

# PAGES

PAST GLOBAL CHANGES

# A CORE PROJECT OF THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME IGBP

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## News of the International Paleoscience Community Volume 2, Number 2- July 1994

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### EDITORIAL

In the last year our perception of the role of PAGES in Global Change Science was confronted with discoveries of unexpected events, such as the rapid climatic changes in the Eemian interglacial observed in the Greenland ice cores. Though these latest findings are somewhat controversial, they have not only received a lot of attention but also produced new key questions for global change research. Corresponding signatures of climate change are becoming more and more visible in oceanic records too as time resolution improves. It will be a challenge for paleo-scientists working on continental records to produce data of similar relevance in areas where most of the world's population lives.

The new PAGES project organization tries to link these records to a network of global understanding of the nature and rate of past environmental change and how such changes compare with modern environmental variation. We also try to focus on the invaluable and unique perspective that paleo information provides for dealing with the impact of climate change at the global, regional and local scales.

The PAGES SSC meeting in Canberra, 8-10 June, 1994 assessed the new PAGES core project organization. Its five Foci then could also serve as a scientific orientation plan for individual research programs throughout the international paleoscience community.

H. Oeschger, Chairman of PAGES Scientific Steering Committee

### PAGES WORKSHOPS

#### PAGES workshop on land use and climate impacts on fluvial systems during the agricultural period

Results presented at a PAGES planning meeting in Bern, 10-11 February 1994 suggest that over time scales of decades to centuries to millennia it is possible to separate the effects of land use and climate on flux of materials in fluvial systems. Land use is the dominant control of this flux, but it is significantly modulated by climatic variations. PAGES research will establish the frequency and severity of flood and drought events in the period prior to

instrumental records. The report from the meeting is in preparation and we anticipate follow-up meetings to plan research in a number of regional catchments.

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#### PEP III transect through Europe and Africa, PAGES planning workshop, Berne, Switzerland

An international group of 12 scientists met in Berne, 13-14 December 1993 to discuss the scientific goals and general strategy of the PEP III program (Pole-Equator-Pole, across Europe and Africa). After an estimation of the state of the art, five research foci have been defined: 1. validation of climate model response to altered forcing with the support of multivariate data for 21 and 6 ka; 2. analysis of seasonal to century-scale climatic variability and the early detection of anthropogenically-induced climate change; 3. understanding the large instabilities in the climate system over the last deglaciation; 4. abrupt large-scale changes during the current interglacial, such as lake-level changes; and 5. climate dynamics over the last two glacial/ interglacial cycles. Efforts of the international community must be focussed on a few key sites where long drill-cores are available.

Abstracted from a report by F. Gasse, France, TEL: +33-69416756; FAX: +33-64465938.

#### PEP II transect through Asia and Australia, PAGES planning workshop, Beijing, China

The Institute of Geology of the Chinese Academy of Sciences and PAGES sponsored a PEP II planning and organizational workshop in Beijing, 7-12 April 1994. Sixty scientists presented current work on proxy data methods and palaeoclimates along the PEP II transect. Workshop groups discussed a variety of research questions that need to be investigated.

The working groups emphasized that the positions of the Westerlies, and the Siberian and Australian Highs are very significant components of the climate system along the PEP II transect and need to be tied in with the variability of the monsoon systems. Similarly, the intricacies of the effects of sea level change and evaporation from the seas around Japan, China, and

the Sunda and Sahul shelves are also important factors governing climate along the transect. The workshop stressed that our understanding of monsoon activity could be greatly enhanced by research into the effects of the relative lack of a northern ice sheet in the region, the presence of a "Third Pole" (the Tibetan Plateau) and the world's largest pool of warm water around Indonesia. It was regarded as essential that the relative strength of human and climate impacts in the environment should be studied. The long historical records from China, Japan, Korea and Indonesia are thought to hold great potential for additional information.

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#### PAGES workshop on paleomonsoons in Africa and surrounding oceans and START-Africa workshop

The INQUA/PAGES paleomonsoons project held a joint meeting and workshop with the START Africa program in Mombassa, Kenya, 13-14 December 1994. The meeting was co-sponsored by the IGBP Core Project PAGES, the IGBP-START Secretariat (System for Analysis, Research and Training) and the German Ministry of Research and Technology (BMFT). Some 40 representatives of leading research groups from Africa, Asia, Australia, Europe and the USA were present.

