial canal and non-pitted surface.

The status of phytolith research

The literature clearly divides the study of opal phytoliths into three main areas -- botany, archaeology and paleao-environmental research -- and to a lesser degree pedology. Much of the important botanical research was undertaken overseas, originally in North Wales and later in North America (e.g. Parry & Smithson 1957, 1966; Sangster *et al*. 1968, 1985, 1996). Most of the archaeological research is centered on the United States (e.g. Rovner 1983); some pedological work is being undertaken in Japan (e.g. Kondo & Sase 1986) and Europe (e.g. Bartoli 1985).

What has emerged from these studies is the realization that phytoliths are a more complex plant fossil than pollen. While in many studies phytoliths are used in addition to pollen to determine environment, a better understanding of the advantages and limitations of phytoliths is developing and areas of research are arising where phytolith analysis plays a pivotal role (e.g. Ryan 1996). This trend is in contrast to a viewpoint of less than twenty years ago when many researchers assumed that because of similarities in size and specific gravity that phytoliths would behave in a similar way to pollen in the soil (e.g. Pearsall 1978).

Phytolith research in Australia

Amorphous silica particles were observed in Australian soils by Carroll (1931) who identified them as sponge spicules. It was to take nearly 25 years before this was corrected but not before others had contributed to the topic. Thus Leeper *et al*. (1936) referred to the presence of hyalite and sponge spicules in soils, and in a subsequent paper by Nicolls (1939), the occurrence of fresh-water sponge spicules in Victorian soils was considered in terms of an aeolian origin. Brewer (1955) discussed diatom skeletons and sponge spicules in soils of New South Wales and put forth an alternative hypothesis that they developed *in situ* at a time when the soils were wetter. Subsequently, Baker & Leeper (1958), after Baker had consulted with Smithson in North Wales in 1957, reassessed the opaline silica in soils as plant phytoliths. There followed a series of papers by Baker where he observed phytoliths shapes in soils and dust, classified phytoliths and statistically compared assemblages (Baker 1959a), listed categories of phytoliths according to placement in cells of plants and discussed phytolith presence in sediments in the late Pliocene (Baker 1959b). He established the presence and importance of phytoliths in Australian soils as well as their persistence as fossils. Colleagues of Baker, L.H.P. Jones *et al*. (Jones *et al*. 1963; Jones & Milne 1965; Jones & Handreck 1965), evaluated the effects of silica in oats, *Avena sterilis*, on digestion by farm animals especially the relationships between silica deposition in the plant and growth stage, and the form of uptake of the silica.

Much of the recent research in Australia parallels international trends and has centered on the use of phytoliths in identifying plants and plant communities in archaeology and paleoenvironmental research. Some Australian researchers have utilized phytoliths in overseas projects (Wilson 1985; Williams *et al.* 1986) and a few are beginning to concentrate efforts in archaeological research in Australia (Bowdery, 1984, 1989, 1996; Fujiwara *et al.* 1985). Combined phytolith and pollen analysis has been used by Warren (1994) in Tasmania. Pedological aspects of phytoliths have been examined in Australian soils by Hart (1992), Boettinger (1994) and Hart & Humphreys (1996). A largely untapped source of phytolith information in Australian soils is provided in Stace *et al.* (1968).

Nevertheless, few researchers in Australia are familiar with phytoliths and fewer still are aware of the problems confronted when dealing with them. The lack of continuity of research in Australia means that the opportunity to see phytoliths, apart from in photographs and other images, does not exist. Few Australian University courses deal with phytoliths and many of the current generation of phytolith students must start from scratch.

Morphology

The diversity of phytolith shapes is fascinating but the repetitive shapes represent only a small proportion of phytolith in both plants and the soil. Most phytoliths are in the form of platy irregular pieces which are often considered unimportant. Indeed, what is commonly extracted from a sediment is the plant opal from a limited fraction, the silt. This is due to problems in extracting clay-sized opal even though it is known that considerable amounts occur especially in the coarse clay fraction. Wilding & Drees (1974) suggest that the 50-70% of phytolith is clay-sized and if this is generally the case it is obvious that the assumption that the silt sized fraction is representative of the total phytolith assemblage may prove to be false. Minor amounts are generally found in the sand though this fraction too is usually not considered important.

