PAGES
PAST GLOBAL CHANGES

A CORE PROJECT OF
THE INTERNATIONAL
GEOSPHERE-BIOSPHERE
PROGRAMME IGBP

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EDITORIAL

From Reduction to Integration

In Physics Today (Nov. 1993), Philip Anderson related: "The ability to reduce everything to simple fundamental laws does not imply the ability to reconstruct the universe." One certain result of global change science is awareness of the complexity of Earth systems and the broad spectrum of research strategies that are needed to study them. One example of this spectrum is the analysis of isotopic records of both past and present precipitation. For this exercise, data from the IAEA-WMO Global Network of Isotopes in Precipitation (GNIP) is critical.

In January, a workshop on "Tracing Isotopes in Past and Present Precipitation: Opportunities for Climate and Water Studies," was jointly sponsored by WMO, IAEA, IASH and PAGES. The workshop discussions recognised that isotopic data are important not only because isotopic signatures of Earth-system components are often recorded in natural archives, but also because this information integrates the effects of physical, chemical, and biological processes along water pathways. For example, although isotopic signatures can represent classical hydrometeorological parameters, they also provide additional information about the source of water vapor; atmospheric circulation patterns; and interactions with fluvial systems, ecosystems, and the cryosphere. This is fundamental information about the operation of the hydrologic component of the Earth system.

The workshop recommended strengthening the operation GNIP and a wider and more efficient use of the data. A steering committee should provide guidance and help in implementing the workshop recommendations within the large interdisciplinary community. PAGES recommends similar initiatives for other components of the Earth system, such as a global network for monitoring isotopes in trace gases and other atmospheric constituents. Such information would significantly reduce the uncertainties about the sources and sinks of these constituents. Changes in the exchange of trace gases between the atmosphere and biosphere and between the atmosphere and ocean are probably the best indicators of changes in the overall operation of the Earth system.

H. Oeschger, Chairman of PAGES Scientific Steering Committee

PAGES WORKSHOPS

International Himalayan-Tibetan Plateau Paleoclimate workshop

A PAGES workshop focusing on paleoclimate issues in the Himalayan-Tibetan Plateau region, was organised by S. Adhikary of the Himalayan Climate Centre (Kathmandu, Nepal) and P. Mayewski and C. Wake of the Glacier Research Group (University of New Hampshire, Durham, NH, USA). The workshop was held in Kathmandu, Nepal, 2-7 April 1995 and included over 70 scientists from 13 countries. It provided a forum where researchers presented results of paleoclimatic investigations and discussed objectives and implementation of future paleoclimatic research programs in the mountains of central Asia.

Oral and poster presentations at the workshop summarised results from research on meteorological and hydrological data, ice cores and glaciochemical investigations, lake sediments, loess, speleothems, glacial deposits, and modelling of the monsoon. Also included were discussions of data sharing, modern observational data networks and future needs for the paleoclimate community, and the role of models in understanding the paleo-monsoon.

One of the main products of the workshop will be a Science and Implementation Plan to be published as a PAGES workshop report. This will contain a substantive summary and interpretation of existing paleoclimatic records from the Himalayas and Tibetan Plateau, objectives and implementation plans for future paleoclimatic research in the region, and other topics discussed at the workshop. For more information, please contact: C. Wake, USA (FAX: 1-603-862-2124; E-Mail: c_wake@unh.edu).

Report on an International Inter-American Institute-PAGES Meeting, Mendoza, Argentina