The workshop focused on future scientific projects needed to advance the retrieval and interpretation of climate-proxy records of paleomonsoon phenomena on a 200,000 year time-scale (temporal stream II) at century scale or better resolution. The meeting also reviewed the status of current knowledge on monsoon evolution in Africa and the surrounding seas, discussed collaborative research and prepared recommendations for a science and implementation plan as a guide for future PAGES research in the tropical zone. The following aspects were recommended: verification of the phase relationships of the major shifts in the position of the isohyets since the last interglacial; assessment of the importance of the oceans as "the monsoon fly-wheel"; focus on great rivers draining the monsoonal regions and on fossil corals; and establishment of climate modeling sites within the monsoon region.

Abstracted from a report by S. Kröpelin, Germany,  
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### **MEETING REPORTS**

#### Meeting the Enquete Commission of the German Bundestag

On 29 April 1994, in Bonn, Germany, H. Oeschger spoke as an expert witness at a hearing of the German Bundestag's Enquete Commission on climate change. Because there is still some scientific controversy concerning the severity of projected change in climate, it is difficult for those in the public sector to convincingly propose policies aimed at limiting human induced greenhouse forcing. In the

meeting special attention was given to new results from modeling experiments, paleostudies and studies of the role of aerosols. Scientists are generally extremely careful in formulating their concerns for fear of losing the confidence of the public, should some particular predicted climatic or environmental change fail to take place. Scientists are convinced, however, that our basic understanding of the increase in greenhouse forcing and its effect on the climate of the globe will hardly be subject to major changes. An objective and continually reassessed perception of this issue is indispensable to Global Change research and increasingly indispensable to makers of public policy.

#### Joint Scientific Committee of the World Climate Research Program meeting

At the Joint Scientific Committee of the World Climate Research Program (JSC/WCRP; Geneva, 14-19 March 1994), H. Oeschger reported on PAGES organization, recent advances in paleoclimate research relevant to Global Change and possible future collaboration between PAGES and WCRP. The committee showed great interest in the PAGES strategy and organization. WCRP will place emphasis on the Climate Variability (CLIVAR) initiative and hopes for a fruitful interaction with PAGES concerning information on the pre-instrumental period. H. Oeschger noted that while paleo-parameters are at times difficult to translate into physical model parameters, they are often of unique value because they reflect the direct impact of climate change on vegetation and hydrologic systems. JSC members also showed interest in studying the physical control of the mass balance of ice sheets and of instabilities in the atmosphere-ocean circulation. The committee clearly recognized the importance of model-data interaction in Global Change research.

#### IC/IAI: Inter-American Institute for Global Change Research

A symposium and workshop on High Latitude Processes was held in Buenos Aires, Argentina, 13-17 December 1993. More than 70 scientists from 8 countries attended the meeting designed to obtain a representative sample of the on-going projects examining climate change in high latitudes. The workshop consisted of 33 scientific presentations, a conference by R. Bojkov from the World Meteorological Organization (WMO) on "Ozone changes and the Southern Cross Countries Project for Ozone and UV-B Monitoring and Research", and a round table discussion entitled "Some climatic tendencies in high and mid latitudes in South America".

The workshop focused on developing the IAI Science Agenda on High Latitude Processes. Four working groups were formed: Ozone and UV-B radiation; Present and Past Cryospheric Processes; Climatology and Atmospheric Processes; IAI and other International Organizations. The conclusions of each working group will be published in the final report for the IAI Workshop on High Latitude Processes.

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### The European pollen database is now open

In May 1994, the European pollen database (EPD) officially opened; the data are available for use. The compilation (more than 400 sites from about 20 countries) is aimed at vegetation and climate reconstructions and mapping, and human impact analysis.

The European Pollen Database is financed by the EPOCH and ENVIRONMENT programs of the European Community. Although the Eastern and Central European countries have shown a great interest in the EPD initiative, their active contribution to the project was only recently possible thanks an EEC programme. J.-L. de Beaulieu, J. Guiot and R. Cheddadi from the Marseilles laboratory of Historical Botany and Palynology coordinate the compilation and the distribution of the data. The EPD is available on both diskettes and via FTP.

For more information please contact: European Pollen Database Centre, France, TEL: +33-90961818; FAX: +33-90939803; E-mail: EPD@FRMOP22.CNUSC.FR. Abstracted from a report by R. Cheddadi.

