PAGES
PAST GLOBAL CHANGES

A CORE PROJECT OF
THE INTERNATIONAL
GEOSPHERE-BIOSPHERE
PROGRAMME IGBP

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PAGES NEWS

The start of 1996 has seen major changes in the organization of the PAGES Core Project and its Office in Bern. Frank Oldfield has taken over the role of Executive Director with Bruno Messerli alongside him as Director. Frank's research has been largely concerned with records of recent environmental change in sediments, peat and loess using pollen, magnetic measurements and radiogenic isotopes. Bruno brings to PAGES a wealth of worldwide experience in mountain environments and the surface processes and environmental changes that they have experienced. As well as acting as the main point of contact with the Swiss NSF, he will also serve on the PAGES Scientific Steering Committee.

The Steering Committee has also undergone major changes with the retirement from it of Drs. H. Oeschger, J.-C. Duplessy, T. Liu, J. Pilcher, B. Frenzel, J. Jouzel, R. Peltier, and F. Oldfield. The contribution of the outgoing members is gratefully acknowledged, especially in the case of those (Duplessy, Liu, and Pilcher) who have also served on the PAGES Executive Committee. New members on SSC, in addition to Bruno Messerli, are:

Dr. Zhengtang Guo (Institute of Geology; Academia Sinica, Beijing, CHINA) who has worked on many aspects of loess-based Quaternary geology and paleoclimatology, the Asian paleomonsoon and paleodata management, and is active in the PEP II Transect (Austral-Asia).

Dr. Martin Lautenschlager (German Climate Computer Center, Max Planck Institute, Hamburg, GERMANY), whose research is focused on modeling long term climate changes and paleoclimate through the development of a GCM coupling of the cryosphere, ocean, biosphere and atmosphere. He is an expert on the development of paleoclimate data bases and data handling, and participates in PMIP, WDC, and GCOS.

Dr. Laurent Labeyrie (l'Universite Paris - Sud; Orsay; FRANCE) who is Coordinator for the French national program in paleoclimate research. He works on the evolution of global climate and coupled ice-ocean-atmosphere-continental systems over the last several hundred thousand years, has particular expertise in isotopic studies for paleoceanography and has been involved in IMAGES/PAGES since its inception.

Dr. Keith Briffa (Climate Research Unit; University of East Anglia; Norwich, U. K.), whose research is focused on instrumental records, dendroclimatology and climatic change of the late Holocene. He coordinates the EC project on high resolution climate change in Northern Eurasia over the last 2000 years, and has also worked extensively in the Americas, Russia, and New Zealand.

The replacement of Hans Oeschger by Raymond Bradley as Chair of the SSC has also coincided with the above changes. Hans Oeschger has crowned a distinguished career with irreplaceable service to PAGES through his vision, international scientific standing and intellectual rigor, and will continue to contribute to PAGES in his role as "Past Chairman". Ray Bradley, brings the great wealth and quality of his writing and research on past climate change to his role as successor to Hans.

The new team has several hard acts to follow, not least because Dr. Herman Zimmerman, a major driving force in advancing the PAGES Agenda in his role as Co-Director, has also relinquished this part of his responsibilities. As PAGES moves ever more strongly from the agenda setting to the "implementation" stage of it's operation, it's great debt to the leadership of the first, crucial years becomes increasingly apparent.

GLOBAL PALEOENVIRONMENTAL DATA

This major report has now appeared. It comprises some 90 pages spanning a range of key issues for the PAGES community. The text is divided into an introductory section followed by a Data Management Guide and a comprehensive series of Database Reports covering a wide range of proxy records and user requirements.

A major aim of the workshop was to develop a coordinated data management plan that 1) takes advantage of scientific expertise and experience of the individual centers in compiling PAGES

related data, and 2) assists individual centers with data sharing and distribution on a global basis.

To accomplish these goals, the workshop was organized around a series of presentations that describe national and regional data efforts, and a series of working group sessions, each focused on a different category of paleoenvironmental data.

In some cases the Report outlines protocols and data efforts already in place and well-established. In other areas, the discussions are more preliminary, and describe what the participants would like to see in terms of data management, along with some general guidelines. The workshop and this report are viewed as an important first step in an evolutionary process that will fuel the international research community with the paleoenvironmental data needed to understand how the Earth system works, and how the behavior of Earth system processes can be predicted.