The Inter-American Institute (IAI) promoted two days of interchange between PAGES representatives and regional scientists from Argentina, Bolivia, Brazil, and Chile. This meeting was held in connection with administrative PAGES meetings at IANIGLA-CRICYT (Instituto Argentino de Nivología y Glaciología-Centro Regional de Investigaciones Cientificas y Tecnicas) in Mendoza, Argentina, 20-25 March 1995. The first day began with introductory remarks on the PAGES program, the IAI agenda, and the PAGES-PEP I (Pole-Equator-Pole Paleoclimates of the Americas) research initiative, and was followed by presentations on topics

including: instrumental climate analysis (P. Aceituno, V. Barros), historical climates (R. Prieto), tree-ring data (J. Boninsegna, F. Roig), ice core data (A. Aristarain), paleo-ecological records (M. Paez, C. Villagran, W. Volkheimer), glacial records (J. Argollo, L. Espizua), geomorphological records (M.-A. González, M. Iriondo, J. Stevaux), and archaeological data (L. Borrero). R. Lara Lara (IAI) expanded on the mission, research agenda, ongoing activities, and future plans for scientific cooperation. The prospect of a funding agency (IAI) supporting cooperative research ventures within the Americas was enthusiastically received. Plans to submit planning proposals to IAI in 1995 once the call for proposals is issued were discussed, as was cooperation in the context of the PEP I research agenda. Abstracted from a report by V. Markgraf, PEP I leader, USA (FAX: +1-303-492 6388; E-Mail: markgraf@spot.colorado.edu).

UPCOMING WORKSHOPS

International Workshop on Continental Drilling for Paleoclimatic Records

A workshop on Continental Drilling for Paleoclimate Records, sponsored by PAGES and the GeoForschungs-Zentrum, Potsdam, Germany in conjunction with the International Continental Drilling Programme (ICDP) will be held at the GeoForschungs-Zentrum in Potsdam, Germany, 30 June-2 July 1995. Climatic records from the continents provide information critical for the complete reconstruction of the Earth's environmental history, for an understanding of climate spatial variability, and because continental climatic changes are most pertinent to human activities.

PAGES proposes to develop a template of a continental drilling project for the recovery of paleoclimatic records which will satisfy the requirements of the global-change community. Crtiteria for site selection; choice of drilling methods; sample, analytical, and data protocols; and publication policy will be discussed. The resulting model would serve as a basis for evaluating proposed drilling projects by the scientific community and by funding agencies and would provide an incentive for advance planning and coordination. The model would also promote the scientific synergy that emerges from large, interdisciplinary projects. Organisers: S. Colman, PAGES office; S. Leroy, Queen's University of Belfast, N. Ireland (FAX: +44-1232- 321 280; E-Mail: s.leroy@qub.ac.uk); and J. Negendank, GFZ-Postdam, Germany (FAX: +49-331-288 1302; E-Mail: neg@gfz-potsdam.de).

GAIM Science Conference

GAIM (Global Analysis, Interpretation, and Modelling) Core Project of the IGBP is organising a science conference in Garmisch-Partenkirchen, Germany, 25-29 Sept. 1995. The purpose of this meeting is to advance the study of the coupled dynamics of the Earth system using as tools both data and models. Session topics will be grouped by time periods, including: Paleo (<20 kyr), Historical (<2 kyr), and Contemporary (<20 yr). Major participation by PAGES scientists is encouraged because of the strong paleo agenda of the meeting. For more information: D. Sahagian, GAIM task force, USA (FAX: +1-603-862 1915; E-Mail gaim@unh.edu).

ADDITIONAL ITEMS

First IMAGES Cruise

The Marion Dufresne, a French (IFRTP) vessel designed to acquire high-quality, 40-m cores, departed for the North Atlantic in late May. The cruise, with Laurent Labyrie as chief scientist, is the first in a series planned by the IMAGES program. The cruise was jointly funded by France, the US, Canada, Germany, the UK, Spain, and Norway. Cores acquired during the cruise will provide the raw materials to accomplish IMAGES goals to quantify climate and chemical variability of the oceans on time scales of oceanic and cryospheric processes, to determine its sensitivity to identified internal and external forcing; and to determine its role in controlling atmospheric CO_2.