### Medieval Warm Period

A workshop held in Tucson, Arizona, 5-8 November 1993, has produced a special issue of the journal *Climate Change* detailing the state of current understanding of the Medieval Warm Period (*Climate Change, Special Issue, The Medieval Warm Period*, Vol. 26, Nos. 2-3, Ed.: M. K. Hughes, Univ. of Arizona, and H. F. Diaz, NOAA). The issue contains 13 papers reviewing the evidence for the existence of a Medieval Warm Period, and its possible causes. Forty-nine researchers participated in the workshop aimed at defining the critical variables and types of proxy records needed for climatic reconstruction of the period 900-1300 yr AD. Participants reviewed availability of suitably high quality data with a view to assessing the often over-simplified amplitude and duration of the Medieval Warm Period, and the number and quality of the data from all sources to yield usable large estimates of climatic changes.

Abstracted from a report by M. Hughes, USA, TEL: +1-602-6212191; FAX: +1-602-6218229; E-MAIL: MHUGHES@CCIT.ARIZONA.EDU.

## **ADDITIONAL ITEMS**

### Paleomonsoon project

S. Kröpelin will co-host a one day symposium at his institute during the INQUA Congress in Berlin, 3-10 August 1995. The subject will be "Environments in the axis of the Old World desert belt during the terminal Pleistocene and early Holocene." The symposium will review the status of current knowledge about the environmental and climatic conditions in North Africa, the Arabian peninsula, India and central Asia from 130,000 to 5,000 years before present.

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### PALE: Newsletter and protocol publication

PALE (paleoclimates of arctic lakes and estuaries) is a PAGES operational task designed to focus on temporal stream I and II objectives in the Arctic regions.

International collaborative projects are well underway with most of the Arctic-rim nations participating. PALE forms the Arctic linkage for the PEP transects and close ties will be maintained between these elements. PALE produces an annual PALE Newsletter.

For additional information, please contact: J. Andrews, USA, TEL: +1-303-4925183; FAX: +1-303-4926388. The research protocols for PALE have been published by PAGES (report series 94-1). Copies can be ordered at the PAGES/CPO.

### New SSC-Members

PAGES is pleased to welcome three new SCC members replacing J. Price, J. Rabassa and J. Eddy, to whom we express our gratitude for their service to the PAGES community. We welcome the following to the PAGES SSC: Thomas F. Pederson, Department of Oceanography, University of British Columbia, Vancouver, Canada, an expert in Quaternary paleoceanography and paleo geochemistry, particularly with respect to the history of productivity and paleonutrient fluxes, and the history of organic matter in the ocean, as well as in stable isotope geochemistry in sedimentary systems. Tim Partridge, Transvaal Museum, Department of Palaeontology and Palaeoenvironmental Studies, Forest Town, South Africa is a specialist in Quaternary Geology of the Southern Hemisphere. His interests focuses in the paleoclimate of Southern Africa. Jonathan T. Overpeck, Paleoclimatology Program at the National Geophysical Data Center, National Oceanic Atmosphere Administration, Boulder, Colorado, USA, has expertise in Late Quaternary climatic patterns and causes of decadal to millennial-scale climatic and ocean dynamics. He leads the World Data Center-A for paleoclimatology and has been closely associated with the data activities for the PAGES project.

### Jean-Charles Fontes

On 2 February 1994, Jean-Charles Fontes died in a car accident in Mali during a scientific mission. Professor J.-C. Fontes was director of Paris Sud and had only recently become director of the isotope laboratory of the IAEA in Vienna. He was a scientist with a unique flair for Earth system science and a grasp of the enormous potential of isotope techniques in many fields. Just one month before his death he attended the PEP III PAGES workshop in Berne. During lively discussions with Jean-Charles, it became evident that a very promising collaboration between him and PAGES would have evolved. PAGES will play a role in promoting isotope studies in Global Change Science in the spirit of Jean-Charles Fontes.