Phytolith shape is controlled by the shape of the plant cells at the time of silica deposition. For this reason most phytoliths are sheet-like, i.e. form between cells, or globular, i.e. fill the cell as a complete or partial internal cast of the cell (Bennett 1982; Perry 1989). The morphology of phytoliths in monocotyledonous plants and in particular the Poaceae, has been examined in considerable detail, but that in dicotyledonous plants has received less attention. This is partly due to the more fragile nature of the later which are difficult to extract and also because they occur in smaller quantities. The consensus is that it is possible to identify phytoliths from the Poaceae to sub-family or even tribe in some cases (Twiss *et al.* 1969; Brown 1984, 1986). Such work has been undertaken in rather limited numbers of sub-families and is based on the botanical classification of the grasses, which itself is open to various interpretations.

It is not known whether or not regional or even global phytolith keys are feasible at present. Existing knowledge is not particularly optimistic. For example, recent comparisons of stipoid flora between Australia and North America showed that different sets of characteristics are required for classification. In particular the lemma epidermal patterns and the arrangement of silica bodies there-on are treated very differently (Barkworth & Everett 1986). At this stage it is suggested that area specific keys be used. The formulation of suitable keys is likely to be a major issue for many researchers and as a consequence this topic is expanded upon below.

Phytolith systematics

There are three main approaches to the systematics of phytoliths: the para-taxonomic, the botanical and the morphological approaches (Mulholland & Rapp 1992). The parataxonomic approach considers each phytolith morphology to be an entity which can be assigned a Latin name following the Linnean system. Mulholland & Rapp (1992) mention that this approach is still generally used by micropaleontologists although phytoliths are known to originate in plants and this method is usually adopted when the origin of the entity is not known, such as with conodonts. Researchers using this approach point out that multiplicity and redundancy of shape is common. Multiplicity is the presence of several types within a single plant; redundancy is where the one type appears over several species. Botanists dealing with plant materials, name phytolith types after the cell which the silica body occupies (i.e. epidermis, haircell, mesophyll), while the

morphological approach defines disarticulated shapes (e.g. dumbbell, cross, trapezoids). This latter approach encompasses methods where only geometric shapes are described, as well as those which relate some shapes to plant elements (Mulholland & Rapp 1992).

Keys for the identification of phytoliths abound in the literature. Mulholland & Rapp (1992) discuss a grass silica-body key which utilizes geometric shapes which are related to anatomical origin. Their 7 categories are based on cell type and the category 'silica-body' is divided into eight shape types which are the outline of the silica-body base in planar view. Cereal grain phytoliths have been divided into 23 types based on origin within the plant (Kaplan *et al.* 1992). In this, as with most studies, the aim has been to identify phytoliths from particular regions. However, the development of regionally specific keys can only be realized after many years of collecting, photographing and describing. This approach highlights the problems faced in countries such as Australia, where very little identification work has been attempted. In reviewing attempts of classification in Australia, Bowdery (1989) attributed the great diversification in classification and nomenclature to the fragmentation in research.

Nevertheless, two recent Australian keys are based on many years of extensive research. Hart (1992) erected a key for the identification of disarticulated phytoliths in soils of New South Wales. A morphological approach was taken to produce a key comprising an aggregational or exclusive hierarchy in three sections. The first section comprised those shapes which are generally considered to be grass-derived and which lack ornamentation. They were subdivided further on the basis of shape alone. The second section comprised three levels: basic three-dimensional shape (rods, spheres, etc.), secondary shape character-istics (thick, thin, single, compound, etc.), and surface ornamentation (smooth, ridged, etc.). The third section comprised two classes: unclassified opal (pieces not fitting into the above scheme) and opal of other biological origin (diatoms, sponge spicules, etc.). Bowdery (1996) constructed a numerical scheme based on morphology within the broad botanical groups of Poaceae and Dicotyledon/Monocotyledon (non-Poaceae) in her study of archaeological sites of the Australian arid zone. The first level comprised geometric shapes; subsequent levels were types of ornamentation. Both of these schemes are for disarticulated phytoliths and both are extendable.