The World Data Center-A serves as a primary data coordination center for all types of data relevant to PAGES scientific foci. The WDC-A will make all data holdings available to all scientists without restriction. The WDC-A is also committed to the long-term archive and distribution requirements for these data. With regard to data formats and data content, the WDC-A works closely with PAGES scientists and project leaders to make sure that the data are archived in a consistent and easy-to-use format.

Regional and national data efforts are generally more focused than the WDCs, and are not always able to meet the ICSU guidelines for data distribution. Thus some data holdings from these centers may not be freely available. Also, because of the focused nature of some regional data efforts, some of the data holdings are not relevant or appropriate for use by the general paleoclimate and global change communities. In the case where these data are relevant and can be shared, the WDC-A will assist in data archive and distribution.

The WDC-A will serve as a conduit for data distribution to the broad IGBP community by serving as a node in a distributed data archive network, and also by maintaining and distributing data for individual centers where appropriate. In many cases the WDCs will continue to rely on the scientific expertise and experience of the regional centers in compiling or evaluating individual categories of data. The need to recognize the effort of individual scientists who produce, analyze, and publish the data was a concern stated throughout the workshop.

The issue of how to properly credit scientist is complicated because it varies between countries and scientific disciplines. Procedures at the WDC-A have always encouraged contributions of published data as opposed to unpublished data, to reinforce the credit received from publishing data, and also to maintain a level of peer review for all archived data.

A report from the 1993 PAGES Workshop
Organized by: J.T. Overpeck, J. Pilcher
Edited by: D. M. Anderson

RECENT WORKSHOPS

ISOTOPES AND CONTINENTAL RECORDS

Two recent meetings, the first at IAEA Vienna (Nov. 8-10, 1995), the second at GFZ Munich (Nov. 13-16, 1995) have brought to the fore the growing significance of stable isotope records in lake sediments, tree rings, peat and other continental archives of environmental change. These meetings were sequels to the Rüttihübelbad Workshop jointly sponsored by PAGES, WMO, IAEA and IAHS in January(23-25), 1995. Two salient points become increasingly clear: the first concerning the special role of isotopes in a wide range of palaeorecords, second concerning the need to sustain monitoring networks in order to provide the basis for calibration.

Most continental archives of past environmental change contain a wealth of response signatures both to climatic forcing and, for more recent times, to the interwoven effects of changing climate and human activity. The extent to which these signatures are translatable into quantitively defined climatic parameters is highly variable. All too rarely are they adequate for the quality of reconstruction required either to constrain effectively hindcast model experiments, or to provide independent variables against which the records of ecosystem response can be compared and interpreted. Demonstrating climate forcing in tune with marine or polar ice core records is one thing; providing regionally applicable, calibrated quantitive estimates of forcing functions within the climate system is something else.

Approaching this second goal is not the perogative of any single type of proxy record, but within the range of presently available archives, stable isotope records are among the most promising. Already, there are notable examples of research where calibration of $\partial^{18}0$ records in lake sediments to independently documented temperature variation during the period of historical and instrumental records provides a robust framework for quantitative reconstruction over longer periods (e.g. U. Von Grafenstein et al; Journal of Paleolimnology 11; 349-357, 1994). The key to broadening this type of research to a wider range of contexts lies in a concented effort to establish more empirical correlations between isotopic ratios and climatic variation for the most recent parts. There is also a need to document, by contemporary observation and experiment, the wide range of processes that mediate between atmospheric temperature and the proxy record under consideration, whether this is lacustrine organic matter, biogenic or precipitated carbonate, or a tree ring. The thrust of any such research is interdisciplinary in the fullest sense, requiring, in the case of lake sediment records for example, collaboration between hydrologists, sedimentologists, biologists, and isotope chemists.