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## PAGES CALENDAR

- 7-12 August 1994, International Symposium on the **Role of the Cryosphere in Global Change** (International Glaciology Society); Columbus, Ohio, USA. Contact: Secretary General, International Glaciology Society, Lensfield Road, Cambridge CB2 1ER, UNITED KINGDOM.
- 8-10 August 1994, International Symposium on **Global Change in Asia and the Pacific Regions;** Beijing, CHINA. Contact: Duzheng Ye, P.R. CHINA (TEL: +86-1-571939; FAX: +86-1-2562347).
- 14 August 1994, Workshop on PAGES Chronologies – **Dating Techniques and Comparability of Chronologies;** Glasgow, UNITED KINGDOM. In connection with the 15th International Radiocarbon Conference. Contact: W. Mook, THE NETHERLANDS (TEL: +31-2220-69366; FAX: +31-2220-19674).
- 14-23 August 1994, IGCP: 349 meeting on **Desert margins and paleomonsoons of the northern hemisphere, old worlds: 135,000 yrs B.P. to the present;** Xian, CHINA. Contact: Zhou Jie, P. R. CHINA (TEL: +86-29-5255951 #3011; FAX: +86-29-5262566).
- 15-18 August 1994, Symposium on **The South Atlantic: present and past circulation;** Bremen, GERMANY. Contact: B. Donner, GERMANY (TEL: +49-421-2183389).
- 25 August-2 September 1994, International Conference on **the Arctic and North Pacific, Bridges of Science between North America and the Russian Far East;** Anchorage, Vladivostok. Contact: G. Weller, USA (FAX: +1 907-4747290; E-MAIL: gunter@dino.gi.alaska.edu).
- 2-7 September 1994, ESF Conference on **Arctic ocean grand challenge. Session on paleoenvironment and climate;** Helsinki, FINLAND. Contact: J. Hendekovic, FRANCE (FAX: +33-88366987).
- 6-9 September 1994, 2nd European Regional Meeting on **Coral Reefs in the past, present and future;** Luxemburg, LUXEMBURG. Contact: J. Geister, SWITZERLAND (TEL: +41-31-6314567; FAX: +41-31-6314843).
- 5-9 September 1994, International Conference on **Arctic Margins;** Magadan, RUSSIA. Contact: D. Thurston, Alaska, USA (TEL: +1-907-2716545; FAX: +1-907-2716565; E-MAIL: AHDT@acad2.alaska.edu).
- 10-17 September 1994, INQUA/GLOCOPH: International Meeting on **Global Continental Paleohydrology;** Southampton, UK. Contact: J. Branson, Geodata Institute, Univ. of Southampton, Southampton, SO9 5NH, UNITED KINGDOM.
- 10-15 September 1994, ESF conference on **Alluvial basins: present and past environments;** Lunteren, THE NETHERLANDS. Contact: J. Hendekovic, FRANCE (FAX: +33-88366987).
- 3-7 October 1994, NATO Workshop on **Climatic Fluctuations and Forcing Factors the last 2000 years;** Tuscany, ITALY. Contact: R. Bradley, USA (TEL: +1-413-5452794; FAX: +1-413-5451200).
- 4-7 October 1994, BAHC-LOICZ-PAGES workshop on **delivery of terrestrial material to freshwater and coastal ecosystems;** Durham, New Hampshire, USA. Contact: C. Vörösmarty, USA (TEL: +1-603-8621792; FAX: +1-603-8621915; E-MAIL: cv@cyoling.unh.edu).
- 12-15 October 1994, NATO Workshop on **Biomass burning emissions and global change;** Algarve, PORTUGAL. Contact: J. Clark, Durham, USA (TEL: +1-919-6607402; FAX: +1-919-6607425; E-MAIL: jimclark@sun1.botany.duke.edu).
- 23-31 October 1994, INQUA workshop on **laminated sediments in sebkhas/salt lakes and the mapping of the Holocene vegetation of the southern Mediterranean;** Zarzis, TUNISIA. Contact: E. Schulz, GERMANY (TEL: +49-931-8885546; FAX: +49-931-8885544).
- 25 October 1994, PAGES scientific meeting, PALE session on **Paleoclimate records from Arctic lakes and estuaries** at the Geol. Soc. of America; Seattle, WA, USA. Contact: G. Miller, USA (TEL: +1-303-4928437; FAX: +1-303-4926388; E-MAIL: miller@stable.colorado.edu).
- 5-10 November 1994, ESF Conference on **Glacial-Interglacial Sealevel Changes in four dimensions: continental shelf evidence of sealevels over the last 25 ka;** St-Martin (near Mannheim), GERMANY. Contact: J. Hendekovic, FRANCE (FAX: +33-88366987).
- 16-20 November 94, PAGES/CLIVAR meeting on **global climate and environmental changes over the last centuries;** Venice ITALY. Contact: J. C. Duplessy, FRANCE (TEL: +33-1-69823526; FAX: +33-1-69823568; E-MAIL: duplessy@eole.cfr.cnrs-gif.fr).
- 21-23 November 1994, International workshop on **the late Quaternary history of the oceans in the Australian region; comparison with the Atlantic record;** Canberra, AUSTRALIA. Contact: P. Dedecker, AUSTRALIA (TEL: +61-6-2492056; FAX: +61-6-2495544; E-MAIL: sxn653@sogar.anu.edu.au).
- 3-7 January 1995, 4th International conference on **the Evolution of East Asian Environment;** Hong Kong. Contact: Secretariat HONG KONG (FAX: +852-5595884; E-MAIL: CASLIB@HKUCC.BITNET).

