

CANADA

Water and Climate Studies in Canada using Isotope Tracers: Past, Present, Future

31st January and 1st February 1997,
Waterloo, Canada
Report of the workshop

This two-day workshop was convened with the twin aims of reviewing the state of water and climate research in Canada using isotope tracers and investigating the establishment of a revitalized "Canadian Network for Isotopes in Precipitation", as a contribution to the international GNIP program (Global Network for Isotopes in Precipitation), which is the well-known offspring of long-standing IAEA/WMO efforts to document the distribution of water isotopes in the global water cycle. About 60 participants from university, government, and the private sector gathered for two days of presentations and discussions at the University of Waterloo, Ontario, Canada.

The workshop was sponsored by Environment Canada, through the Atmospheric Environment Service (Downsview, Ontario) and the National Hydrology Research Institute (Saskatoon, Saskatchewan), with additional support from the Canadian Geophysical Union, the Waterloo Centre for Groundwater Research, and several other Waterloo-based university research bodies.

Background on international GNIP activities, the PAGES perspective, and comments on experience gained from national isotope networks in Switzerland and Germany were provided in Plenary Lectures from Klaus Froehlich (IAEA) and Ulrich Schotterer (PAGES). Special guests Emi Ito (University of Minnesota) and Carol Kendall (US Geological Survey) offered narrative on the current situation in USA regarding potential for developing a national precipitation network and the existing USGS isotopic data base from surface waters. Subsequent presentations were selected to sample the broad spectrum of past and present activities in Canada, falling into three general areas: assessment of existing isotopic data from past and ongoing precipitation sampling in Canada and efforts to define the nature of isotope-climate linkages; atmospheric studies, including discussion of carbon and oxygen stable-isotope signals in atmospheric carbon dioxide and links with the water cycle; and the use of isotope tracers in hydrologic, paleohydrologic, and ecologic studies of surface and ground waters, groundwater, and the water isotope records preserved in other archives.

The presentations demonstrated clearly that substantial Canadian expertise exists in this field, complemented by the capacity and willingness to train young researchers. The discussions also led to consensus that an ex-

panded network of 20-30 meteorological stations collecting monthly-composite precipitation samples for isotopic analysis was desirable and feasible, building on the network of sites in Canada currently contributing data to GNIP. The existing "CNIP" includes Ottawa (1953-present) and eight northern stations (1989-present), plus data in the GNIP archive from previous monthly-composite sampling campaigns at a number of other sites in the 1970s and 1980s. Various targeted research projects, including ongoing event-based precipitation sampling in Winnipeg (1992-present), have also generated abundant data that are not yet formally archived. A revitalized CNIP would constitute a valuable Canadian contribution to international water and climate studies, as well as providing a framework for nested campaigns requiring more intensive temporal or spatial sampling, such as the Mackenzie Basin Study of the Global Energy and Water Cycle Experiment (GEWEX-MAGS).

The workshop culminated in a provisional agreement to work towards the establishment of a rejuvenated and expanded CNIP, based on a model in which responsibilities for sample collection and analysis would lie, respectively, with the Atmospheric Environment Service of Environment Canada and a consortium of university and government isotope laboratories. A special sub-committee of the Committee on Isotope Tracer Techniques within the Hydrology Section of the Canadian Geophysical Union will assume responsibility for overall scientific direction and administration, and the continuity of the program.

Aspects of the challenges and opportunities associated with CNIP will also be addressed at the upcoming annual meeting of the Canadian Geophysical Union (Banff, 4-9 May 1997) and the ISOBALANCE International Workshop on Application of Stable Isotopes in Water Balance Studies (Saskatoon, 14-18 July 1997).

Further information about the CNIP Workshop and ongoing activities can be obtained through:

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GERMANY

Cooperative Research Project "ACACIA" (Arid Climate, Adaptation and Cultural Innovation in Africa) 1995-2010

This long term research initiative in Germany contains several sub-projects of interest to PAGES. Three of these are described briefly below.

Further information can be obtained from the project leaders through Stefan Kroepelin.

CLIMATIC CHANGE AND HUMAN SETTLEMENT BETWEEN THE NILE VALLEY AND THE CENTRAL SAHARA

In follow-up to the long-term interdisciplinary project, "B.O.S." (Settlement History of the Eastern Sahara; 1980-1995) further and more detailed research will be conducted in the Northern Libyan Desert. This sub-project focuses on the initial stages and spread of food-producing economies, the general question regarding the mono- or polycentric development of Neolithic phenomena, and the relevance of these processes to the birth and rise of Egyptian civilization.

Since the ecological setting for human activity in this region can be divided into three larger environmental zones - the summer rains in the North, winter rains in the South, and the Nile Valley in the East - the study of regional climatic development is a necessary prerequisite for understanding the historical development and the possible role and range of interregional contacts. Therefore, a detailed regional chronology must be determined based on geomorphological / sedimentological analyses as well as archaeological excavations, which take into consideration palaeobotanical and archaeo-zoological aspects.

Within the general framework of the Cooperative Research Project - man and his environment - this sub-project focuses on the earliest indications of the interdependence between socioeconomic development and environmental conditions, investigates the transition to a productive economy, and therefore endeavours to record the initial stages of cultural change, which apparently began in the north of the continent and following a few millennia would later affect the south.