Elsewhere, Rovner & Russ (1992) examined phytolith classification and commented that, in defining a phytolith type, idealized and simplified models are used which tended to reduce to a central tendency. Shape attributes are descriptive (i.e. dumbbell, cross), and the problems of multiplicity and redundancy are not helped by this. Rovner & Russ consider that new procedures specific to phytoliths should be developed, utilizing image analysis to measure the attributes of size, shape and frequency. They report results of tests on maize phytolith short cell populations which they found promising (1992).

The proliferation of keys, each differing in nomenclature and shape descriptions, is unavoidable at this stage. A considerable amount of basic research is required before a more standardized approach can be anticipated.

The species-specific phytolith

Much of the phytolith research in the archaeological and paleoenvironmental areas has been directed at finding either a species-specific phytolith, a single shape diagnostic of a plant species, or an assemblage of phytoliths diagnostic of a vegetation community. In this respect the aim of this approach, the identification of plant species or communities, is the same as for pollen.

In archaeology, the discovery of a phytolith diagnostic of cultivated cereals or vegetables has long been pursued. The presence of cross-shaped phytoliths at an archaeological site in Ecuador has been used to support arguments for cultivation of maize on the basis that this opal shape is found in this cereal (Pearsall 1978). Not surprisingly, this contention raised considerable interest in American prehistory (Moore 1978, Rovner 1983) and prompted further studies of this type. For example, Bozarth (1986) reported distinctive phytoliths derived from bean pods and the curcurbit rind as part of a reference collection of plants to assist in an examination of prehistoric villages in the central plains of North America. Distinctive phytoliths have also been

reported in palms, bananas and plantains (Piperno 1987).

In palaeoenvironmental reconstructions the species-specific phytolith is assumed to indicate a particular species and hence environment. For example, the presence of cone-shaped opal in soil was assumed to indicate the presence of sedges (Cyperaceae) as this shape was found as a conical hat on an organic pad projecting from the inner tangential walls of living epidermal cells in these plants (Mehra & Sharma 1965). This shape has also been reported as being specific to the Cyperaceae by Norton (1966), Piperno (1987), and Ollendorf (1992). However, in one small sample of Australian vegetation, this phytolith shape was found in dicotyledonous families including several *Acacia* species (Hart 1990, 1992).

At this stage in phytolith investigations it is likely that more and more of these simple associations will be called into question. Indeed it may be unrealistic to expect very many examples of species specific phytolith given the means of opal formation and the cell sites where it is deposited. Nevertheless, it is reasonable to expect that diagnostic characteristics may exist at a higher taxonomic level as seems to be the case with the grasses at least to the level of tribe (Twiss *et al.* 1969).

Phytolith assemblages

The examination of phytolith assemblages diagnostic of a particular vegetation type is, as yet, in its infancy, both world-wide and in Australia. While some work in the Poaceae has been published (Piperno 1987), very little has been done outside areas which have a dominantly grass vegetation. It appears possible to identify assemblages from dominantly grass communities due to their more robust shape. It is assumed in many assemblage studies that the plant opal assemblage derived from the topsoil characterizes or is related to that in the modern vegetation growing on it and that this may then be used as a reference assemblage to identify past vegetation communities. However, this assumption may be unfounded. Thus in one Australian study Hart (1992) found that phytolith assemblages obtained from topsoils from three different plant communities in the Pilliga State Forests were so similar that they could not be differentiated. This was despite the fact that these communities differed in species and structure: mallee dominated by *Eucalyptus viridis*, a heath or broom dominated by *Melaleuca uncinata*, and an open woodland consisting of *Callitris columellaris* and *Eucalyptus creba*. The situation is even more confusing than this since a comparison of four sites of the same community, broom, showed that the assemblage differences were much greater than between the different communities.

Both botanical and pedological factors influence the sediment phytolith assemblage. Botanical factors include species diversity and proportion, relative amount of plant opal production and its size range. Horizontal and vertical displacement of the phytoliths and dissolution rates of opal-A are important mechanisms from a pedological viewpoint. In addition, changes to phytolith assemblages may be brought about by environmental stresses imposed on the plant. Hart (1996) has shown that fire affects the amount and morphology of the phytoliths available for incorporation into the soil. It is also possible that a different type of functional classification of vegetation communities is required. In particular a broadening of definition is implied if phytolith assemblages are to be used in palaeoenvironmental reconstructions.