## The Younger Dryas as viewed through the Summit Greenland ice cores

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Of the various paleorecords available to science, ice cores from polar ice sheets provide the most direct and highest resolution view of the paleoatmosphere. In July 1993 the Greenland Ice Sheet Project Two (GISP2; 72.60 N; 38.50 W; 3200 m.a.s.l.) successfully completed drilling through the base of the Greenland Ice Sheet at 3053.44 meters (Mayewski et al., 1994a). GISP2 and its European companion project GRIP (the Greenland Ice Sheet Project, sited 30 km to the east of GISP2), which penetrated the ice sheet to a depth of 3028.8 m one year earlier, have now developed the longest paleo-environmental ice core record, >250,000 years available from the Northern Hemisphere (Dansgaard et al., 1993).

Marking the end of the last major climate reorganization, the Younger Dryas (YD) was the most significant rapid climate change event that occurred during the last deglaciation of the North Atlantic region. Most recently the YD has been redated and reinterpreted by Alley et al. (1993) using precision, sub-annually resolved, multivariate measurements from the GISP2 core as a 1300+/-70 year duration event that terminated abruptly, as evidenced by an ~7°C rise in temperature deduced from the oxygen isotope record (Grootes et al., 1993) (Figure) and a twofold increase in accumulation rate at ~11.64 ky BP (Figure). The transition into the Preboreal (PB) was remarkably fast, occurring over a period of approximately a decade (Alley et al., 1993).

High resolution (mean 3.48 yr/sample), continuous measurements of GISP2 anions (chloride, sulfate and nitrate) and cations (sodium, magnesium, potassium, calcium and ammonium) were used to reconstruct the paleoenvironment during the YD because these series record the history of the major soluble constituents transported in the atmosphere and deposited over central Greenland. These multivariate glaciochemical records provide a robust indication of changing source characteristics and/or transport paths of these soluble components in response to climate change. A dramatic example is provided by the calcium series covering the last ~10-18 kyr B.P. (Figure). Prominent periods of increased dustiness have been observed in the record peaking approximately every 400-500 years: during the early Preboreal (PB) at ~11.4 ky BP; throughout the YD at ~11.81, 12.22 and 12.64 ky BP; during the Bølling/Allerød (B/A) at ~13.18, 13.65, 14.02 ky BP; and during the Glacial. Such events have been attributed by Mayewski et al. (1993a, 1994b) to changes in the size of the polar atmospheric cell and in source regions (e.g., growth or decay of continental biogenic and terrestrial source regions).

The record of variations in the methane (CH<sub>4</sub>) concentration of trapped gases in the GRIP ice core (Figure) shows that tropical and subtropical climates were more restricted during the YD and earlier cold events (Chappellaz et al. 1993). The major natural source region of CH<sub>4</sub> is low-latitude wetlands; higher atmospheric concentrations are presumably due to the greater areal extent of tropical and subtropical wetlands (Chappellaz et al., 1993).

The ammonium flux record (NH<sub>4</sub>) from GISP2 provides an estimate of continental biogenic source strength during the YD (Mayewski et al., 1993b) (Figure). Further, NH<sub>4</sub> outliers have been interpreted as northern high-latitude biomass-burning events (Taylor et al., 1992; Whitlow et al., 1994) based on their association with other chemical products of biomass-burning (Legrand et al., 1992). Although at the onset of the B/A, NH<sub>4</sub> flux levels and outliers rose dramatically; during the YD, NH<sub>4</sub> flux levels drop only minimally and the number of NH<sub>4</sub> outliers decrease slightly. Since concentrations are highest near continents (Logan, 1983) and decrease with transport as a consequence of deposition, it appears that continental sources close to Greenland (North America and Europe) were not as dramatically affected during the YD as were low-latitude wetland regions as evidenced by the CH<sub>4</sub> record. This may indicate the continued importance of ice sheets and permafrost in limiting the growth of vegetation at higher latitudes until the end of the YD. Both low-latitude source CH<sub>4</sub> and NH<sub>4</sub> rise at the end of the YD (Chappellaz et al., 1993; Mayewski et al., 1993a).