Inter-hemispheric ^{14}C Calibration

The radiocarbon dating laboratories at Queen's University Belfast and Waikato University, New Zealand, have embarked on a project to develop a high-resolution, high-precision ^{14}C calibration dataset linking the northern and southern hemispheres and spanning the period AD 950 to AD 1950. The project will use dendrochronologically dated wood to: (1) provide the first ^{14}C calibration curve for the southern hemisphere; (2) detect inter-hemispheric ^{14}C offsets,if any; (3) assist research in oceanography and palaeoclimatology including investigations of the relative importance of inter-hemispheric tropospheric exchange over a millennium (using ^{14}C as a tracer); (4) provide information on any temporal variability in inter-hemispheric offsets. Report from F. G. McCormac, N. Ireland, (FAX: +44-1232-321 280; E-Mail: gmccormac@geos_01.gg.qub.ac.uk) and A. G. Hogg, New Zealand (E-Mail: a.hogg@waikato.ac.nz).

Paleolimnology of Alpine-Adriatic Lakes (PAAL)

The PAAL project was proposed by the Austrian National Committee for IGBP as a national contribution to the PAGES effort. It has received support from the Austrian funding agencies. The overall project goal is to decipher ecosystem response to climate changes within lacustrine coastal systems and their catchments during the last 15,000 years. Special emphasis will be given to Adriatic sea-level changes as a forcing agent from the coast to the Alpine region, along with the effects of human activities. The project objectives include (1) obtaining fine-resolution proxy paleoclimatic records along a north-south transect from the southeastern Alps to the Adriatic, using geochemical and biological indicators; (2) reconstruction of past climatic changes during periods of rapid change and human influence; and (3) linking and correlating data obtained from terrestrial, aquatic, and marine environments. Project Coordinator: R. Schmidt, Institute for Limnology, Mondsee, Austria (TEL:+43-6232-3125; FAX: +43-6232-3578).

Lago Titicaca project: An international collaborative research on paleoenvironments and paleoclimate

G. Seltzer (Syracuse University, USA) and P. Baker (Duke University, USA) are co-ordinating a large project on Lago Titicaca, Bolivia. Sedimen-tological,

geochemical, and biotic studies of long cores obtained in Lago Titicaca can provide useful information on the paleoenvironments and paleo-climate of the Andean subtropics, especially on past precipitation changes. The basin has probably existed since at least the Pliocene and may contain a long sedimentary record of hydrological and environmental change in the area. A 3-year proposal to the U.S. National Science Foundation focusing on coring in the lake recently was submitted. It involves a number of scientists and students from both South and North American institutions. For more information, contact G. Seltzer, Syracuse University (FAX: +1-315-443 3363; E-Mail: goseltze@mailbox.syr.edu).

The Nansen Arctic Drilling Program (NAD) news

The Nansen Arctic Drilling Program (NAD) was formed to deeply probe the marine sedimentary record of the Arctic Ocean. The primary scientific goals of NAD are to understand the climatic and paleoceanographic evolution of the Arctic region and its effects on global climate, the biosphere, and the dynamics of the world ocean and atmosphere. The project emphasizes the last two glacial-interglacial cycles.

On 25-26 November 1994, a Laptev Sea drilling workshop hosted by the Arctic and Antarctic Research Institute was held in St. Petersburg, Russia. The objectives were to determine the scientific merit, technical, political, and fiscal feasibility of scientific drilling in the Laptev Sea. This area was chosen because of the large existing data base and ongoing German-Russian programs. Scientifically it also promises a high return due to its present position in a marginal ice zone and the presence of large rivers. The latter will make it possible to decipher the terrestrial record of continental glaciation and the hydrological regime over time. NAD hopes to provide the northern link to the MESH and IMAGES programs.

A pilot program of one or two sites will be drilled in winter 1995-1996 or summer 1996. Core length would be 400-500 m with undisturbed high quality continuous recovery. Presently proposed sites need better documentation in order to raise them to standards of ODP shallow water sites. Ultimately NAD will require an ice reinforced drill platform like SHASHIN with icebreaker support. In the interim, 50 m cores may be possible utilising existing ice breakers and new technology. For further information, contact: L. Johnson, Chair NAD executive committee, USA (FAX: +1-703-525 7206; E-Mail: gljgerg1@aol.com).