Other attributes

Shape is only one attribute of plant opal; the remainder hinge on its composition and the properties stemming from this are used to identify the material as opal (mineralogical properties) and in separation techniques (specific gravity). These properties are well documented (e.g. Jones & Beavers 1963; Drees *et al.* 1989). However, very little use of these other properties has been made except for dating (electron spin resonance, thermoluminescence, carbon-14, etc.). The major limitation at present is in obtaining pure samples such as to ensure that the dated carbon, for example, is the occluded carbon trapped in the opal and not more recent carbon deposited on the surface of phytolith fragments.

A largely untapped source of information may be available from other occluded elements trapped within the open lattice structure of opal-A. Compositional variation may tell us something about host plant growth conditions including sediment, nutrient availability and toxicity.

The advent of more sensitive instruments with which to explore the elemental composition of phytoliths provides a basis for "finger-printing" phytoliths from a particular sediment with the potential to determine provenance (Hart 1992).

Technical problems

Separation from plants and sediments The separation of phytoliths from plant material does not generally present a problem once the researcher decides on whether it is in-place or completely disarticulated phytoliths which are required. For example, epidermal peels or dry-ashing might be used to examine reasonably *in situ* phytoliths while wet ashing (oxidation) may be used to completely disarticulate the phytolith.

Heavy liquids are generally used to float phytoliths from the silt fraction of sediments and soils. Zinc bromide has been used for some time in quantitative work, but is hazardous and many phytolith researchers are now using sodium polytungstate which is non-hazardous (Hart 1988; Rosen 1992). In non-quantitative work, ultrasound (Fujiwara *et al*. 1985) or a crucible method (Powers & Gilbertson 1987) may be used to concentrate phytoliths. Each method tends to produce slightly varying assemblages of phytoliths, depending upon settling time, sonication period, and many other variables (see Bowdery 1996, for an evaluation of these methods) and thus comparisons between workers may be difficult. In the clay fraction the usual heavy liquid separation methods are unsuitable. The ability to separate phytoliths from other clay sized materials presents a major research challenge.

Purity of sample It is essential that samples of phytoliths be pure; that is individual phytoliths be free from coatings such as charcoal and clay and from chemicals used in separation techniques, and the sample as a whole contain no other sediments or organic materials. Heavy liquid separation does not provide a pure sample, and while the small amount of extraneous material can be accounted for by point counting methods, for sample preparation where purity is essential such as trace element determination and carbon dating, extra steps need to be taken after separation (Hart 1992). Considerable research effort is required to improve techniques for securing pure samples.

Problems in interpretation of data Phytoliths may be moved by the wind, by water over the surface, in bush fire smoke, by animals and insects, etc. Thus in interpreting data, an understanding of the various processes which might affect phytolith mobility is necessary. Australian research in this area has demonstrated that phytoliths may be partitioned within the soil or sediment according to feeding preferences of soil mesofauna especially ants, termites and earthworms. Such preferences can be expected to generate different assemblages of phytoliths between soil layers or even within the layers such as between pedotubules (infilled faunal channels) and the surrounding soil (Hart & Humphreys 1996). Apart from bioturbation, phytoliths can also be conveyed between soil layers by other mechanisms leading to the mixing of assemblages. This reaches an extreme form in cracking clay soils (vertosols/vertisols) where stresses induced by wetting and drying and other forms of deformation leads to pronounced turbation (e.g. Boettinger 1994). However, mixing can also occur by pervection (downward movement of particles, phytoliths in this case, through interconnecting voids). This has been shown in a podzol where phytoliths tend to concentrate above a denser pan (Hart & Humphreys 1996). This synopsis indicates that there is every expectation that any phytolith assemblage in soil or sediment has been influenced by a variety of mixing mechanisms. Due allowance of this is required for meaningful interpretation.

Conclusions

During the period of research which took place in the 1950's and 1960's, Australian scientists made valuable contributions to the investigation of phytolith characteristics. However, possibly due to the need to concentrate their research efforts elsewhere in a continent having unusual flora, a short European history and a small population, this initial impetus was lost or at least slowed down somewhat.