Equally important is the availability of the GNIP (Global Network: Isotopes in Precipitation) database, for this provides the template whereby calibration, in suitable environments, may be achieved. Maintaining and strengthening the GNIP network through the involvement of a wider range of responsible agencies was the primary

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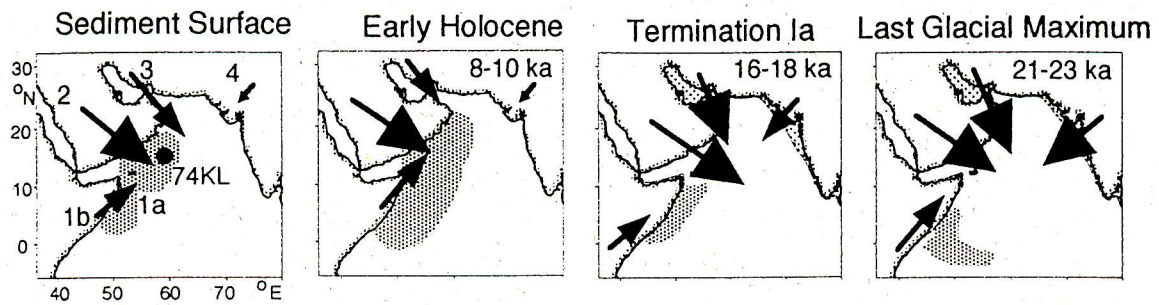
Dust transporting winds, upwelling



Century-scale evolution of atmospheric circulation

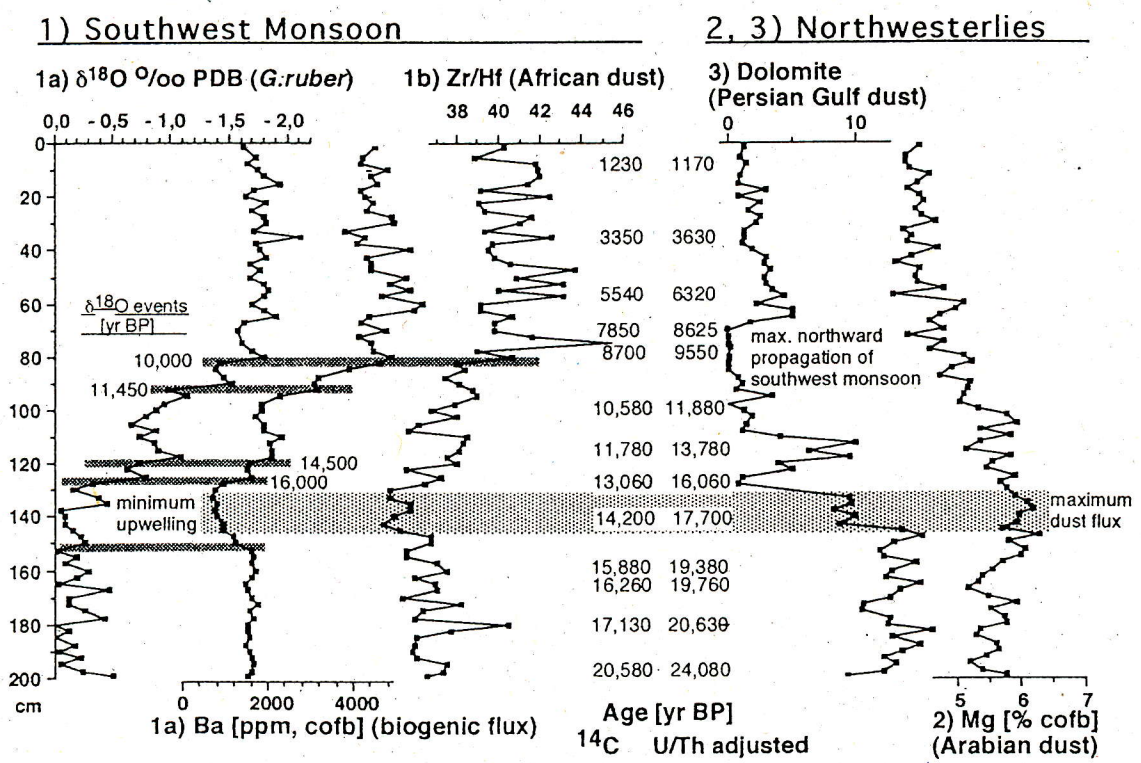


Figure: *(above)* Late Pleistocene patterns of southwest-monsoon-driven upwelling (shaded area 1a), and in the position and geographical extent of major dust plumes during the past (arrows 1b-4, the arrows are scaled to approximate the mass of dust transported). Core location 74KL in the western Arabian Sea.