Isotope Workshop (IAEA-WMO-IAHS-PAGES) Update

An executive summary was presented by PAGES at the Twelfth WMO Congress in Geneva in June. An IAEA-WMO-IAHS-PAGES Steering Committee to implement the recommendations from the Workshop will be constituted at a follow-up meeting organized by IAEA in Autumn 1995. At the Tenth Conference of the African Geological Society, PAGES will organize of a two-day isotope workshop on African participation in Global Network of Isotopes in Precipitation (GNIP) (see Editorial).

New IGBP National Committee Reports and Other Publications

The following publications have been issued by the respective IGBP National Committees:

India: "Global Change Studies", ISRO-GBP-SR-42-94, IGBP-related research in 1994. At least 11 papers are directly relevant to PAGES. Copies: Programme Director, Indian Space Research Organisation (ISRO) Geosphere Biosphere Programme, ISRO-GBP programme office, 321, Antariksh Bhavan, Department of Space, Bangalore 560 094, India.

Belgium: "IGBP and Global Change-related research in Belgium", no. 2, 1994. PAGES-related research is illustrated by 15 programmes, most of them nationally or internationally funded. Copies: O. Vanderborght, Royal Academies of Sciences Academy House, Hertogsstraat 1, 1000 Brussels, Belgium.

New Zealand: Global Change News, A newsletter about IGBP-related research, published by the Royal Society of New Zealand, P.O. Box 598, Wellington. PAGES contact: Prof. Jane Soons, Dept. of Geography, University of Canterbury.

The World Data Center - A for Paleoclimatology has issued a publication entitled "Lake Status Records from the Former Soviet Union and Mongolia: Data Base Documentation." Copies: Mildred England (+1-303-497-6227; Email:mke@mail.ngdc.noaa.gov). Data presented in this report are available through a variety of World Wide Web services, as well as on diskettes (at a nominal cost). More information: info@mail.ngdc.noaa.gov.

New Projects

At the meeting of the PAGES Scientific Steering Committee in March, 1995, in Mendoza, Argentina, the following projects were approved as part of the PAGES organizational structure. More information about these projects will be forthcoming.

Annual Records of Tropical Systems (ARTS): focusing on corals and other annual records of Time Stream I from tropical climate systems, this project will become a task of PANASH. Contact: J. Cole, USA (FAX: +1-303-492-6388; E-MAIL: coleje@spot.colorado.edu).

Himalayan Interdisciplinary Paleoclimate Project (HIPP): becomes Task 2 of the PEP II transect. See workshop report above for description and contact information.

PAGES-CLIVAR Collaboration on climate variability, focusing on Time Stream I, becomes Focus V, activity 1. Contact: J.-C. Duplessy, FRANCE (FAX: +331-69 82 3568; E-MAIL: duplessy@eole.cfr.cnrs-gif.fr).

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PAGES CALENDAR

Aug. 3-10, 1995: PAGES symposium at the **INQUA** Congress*; Berlin, GERMANY.
1. Main symposium No. 1: **PAGES Stream I and Stream II**; Contacts: J. Pilcher, U.K. (FAX: +44-1232-321 280; E-MAIL: jpilcher@geos_01.gg.qub.ac.uk) and J.-C. Duplessy (FAX: +33-1-69 823568; E-MAIL: duplessy@cfr.cnrs-gif.fr).
2. **Paleoclimate of the Southern Hemisphere during the last 140,000 years: metachronous with that of the Northern Hemisphere?** Contact: J.-C. Duplessy, FRANCE (cf. supra).
3. **Paleomonsoon variations and global change during the Late Quaternary.** Contact: S. Kröpelin, GERMANY (FAX: +49-30-838 4882; E-MAIL: skroe@fub46.zedat.fu-berlin.de).

Aug. 14-18, 1995: PAGES session on **Paleogeographical and historical dimensions of global change** at the International Geographical Union*; Moscow, RUSSIA. Contact: A. Velichko, RUSSIA (TEL: +7-095-238 0298; FAX: +7-095-230 2090).