To take full advantage of the present upsurge in interest, concerted effort needs to be made to ensure that Australasian scientists both keep abreast of developments overseas and develop expertise in phytolith analysis specific to their region. This is an exciting area of research which promises to both

complement and augment existing techniques for investigations in several disciplines.

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QUATERNARY AUSTRALASIA PAPERS

Paper: Quaternary Australasia 15/1 (1997)

THE AUSTRALIAN QUATERNARY DATA ARCHIVE (AQUADATA): REINCARNATION OF THE AUSTRALIAN QUATERNARY CLIMATES DATABASE (QUATDB)

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Abstract

The Australian Quaternary Climates Database (QUATDB) was a recent initiative to collate data relating to climate change during the last 2 million years. This project ran from 1991-1996 at the Australian Geological Survey Organisation and resulted in a number of publications. We present here a continuation of that project in a new form: the Australian Quaternary Data Archive, part of the Australian Quaternary Data Home page. This electronic data repository will store those data-sets which were contributed to QUATDB and provide a central location for the housing of published Quaternary data.

The *Quaternary Australasia* Home page is also present on this web site. This site contains past issues of the Australian Quaternary Association's (AQUA's) biannual newsletter, a links page to other Quaternary web sites, a billboard of upcoming conferences and contact information for AQUA.

Australian Quaternary Data Home Page

The World Wide Web has become a very convenient form of access to data held by institutions. Quick, visual, interactive, easy to search and simple to operate it brings together, in an unparalleled fashion, those who need the information with those who have it. The ability to query corporate databases and download the results (as with on-line library catalogues) adds wings to a researcher's speed of data acquisition. That it has been a popular success is shown by groups such as the World Data Centre-A for Palaeoclimatology in Boulder, Colorado, whose web site shows increasing numbers of users. With a small number of researchers spread over a vast area, the Web forms an ideal way of bringing the Australasian Quaternary community and its research together. This Home page is designed to act as a nexus for Quaternary sites within Australia and promote communication between workers.

The pilot Home page advertised at the 1997 AQUA General Meeting is no longer available. The Australian Quaternary Data Home page can now be found at:

http://wwwrses.anu.edu.au/envgeo/AQUADATA/AQUADATA.html

There are 3 main areas within this Home page, as follows.

Australian Quaternary Climates Database (QUATDB)

The Australian Quaternary Climates Database (QUATDB) was begun in 1991 under joint funding from the National Greenhouse Advisory Commission and the Australian Geological Survey Organisation (AGSO). The aim was to develop a database of Quaternary palaeoclimate research and produce a set of palaeoclimatic maps for comparison with climate change model outputs. From 1991 to 1996 the database structure was developed and a significant quantity of data entered with the assistance of students from the ANU. The project culminated in the production of a series of time-slice maps showing palaeoclimatic interpretations for key times during the Late Quaternary (a part of the 1996 CLIMANZ IV conference: Hunt & Chappell in prep.) and a project detailing the surface temperature of the Last Glacial Maximum oceans around Australia (Barrows *et al*. 1996).

Following the 1996 restructure at AGSO it was decided to transfer management and future development of the database over to the Environmental Geochemistry Group in the Research School of Earth Sciences at the ANU. Data originally stored within QUATDB is now being transferred into an on-line archive (Australian Quaternary Data Archive) to act as a regional centre for Quaternary data.

Australian Quaternary Data Archive (AQUADATA)

The Australian Quaternary Data Archive (AQUADATA) is the official repository for data-sets relating to Quaternary climate change in the Australian region. Most of the data here has been extracted from QUATDB. Also included are data-sets describing the modern biogeography of Australia and links to other databases.