(beolow) Variations of components 1a-4 during the last 25,000 years in core 74KL. Geochemical analyses are done on the bulk sample by ICP-MS techniques, but expressed on a carbonate-and-opal-free basis (cofb). All data of core 74KL are accessable by ftp from the NOAA World Data Center A-Paleoclimatology data bank, ftp.ngdc.noaa.gov, in the directory /paleo/paleocean/sw_monsoon_events;
E-MAIL: paleo@ngdc.noaa.gov

The PAGES Core poject Office provides this illustration in the hope that you will find it useful as an "overhead" transparency for lecture purposes.

Eolian Input To Marine Sediments In The Arabian Sea: Tracers Of Pastmonsoon Circulation.

Frank Sirocko, Geological-Paleontological Institute, University Kiel, 24118 Kiel, Germany

Monsoonal winds, which dominate the climate of southern Asia and East Africa are characterized by two different seasons, (i) vigorous, rain-bearing monsoon winds from the southwest during summer, (ii) rather gentle and dry winds during winter from the northeast. The southwest monsoon carries large amounts of water vapor which stems from evaporation in the subtropical areas of the southern hemisphere, and, after crossing the equator, is the major source of precipitation on subtropical continents, providing the runoff for some of the largest rivers of the world.

The maximum of southwest monsoon intensity in July parallels the seasonal maximum of dust observations over the ocean (Sirocko & Sarnthein, 1989) and of the flux of lithic particles in sediment traps deployed in the western Arabian Sea (Nair et al., 1989). Studies on the entrainment of dust, and its trajectories as visible on satellite images, reveal, however, that the majority of modern summer dust is not derived from the southwest monsoon winds directly, but originates from the Mesopotamian lowland and the central Arabian desert, transported by northwesterly winds that extend in the midtroposhere over the Arabian Sea as far as the coast of India (Ackerman & Cox, 1982).

Proxy indicators for the southwest monsoon in deep-sea sediments are upwelling related records (e.g., $d^{18}O$ of planktonic foraminifera, Ba content; shaded area 1a), or direct records of the wind intensity (clastic grain-sizes; magnetic susceptibility, mainly a function of heavy mineral abundance). As heavy minerals settle more rapidly from atmospheric dust than siliciclastics, we regard an increase in abundance near East Africa to be the most direct tracer for the vigor of the southwest monsoon winds (e.g., Zr/Hf ratio; arrow 1b).

Mg content, in contrast, represents the mineral phases dolomite, palygorskite and mafic minerals, and shows a large plume in the tracks of northwesterly winds in front of the Arabian desert (arrow 2: Sirocko et al., 1991). A third source of dust, being derived from the Persian Gulf area, is extremely rich in Cr, chlorite and dolomite, and particles are transported during spring and summer in a northern branch of the Arabian northwesterlies, which spread over the ocean north of the southwest monsoon (arrow 3). Thus, dolomite is an indirect tracer of the position of the southwest monsoon, the northernmost extent of which is identical with the southernmost extent of the Persian Gulf northwesterlies. During glacial times, additional proportions of dust were derived from the then strong northeast monsoon winds, which hardly transport any dust over the ocean today (arrow 4).

Using these tracer minerals/elements in core 74KL from the western Arabian Sea (Sirocko et al., 1993), we observe the following evolution of the monsoon circulation: Upwelling and southwest monsoon winds were weak during the LGM, and reached a severe minimum between 18-17 ka during the depositional time of Heinrich Layer 1 in the Atlantic; dust flux from the Arabian desert, in contrast, was at a maximum at this time. Two increases of southwest monsoon strength are observed at 16 ka and 14.5 ka, followed by a slight reduction during the Younger Dryas. Upwelling flux increased rapidly at the end of the Younger Dryas 11.5 ka, but southwest monsoon wind strength did not reach its Holocene level before 10 ka. The maximum northern position of the southwest monsoon was then reached between 9-10 ka during the time of maximum solar insolation at northern subtropical latitudes, when dolomite-rich dust from the Persian Gulf did not reach the position of core 74KL.

The first major monsoon event at 16 ka is synchronous with first deglacial changes in Antarctica (Jouzel et al., 1995), the events at 14.5 ka and 11.5 ka are synchronous with sharp climate transitions as recorded in the Greenland ice (Grootes et al., 1993), indicating that tight global teleconnection between the atmospheric circulation in the subtropics and high latitudes have existed during times of past abrupt climate change (Sirocko et al., 1996).