Aug. 20-25, 1995: International symposium on **Glacial Erosion and Sedimentation***; Reykjavik, ICELAND. Contact: Secretary General of the International Glaciological Society, UK (TEL: +44-1223-355974; FAX: +44-1223-336543).

Aug. 21-25, 1995: First International Limnogeological Congress on **Research methods in ancient and modern lacustrine basins***; Copenhagen, DENMARK. Contact: N. Noe-Nygaard, DENMARK (TEL: +45-35-322 491; FAX: +45-35-322 499).

Aug. 22-25, 1995: International conference on **Past, present, and future climate***, Helsinki, FINLAND. Contact: P. Heikinheimo, FINLAND (FAX: +358-0-774 882 99; E-MAIL: pirkko.heikinheimo@aka.fi).

Sept. 1-3, 1995: **CircumArctic PaleoEnvironments (CAPE)** organizational meeting; Copenhagen, DENMARK. Contact: S. Bjorck, DENMARK (E-MAIL: Svante@geo.gcol.ku.dk).

Sept. 4-8, 1995: Third international conference on **Modelling of global climate change and variability***; Hamburg, GERMANY. Contact: L. Dümenil, Hamburg, GERMANY (TEL: +49-40-41 173 310; FAX: +49-40-41 173 366).

Sept. 11-15, 1995: Workshop on **Climatic Change at High Elevation Sites***; Wengen, SWITZERLAND. Contact: H. Diaz, USA (FAX: +1-303-497 7013); E-MAIL: hfd@noaacdc.colorado.edu).

Sept. 16-21, 1995: **GISP2-GRIP** Joint Workshop; New Hampshire, USA. Contact: M. Twickler, USA (FAX: +1-603-862 2124; E-MAIL: smo@unh.edu).

Sept. 18-22, 1995: ESF symposium on **Ice sheet modelling**; Chamonix Mont-Blanc, FRANCE. Contact: P. Pirra, ESF, 1 quai Lezay-Marnésia, F-67080 Strasbourg Cedex, FRANCE.

Sept. 24-29, 1995: **GAIM science conference***, Garmisch-Partenkirchen, GERMANY. Contact: D. Sahagian, GAIM task force, Durham, NH, USA (FAX: +1-603-862 1915; E-MAIL: gaim@unh.edu).

Oct. 7-12, 1995: ESF conference on **The ecological setting of Europe, from the past to the future: the establishment of plant and animal communities in Europe since the Last Glaciation**, La-Londe-les-Maures, FRANCE. Contact: B. Berglund, SWEDEN (FAX: +46-46-104 830; E-MAIL: bjorn.berglund@geol.lu.se).

Oct. 10-14, 1995: 5th International Conference on **Palaeoceanography***; Halifax, CANADA. Contact: D. Piper, CANADA (E-MAIL: piper@agcrr.bio.ns.ca).