NATIONAL ACTIVITIES

WADI HOWAR - SETTLEMENT AREA AND THOROUGHFARE AT THE SOUTHERN MARGINS OF THE LIBYAN DESERT

Located on the southern fringes of the Libyan Desert, the Wadi Howar is the largest dry river system in the Eastern Sahara - stretching over 800 km from eastern Chad to the Nile. Geomorphological and palaeontological investigations have confirmed that this wadi was still an important tributary of the Nile during the early Holocene; later it was transformed into a chain of freshwater lakes fed by local rainfall. Since the Wadi Howar was both a settlement area with ecologically favourable conditions and a route connecting the inner regions of Africa and the Nile valley, the several prehistoric sites which have been discovered confirm that it was an important site of population activity and interregional cultural contacts.

The rich archaeological and archaeozoological potential and the geomorphological and topographical variety of these sites provide detailed insight into the structures of the settlements and their strategies for survival. They also supply the necessary data for a reliable chronological and clima-

tological sequence. The processes of climatic and economic change - due to desert encroachment - and their cultural implications will be examined with regards to the development and function of regional adaptation strategies as well as the large-scale role of the Wadi Howar as a connection between the Sahara and regions further south.

PALAEOECOLOGY AND THE LATE HOLOCENE SETTLEMENT OF NORTHERN NAMIBIA

Although the state of archaeological research in northernmost Namibia is not as advanced as in other parts of the country, the area has played an important role in many discussions regarding later prehistoric settlement of the whole of southern Africa. This particularly applies to the routes of the so-called "Bantu migrations" and the spread of food production and iron technology. This region, that extends from the Atlantic to the Zambesi, also provides various ecological settings for study: from desert to savannah and woodland conditions. Thus a primary aim of the project is to establish several relatively smaller study sites along a west-east transect, in order to

determine how adaptation strategies and innovations varied when subject to different and changing environmental conditions.

In the first phase of the project, long-term survey activities (including test excavations) will be carried out in close cooperation with botanists and geographers. Only then - and after the archaeological potential and the state of preservation of organic matter (especially botanical remains) has been examined - can more detailed archaeological studies be designed. Although the focus of the project is environmental and economical aspects and the different modes of human adaptation, it also aims at contributing to a more reliable chronological framework for the last 3,000 years of human and environmental history in this region.

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PEP II

PAGES Program in Taiwan (1992-1996)

The Past Global Changes (PAGES) program in Taiwan was initiated in March 1992 soon after the conclusion of the Asian IGBP workshop held in New Delhi, India. Since June 1992 various PAGES research projects have been funded by the National Science Council, Taipei (China). In addition, quite a few projects which are related to the PAGES have been also funded by other programs, such as LOICZ, KEEP (a JGOFS project) and the South China Sea Project. A new integrated program named Taiwan International Marine Past Global Change Study (IMAGES) has been formed and funded.

The first four years (1992-1996) were considered a promotion period for the PAGES Program, aiming to establishing research facility, expertise and protocols. A competent research team of more than 20 principal investigators has been established. Research has been conducted on a wide array of materials, ranging from historical documents, corals, tree rings, paleosols to lake and deep-sea sediments. To ensure proper analyses and further exploration of paleodata, collaboration among professional statisticians and geoscientists, in particular, has been greatly encouraged. Funding for PAGES Program has been in the range of USD \$500,000 per year, occupying 10-15%

of the budget of the NSC's Geology Program. Part of the funds has also come from the NSC's Marine Science Program. While stepping into the fifth year, requests for continuing support are under a more critical peer review based upon previous accomplishments in the past four years.

The program has had a significant impact on Taiwan soft-rock geosciences. For the first time, more than a dozen geoscientists were teamed up in an integrated effort to gain a better understanding of the past environmental changes in Taiwan and its adjacent areas. A team leader was elected every two years to coordinate the interdisciplinary effort and to promote dialog and integration among the various lines of research. Forums covering various progress reports have been held seasonally by the Global Change Center, National Taiwan University. PAGES sessions have been scheduled in almost every annual Geological Society Conference and annual Ocean Science Meeting. Formal presentations of PAGES results in these and other international meetings have been an obligatory task for all the principal investigators.

The PAGES team followed the recommendations of the IGBP PAGES (IGBP Report No.6, 1988) in emphasizing two temporal

streams: 1) the past 2000 years, 2) the last 150,000 years. The main endeavor in the beginning phase was to focus on the multi-proxy reconstruction of past environmental changes and data integration. Taking advantages of the availability of multiple archives in Taiwan and the adjacent areas, scientists obtained season, decade, century and millennium paleorecords from coral, tree-ring, paleosol, lake and marine sediments. Further integration and exploration of these proxy data are being undertaken.

A readjustment of the original PAGES research strategy has been made in collaboration with the new research foci as specified by the PAGES new workplan (IGBP Report No. 28, 1994). The Taiwan area is situated in a key linking area bridging the northern and southern hemispheres in the PEP II transect. The changing conditions of the Asia monsoon, west Pacific warm pool, ENSO and marine circulation are sure to leave discernible reflections in the paleo-records of Taiwan. The PAGES team strives to reconstruct local records and to interpret the records regionally, if not globally.

To foster PAGES research in the monsoon Asia area, an international workshop was held in Taipei, Taiwan, April 21-23, 1993. The theme was: the "High Resolution Records of Past Cli-