Ackerman, S. A. & Cox, S. K., 1982. The Saudi Arabian heat low: Aerosol distributions and thermodynamic structure. *Journal of Geophysical Research,* 87(C 11), 8991-9002.

Grootes, P. M., Stuiver, M., White, J. W. C., Johnsen, S. & Jouzel, J., 1993. Comparison of oxygen isotope records from the GISP2 and GRIP Greenland ice cores. *Nature,* 366, 552-554.

Jouzel, J., Vaikmae, R., Petit, J. R., Martin, M., Duclos, Y., Stievenard, M., Lorius, C., Toots, M., Melieres, M. A., Burckle, L. H., Barkov, N. I. & Kotlyakov, V. M., 1995. The two step shape and timing of the last deglaciation in Antarctica. *Climate Dynamics,* 11, 151-161.

Nair, R. R., Ittekkot, V., Manganini, S. J., Ramaswamy, V., Haake, B., Degens, E. T., Desai, B. N. & Honjo, S., 1989. Increased particle flux to the deep ocean related to monsoons. *Nature,* 338, 749-751.

Sirocko, F. & Sarnthein, M., 1989. Wind-borne deposits in the Northwestern Indian Ocean: record of Holocene sediments versus modern satellite data. In: M. Leinen & M. Sarnthein (Eds.), Paleoclimatology and Paleometeorology: *Modern and Past Patterns of Glacial Atmospheric Transport.* - NATO ASI Series, C, Math. and Phys. Sciences (pp. 401-433). Kluwer Academic Publishers: Dordrecht, Boston, London.

Sirocko, F., Sarnthein, M., Lange, H. & Erlenkeuser, H., 1991. The atmospheric summer circulation and coastal upwelling in the Arabian Sea during the Holocene and the last glaciation. *Quaternary Research,* 36, 72-93.

Sirocko, F., Sarnthein, M., Erlenkeuser, H., Lange, H., Arnold, M. & Duplessy, J. C., 1993. Century-scale events in monsoonal climate over the past 24,000 years. *Nature,* 364, 322-324.

Sirocko, F., Garbe-Schönberg, D., McIntyre, A. & Molfino, B., 1996. Teleconnections between the subtropical monsoons and high-latitude climates during the last deglaciation. *Science,* in press.

concern of the IAEA Meeting in Vienna. One outcome of this meeting is the proposed formation of a Steering Committee through which, in recognition of the vital role of isotope research in many aspects of hydrology, meteorology and palaeoscience, the responsibility of maintaining and expanding the network will be broadened beyond IAEA to include WMO, IGBP, WCRP and UNEP/UNESCO.

CONTINENTAL DRILLING FOR PALAEOCLIMATIC RECORDS

PAGES co-sponsored an international workshop on Continental Drilling for Paleoclimatic records. The workshop took place from June 30-July 3, 1995 and was hosted by the other co-sponsor, the Geoforschungs Zentrum, Potsdam, Germany. A full report is being coordinated and edited by Steve Colman and will be published in 1996. A major outcome of the workshop was the rapid establishment of the PAGES Lake Drilling Task Force that held its first meeting in Washington D. C. from 13 to 16 October 1995. The main objective was to review the nearly 60 planning proposals received from the scientific community as of 13 October. The next goal was to formulate a five-year plan and discuss this plan with the US National Science Foundation, especially those persons closely involved in developing the Earth System History theme of the International Continental Drilling Program (ICDP).

The Task Force is preparing an omnibus proposal to the International Continental Drilling Programme (ICDP) to seek a commitment from ICDP for some level of funding over five years to support drilling and site survey. The priority sites targeted by the Task Force for pre-proposal development at this time are: for drilling support in 1996, Lake Qinghai (China), Lake Poukawa (New Zealand), and Lago di Monticchio (Italy); for site survey support in 1996: lakes Titicaca, Khubsugul, Edward, Bosumtwi, some lakes in Indonesia, Ethiopia and Madagascar. Individual scientists and groups are encouraged to submit competitive proposals to the Task Force and to national funding agencies for scientific support.

For more information, contact:
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Prof. Douglas F. Williams, Dept of Geological Sciences, University of South Carolina, Columbia SC 29209, USA, e-mail: baikal@epoch.geol.sc.edu.