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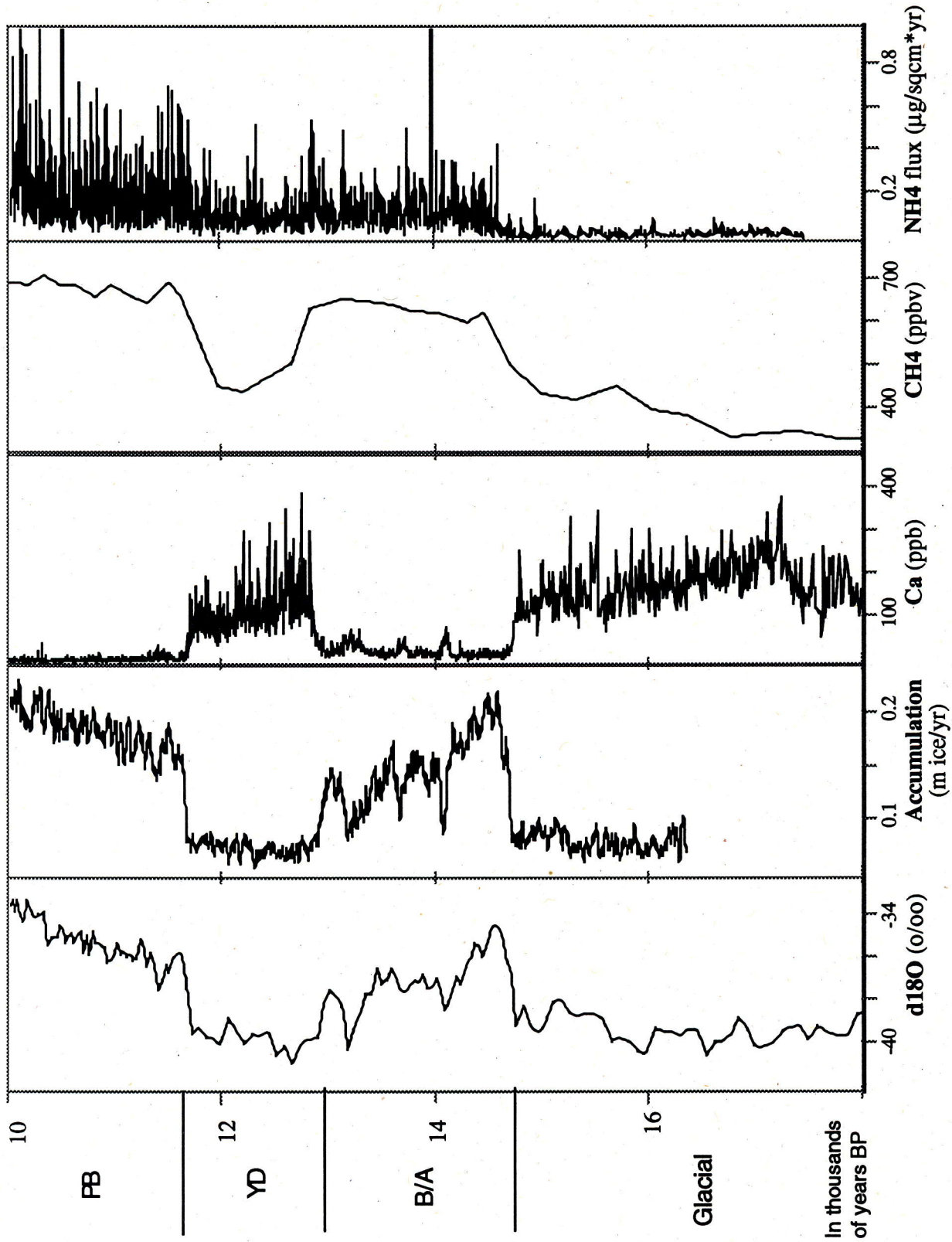
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A multi-parameter view of the period 10–18 kyr B.P. Stable isotopes (from Grootes et al., 1993); accumulation rate (from Alley et al., 1993); calcium (from Mayewski et al., 1993a, 1994b); methane (from Chappellaz et al., 1993); ammonium flux (from Mayewski et al., 1993a). PB=Preboreal; YD=Younger Dryas; B/A=Bølling/Allerød.

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