Structure of the Archive The Archive consists of three principle subdivisions:

(1) Quaternary data-sets This section contains data pertaining to the Holocene and Pleistocene, excluding Modern data-sets. There is further subdivision into six basic themes:

-- Palaeoceanography: micropalaeontology, stable isotope records, sedimentology, geochemistry and geochronology from deep-sea cores;

-- Coastal processes and sea level: a grab-bag of disciplines that seek to reconstruct the history of our coastal systems, reefs, islands and continental shelves;

-- Geomorphology and sedimentology: terrestrial, non-coastal studies of landscape evolution including aeolian, fluvial, lacustrine, periglacial and glacial landforms;

-- Vertebrate palaeontology: the palaeo-biogeography of Australia's vertebrates (principally mammals) as preserved in terrestrial sediments;

-- Limnology and palynology: time-series records of climate change preserved in terrestrial sediment-filled depressions; and

-- Speleothems and ice-cores: time series records of stable isotope, trace element, dust and gas variations from Australian caves and Antarctica.

Each of these themes has a directory listing detailing the data contained within. The data is indexed by senior author and year of publication. Within each author's folder, the data is presented in 2 forms (text and MS Excel 5.0) together with a text file describing the dataset.

(2) Modern data-sets This section contains modern observational studies of animal/plant/microfossil distributions, geomorphic processes and geochemical analyses. These data-sets are intended as an important supplement to the Quaternary data to calibrate and revise transfer functions and mathematical relationships used to derive quantitative palaeoclimatic conclusions. The data will be stored in a format similar to the Quaternary data-sets or as contributed to the Archive.

(3) Other databases As the collection of data into common themes is not a new concept, there are many existing databases already assembled. Where possible, local copies of these databases (such as CLIMAP, 1981) will be made available here. Each of these databases will have its own format and data storage techniques reflecting the primary source.

How to contribute The structure of the data storage will be very similar to that used in QUATDB. Explanations for fields are provided in Hunt *et al*. (1996) and changes will be advertised on the web site. Data will be presented in a fashion where there is as little repetition as possible. Examples of how to present data in a spreadsheet form for contribution are given on the web site, including sample documents.

Those wishing to contribute data should contact the senior author for the best transferal methods.

Quaternary Australasia Home Page

This new section of the web page is the electronic version of the AQUA publication *Quaternary Australasia (QA)*. Past issues of the newsletter are stored here back to the beginning of 1995. The page also contains: contact and membership information for AQUA, forthcoming conference information and an accumulation of all the web pages, listservers and electronic journals advertised in QA since 1995. Links will be added to join the page to those Universities and Geological Surveys in Australia containing Quaternarists. Also included is a

web page for photos taken at the 1997 General Meeting at Lake Eyre.

This site also seeks to address some of the concerns expressed by the immediate past president of AQUA in a previous issue (President's report "A new direction for AQUA?" QA (13/1)). This site will allow quicker dissemination of information presented in QA and will be available to a wider audience. We hope that this will be the first step towards more rapid communication between Quaternarists in Australia.

Future of Quaternary Data Storage in Australia

The response to electronic data storage in Australia has been extremely slow. Groups such as the palynology community have shown initiative and begun to accumulate thematic data-sets. Other sections of the Quaternary community remain less organised and a great deal of original work is in danger of being lost. As data storage is made easier in the present system, it should become routine that tables or appendices of data presented in a paper are quickly reformatted into a database compatible format and lodged within the archive. The increased accessibility of data accompanying a paper will mean increased numbers of citations for contributing authors as other authors can refer to that data in their own work. At present, the transfer of data from existing databases is slow as it is reliant on voluntary labour only. The task of entering data into the Australian Quaternary Data Archive now rests with the research community. The benefits will be reaped only with full participation. Have you contributed yet?

References

Barrows, T.T., Ayress, M.A., and Hunt, G.R., 1996. A reconstruction of Last Glacial Maximum sea-surface temperatures in the Australasian region. *Quaternary Australasia* 14/1: 27-31

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Hunt, G.R., Lenz, S. & Barrows, T.T. 1996 *QUATDB - Quaternary Climates Database*. AGSO record 1996/46).

COVER ILLUSTRATION

The wonderful world of phytoliths ... The front cover illustrates an S.E.M. image of phytoliths (with a diatom lurking in the background) collected by separation of sediment by floating in water. The sample is from a swamp sediment core at Oxford Falls, Sydney. The image was supplied by Diane Hart, Macquarie University, and sets the phytolith theme of this issue: see Diane Hart's review of the First European Meeting on Phytolith Research and call for members of a phytolith research group, and Hart & Humphreys' article reviewing phytoliths from an Australian perspective.