THE GISP 2 AND GRIP ICE CORE RECORDS

The PAGES community continues to follow with great interest the progress of the GRIP and GISP 2 research programs. The most recent joint workshop highlights the outstanding accomplishments of the participating scientists. Consensus is now quite firm on the many major climatic shifts recorded in Isotope stages 2 and 3 back to 110,000 years ago. Recent publications consistently document the great amplitude of the variations recorded, their millennial-scale duration, the rapidity of the shifts between states and even the evidence for "flickering" behavior on timescales of years or decades before the switch between modes is finally established. This agenda-setting research has led to a spate of papers presenting evidence for similarly oscillating behavior in a wide range of proxy records as diverse as ocean sediments, Antarctic Ice and Chinese Loess. The incentive to synchronize and functionally couple these records grows rapidly, alongside the need to model convincingly the rapid and dramatic global changes that have certainly characterized recent earth history.

The latest interpretations of isotopic evidence for the absolute amplitude of temperature variation between the glacial maximum and the Holocene thermal optimum are broadly convergent, despite the considerable challenge posed by the need to calibrate isotopic signatures for such contrasted boundary conditions. The balance of opinion is that the total amplitude of mean annual temperature change in Greenland may have been as high as 20°C.

On shorter timescale, the wealth of proxy records currently being explored provides evidence for solar modulation of climate, atmospheric responses to volcanic activity, and orbitally forced variations, as well as feedback effects involving both clouds and global vegetation change.

Further research on the factors modulating the CO_2 signature in the Greenland Ice, on improving the chronology and the base for correlation with other paleorecords, and on the diverse chemical and physical signatures reflecting sources and atmospheric circulation patterns is in progress, and the present crop of some 200 published papers will continue to grow.

This brief synopsis is based on a more extended and fully referenced account submitted to AGU on behalf of the GISP 2 Executive Committee and the GRIP Steering Committee by R. Alley, P. Mayewski, D. Peel and B.Stauffer.

PROGRESS WITH PEPS

The PEP I Steering Committee Members, headed by Vera Markgraf, held a workshop in La Paz, Baja California, Nov. 18, 1995 on "High Resolution Palaeoclimate Records in the Americas." The progress of PEP I will be greatly advanced by the award of a 3 year NSF grant, starting in August 1995 to support administrative activities and workshop organization. Already the PEP I initiative has generated contributions to several symposia in 1995 and research proposals to IAI, NSF and ESH. PEP I interests were represented by Rob Dunbar at the Dec. 1995 meeting on "Monitoring for Climate Change Detection in the Americas" held in Chile, and there is also a proposal to coordinate a summer institute on high resolution palaeoclimate techniques in marine and terrestrial environments to be held in Peru in 1996. The main goal will be to train scientists, especially from Latin America, and thereby enhance the scope for the future inter-America PEP I collaboration. A major open meeting to bring together the early results of PEP I is envisioned for 1997. *Based on report submitted by Vera Markgraf*

Almost 100 scientists from 12 countries participated in the PAGES/**PEP II** Symposium entitled: Paleoclimate and Environmental Variability in the Austral-Asian

Transect during the past 2000 years. The symposium (Nov-Dec, 1995) was hosted by the IGBP Japan National Committee at Nagoya University.

The focus of the symposium was to encourage the employment of multi-proxy analysis to develop an integrated picture of the past climates and climate variability within the Austral-Asian Transect. Prof. John Dodson, co-leader of the PEP II effort, stressed the need for high resolution proxy records (Temporal Stream 1) to extend the instrumental record and to provide the required data series against which to test human impact on climate. Dodson also pointed to the need to acquire high quality records to better understand the connectivity of synoptic-scale systems across the PEP II region. He noted that the successful application of this approach requires careful calibration of proxy methods in useful climate terms.

In Japan and China, a great deal of detailed paleoclimate information is available through the study of historical documents which include weather and climate observations, records of natural disasters, and agricultural data. Prof. Mikami of Tokyo Metropolitan University suggested that these diaries can be powerful tools for reconstructing the past climate of Japan. Prof. Zhang of the National Climate Center in Beijing, China, noted that within the last 2000 years, a reconstructed "moisture climate index" and a "dustfall frequency series" can be developed with a 10-year resolution. For the last 1000 years, it is possible to attain an annual resolution. These studies demonstrate the power of proxy studies in combination.

A PEP II related symposium scheduled for July 1996 in Brisbane, Australia is foreshadowed in the PAGES calendar.