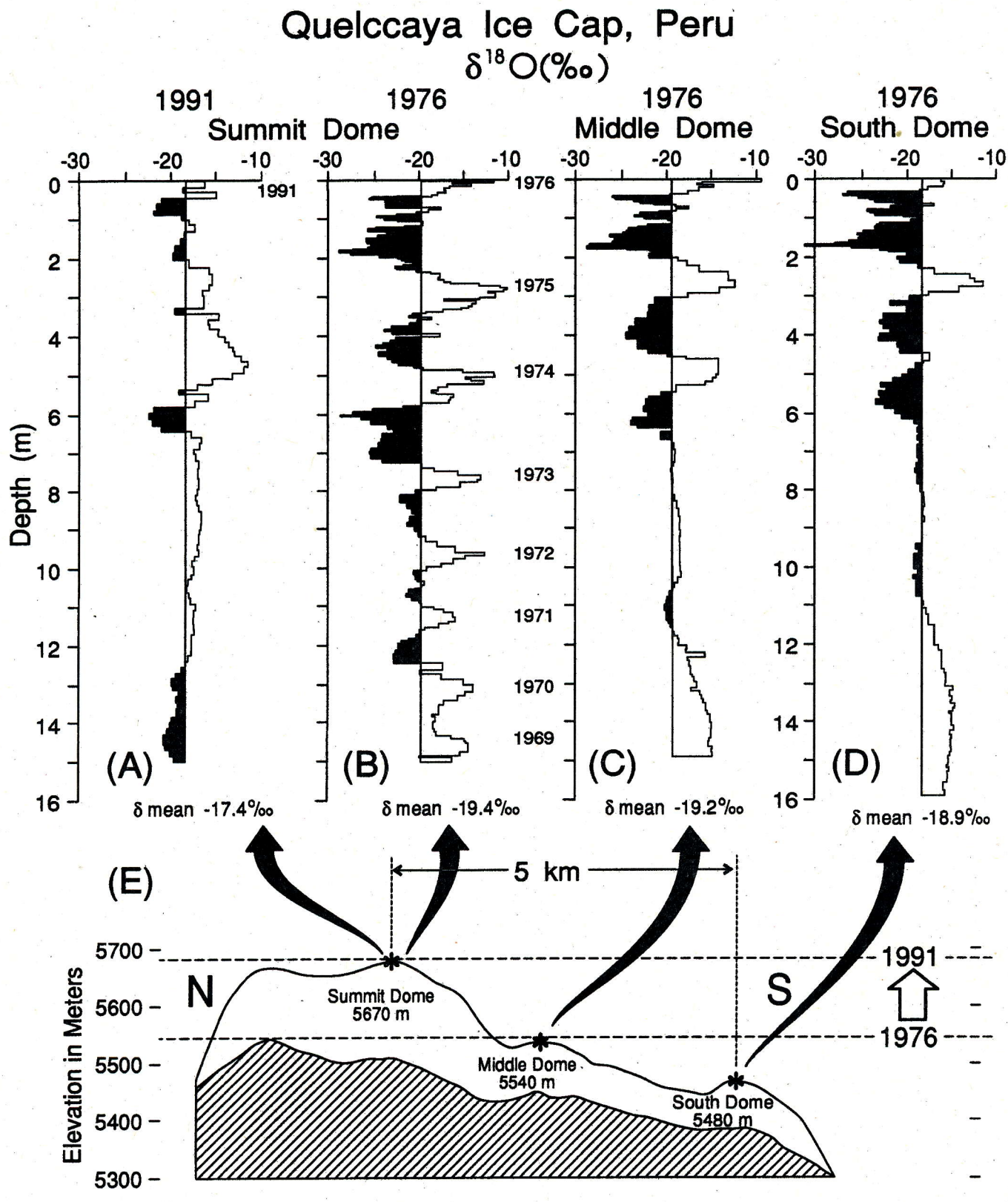
Oct. 23-25, 1995: Open session of the SAC IV on **Natural and anthropogenic changes in Asia: impacts on global biogeochemical cycles***; Beijing, CHINA. Contact: IGBP, SWEDEN (TEL: +46-46-816 6448; FAX: +46-46-816 6405).

Nov. 28-Dec. 1, 1995: PAGES-PEP II international symposium on **Palaeoclimate and environmental variability in Austral-Asian transect during the past 2,000 years***; Nagoya, JAPAN. Contact: T. Sweda, JAPAN (TEL: +81-52-789 4053; FAX: +81-52-789 4012).

Dec. 9-11, 1995: International conference of the IGCP 349 on **Quaternary deserts and climatic change***; Al Ain, UAE. Contact: A. S. Alsharhan, UAE (FAX: +971-3-620 486).

Dec. 17-22, 1995: Symposium of the International Chemical Congress of Pacific Basin Rim Societies on **Volcano-atmosphere interactions***; Honolulu, USA. Contact: R. Andres USA (FAX: +1-907-474 6087; E-MAIL: ffrja@aurora.alaska.edu).