The structuring of the **PEP III** research agenda took shape at a workshop held in Sfax, Tunisia in April 1995 (report available from Francoise Gasse). As well as identifying regional/national steering groups, a series of thematic working groups was envisioned with a view to integrating and comparing data both spatially and between different types of proxy record and environmental context.

Modest financial input has been secured for partial, logistic support in connection with PEP III planning and implementation, and a strongly focused and thematically structured workshop reflecting the priorities identified at the Sfax Meeting is proposed, ideally for Fall 1996.

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PAGES CALENDAR

*March 14-16, 1996: 26th Annual Arctic Workshop, Institute of Arctic and Alpine Research (INSTAAR) Boulder, CO, USA. Contact: M. Duvall, USA (FAX: +1 303-492 0246; E-MAIL: duvall@colorado.edu).

*May 6-10, 1996: 21st General Assembly of the European Geophysical Society, The Hague, NL. "Towards an Integrated Model of the Earth System" consists of 4 sessions. Contact: John Schellnhuber, PIK, Germany (FAX: +49-331-288-2510; EMAIL: john@pik-potsdam.de).

*May 19-22, 1996: AAPG-SEPM annual meeting. Special session on Geochemical Dynamics of Modern and Ancient Lakes. San Diego, CA, USA. Contact: K. Kelts (TEL: +1-612-624 0275; FAX: +1-612-625 3819).

*May 20-22, 1996: AMQUA; Global Warming, Interglacials, Interstadials, Climatic Optima and other events . Flagstaff, AZ, USA. Contact: J. Mead (FAX: +1-520-523-9220; E-MAIL: jim@vishnu.glg.nau.edu).

*May 20-24, 1996: American Geophysical Union Spring Meeting. Session on "Historical Perspectives on Climate Change. Baltimore, MD, USA. Contact: J. E. Penner (TEL: +1-510-422-4110; FAX: +1-510-422-5844; E-MAIL: penner1@llnl.gov).

*May 20-24, 1995: 7th International Conference on Accelerator Mass Spectrometry (AMS-7). Special session on Trace Elements covering new developments and applications related to TEAMS. Tucson, AZ, USA. Contact: D. L. Knies (TEL: +1-202-767 5653; FAX: +1-202-767 5301; E-MAIL: knies@nrlfsl.nrl.navy.mil).

July 1-8, 1996: Joint Meeting of UNESCO-CLIP & INQUA-PAGES Paleomonsoons Project "Monsoon Variations in Intertropical America During the Last Glacial-Interglacial cycle". Punta Cardon, Paraguana, Venezuela. Contact: Stefan Kroepelin (TEL: +49-30-838-6368; FAX: +49-30-841-00363; E-MAIL: skroe@zedat.fu-berlin.de).

June 21-30, 1996: International Conference on Quaternary Glaciation and Paleoclimate in the Andes Mountains, and surrounding tropical and subtropical mountains. Contact: W.C. Mahaney (TEL: +1-416-736 2100 ext.33923; FAX: +1-416-736 5103).

*July 23-27, 1996: Western Pacific Geophysics Meeting; (American Geophysical Union). GPO9 Glacial/Interglacial records of the PEP transects. Brisbane, AUSTRALIA. Contact: M.E. Evans (FAX: +1-403-492-4256; E-MAIL: evans@phys.ualberta.ca).

*June 23-28, 1996: 9th International Palynological Congress. Houston, TX, USA. Special symposium of interest to the PAGES community: Long Continental and Marine Records of Paleoclimate. Contact: H. Mommersteeg (E-MAIL: mommersteeg@bio.uva.nl) or E. Ran (E-MAIL: ran@bio.uva.nl).

*August 4-14, 1996: International Geophysical Congress (several PAGES and PEP II related sessions are being planned). Beijing CHINA. Contact: T. Liu (TEL: +86-10-202-7766 ext. 345; FAX: +86-10-255-8066, or 205-2184; E-MAIL: tsliu@mimi.cnc.ac.cn).

*September 7-9, 1996: Second International Meeting on Global Continental Palaeohydrology: Palaeohydrology and Modeling of Environmental Change. Toledo, SPAIN. Contact: Gerardo Benito (FAX: +34-1-564-0800; E-MAIL: benito@cc. csic.es).

* Open meetings. All interested scientists are invited to attend.