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



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

Melting Of Our Tropical Climatic Archives

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Reliable meteorological observations for climate reconstruction are limited or absent prior to A.D. 1850 for much of the Earth, particularly in both tropical South America and the Tibetan Plateau region of central Asia. Ice sheets and ice caps are widely recognized as libraries of atmospheric history from which past climatic and environmental conditions may be extracted. Much of the climatic activity of significance to humanity (eg., variations in El Niño/ Southern Oscillation and the monsoon system) may not reach or be strongly expressed over the polar ice caps. Tropical records are of particular interest as 50 % of the Earth's surface lies between 30° N and 30° S and 80 % of the current population inhabits these regions. In addition, the tropics are the center of the global hydrological cycle. Unfortunately, as a result of the recent warming all of the known tropical glaciers and ice caps are retreating.

The Quelccaya ice cap provides a classic illustration of this threat. A 1500-year record extracted in 1983 from the Quelccaya Ice Cap (Thompson et al., 1986, 1988 and Thompson, 1992) in the tropical Andes of Peru (13° 56' S, 70° 50' W, 5670 m asl) was recently updated by the analysis of a new core drilled in October 1991. The figure illustrates the ∂18O records from ice cores drilled in 1976 on Quelccaya at three locations; the 5670 m asl summit dome (Fig. B), the 5540 m asl middle dome (Fig. C), and the 5480 m asl south dome (Fig. D). In the 1976 south and middle dome cores, the annual ∂18O signal is lost below 6 m due to percolation of meltwater. However, the ∂18O record from the 1976 summit core shows well-preserved seasonal variations throughout its length, with a mean ∂18O value of -19.40 ‰. When the 1976 record is compared with the 1991 record from the same site (Fig. A and B) it is evident that (1) the ∂18O values have been enriched by 2 ‰ and (2) annual variations are no longer preserved at this site. If the survey to assess the quality of the record preserved in this ice cap had been conducted in 1991, Quelccaya would have been eliminated as a possible site for acquisition of a long ice core paleoclimatic history.

The impact of the recent warming on the Quelccaya Ice Cap can be seen in the massive and accelerating retreat of the margin of the ice cap (Brecher and Thompson, 1993; Thompson et al., 1993). A 130 m-rise in the percolation zone occurred from 1976 to 1991. The observations on Quelccaya are consistent with the conclusions that every tropical ice cap for which we have information is retreating, and where we have sequential information the rate of retreat is accelerating. This is true for the glaciers in the Cordillera Blanca in north central Peru as well as further north in the Andes. Schubert (1993) noted in the Sierra Nevada de Merida in Venezuela that at least 3 glaciers have completely disappeared. Hastenrath and Kruss (1992) compared maps from 1963 to 1987 to demonstrate that total ice cover on Mount Kenya, Africa has decreased by 40 %, a considerably faster rate than during the 1899 to 1963 period. Moreover, recent work by Kaser and Noggler (1991) demonstrates that the Speke Glacier, the best studied and largest single glacier in the Ruwenzori Range (Uganda, East Africa) is in an accelerating state of retreat. A comparison of its present state with former observations reveals that its terminus receded by 35-45 m between 1958 and 1977 (period of 19 years) and by 150 m from 1977 to 1990 (a period of 13 years). Many of these unique tropical and subtropical archives of climate and environmental history are in imminent danger of being lost. It is urgent to retrieve high quality ice cores from them.

Brecher H. H. and Thompson L. G., 1993. Measurement of the retreat of Qori Kalis in the tropical Andes of Peru by Terrestrial Photogrammetry. Photogrammetric Engineering and Remote Sensing, 59 (6), 1017-1022.

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Thompson L. G., Davis M. E., Mosley-Thompson E. and Liu K., 1988. Pre-Incan agricultural activity recorded in dust layers in two tropical ice cores. Nature, 336, 763-765.

Thompson L. G., Mosley-Thompson E., Dansgaard W. and Grootes P. M., 1986. The "Little Ice Age" as recorded in the stratigraphy of the tropical Quelccaya ice cap. Science, 234, 361-364.

Thompson L.G., Mosley-Thompson E., Davis M. E., Lin P. N., Yao T., Dyurgerov M. and Dai J., 1993. "Recent warming": ice core evidence from tropical ice cores with emphasis on Central Asia. Global and Planetary Change, 7, 145-156.