

## Paleoclimatic Studies Suggest That Lake Victoria Was Dry

The first paleolimnological cruises of the IDEAL Program occurred in March and April of this year. Approximately 2000 km of reconnaissance single-channel, digital, seismic reflection profiles covering most of Lake Victoria (Fig. 1) were

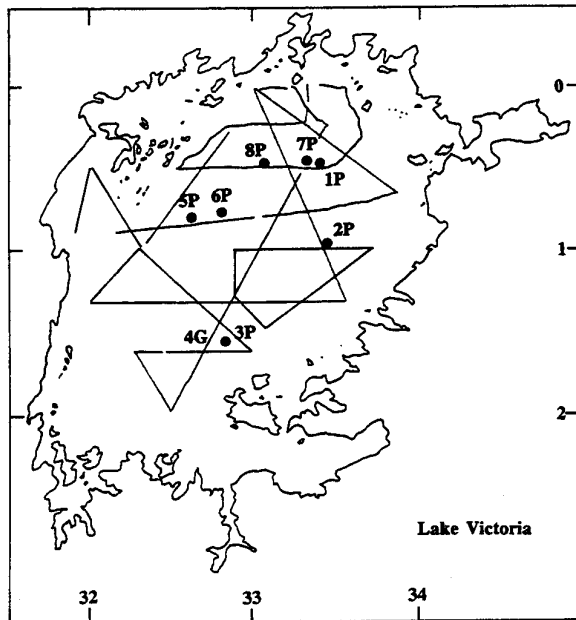


Figure 1. Ship track lines and core locations on Lake Victoria

## Lake Victoria Sediment is Available To Investigators

Samples from the sediment cores recovered on Lake Victoria are available for analyses not currently being conducted by participants on the cruises. We encourage sample requests and are particularly interested in providing material to African colleagues who would like to undertake sedimentological, chemical, or paleontological analyses. The sample-distribution policy takes into consideration prospects for prompt publication of results.

Submit requests to Laura Lee Gance, IDEAL Program coordinator, 2954 King James Way, #6, Madison, WI 53719 (phone and fax 608/274-7974).

obtained with a 1-inch<sup>3</sup> airgun. Seven piston cores and one gravity core were also obtained, most 8-10 m in length.

All field work was carried out aboard the *R/V Ibis* of the Fisheries Research Institute in Jinja, Uganda.

In addition to the geological and geophysical investigations, conductivity/temperature/depth (CTD) casts were obtained for Rose Mugidde (Fisheries Research Institute, Jinja) (see page 2), John Lehman (University of Michigan), and Sally MacIntyre (University of California, Santa Barbara).

One of the main objectives of the cruise was to determine whether Lake Victoria completely disappeared during the last ice age, or whether a smaller, somewhat saline lake occupied the closed basin for several thousand years. Our preliminary analysis of both the seismic profiles and the cores suggests that the lake indeed completely dried out during the late Pleistocene. The first results will be presented at the American Geophysical Union meeting in December.

The piston cores were shipped back to the Limnological Research Center of the University of Minnesota, where Kerry Kelts (University of Minnesota), Immaculate Ssemmanda (Makerere University, Kampala, Uganda) (see page 2), and Mike Talbot (University of Bergen, Norway) and I, along with our students and technicians, sampled the cores for geochronology, pollen, biogenic opal, isotopic composition of organic matter, and carbonate abundance.

Seismic data are being processed by Chris Scholz at the University of Miami and will be distributed to our colleagues at the Uganda Petroleum Exploration and Production Department (Rogers Mukasa and Honey Malinga) and the Tanzanian Petroleum Development Corporation (Nico Mliga, Elias Kilembe, and Sebastian Shana).

This work would not be possible without the strong support of our African colleagues. Dr. Fred Bugenyi and his staff at the Fisheries Research Institute have been very helpful in arranging for the use of the *R/V Ibis* and providing housing and office space for the field program. Geologists from Makerere University and the Uganda Petroleum Exploration and Production Department participated in the cruises, assisting with seismic watch standing and piston coring. The *R/V Ibis* was under the command of Captain Leonard Kabirige of the Fisheries Research Institute. Dr. Nico Mliga of the Tanzanian Petroleum Development Corporation assisted with our logistical needs in Tanzania.

Thomas Johnson  
University of Minnesota

## Lake Victoria Limnology Records Shift in Last 30 Years

Lake Victoria is among the largest lakes on earth. As a major source of animal protein (fish) and water, it supports over 30 million people. Other uses include transport, hydro-electric power generation, and recreation.

Major changes have occurred in the lake over the past three decades. Notably, water quality has deteriorated, and the diversity of aquatic organisms, especially fish, has declined dramatically.

National, regional, and international efforts, including IDEAL, are generating data required to address these problems. One of the objectives is to investigate factors that are driving current changes in Lake Victoria; another is to predict consequences of alternative management options.

Process-oriented experiments and studies have been conducted to understand nutrient dynamics, especially the role of phosphorus and the response of phytoplankton. Data have also been collected on the extent of anoxia (oxygen depletion). Results of this study should help policy-makers mitigate deterioration in water quality.

This work is a collaborative effort of the Fisheries Research Institute in Jinja, John Lehman of the University of Michigan, and Robert Hecky of the Freshwater Institute in Canada.

Major activities of the past year have included water-column analyses from two offshore stations, near Bugaia Island and in Napoleon Gulf, and laboratory experiments. Additional data were collected from other parts of the lake during fish-stock assessment cruises. Oxygen, temperature, pH, and conductivity profiles were measured to determine patterns of mixing and stratification. *In situ* photosynthesis rates were estimated and algal biomass measured. The response of algae to phosphates, nitrates, and silicates was measured alone and in combination, under various light conditions. Various analyses in support of this project are being undertaken at the University of Michigan and at the Freshwater Institute in Winnipeg.

These investigations have revealed anoxia over approximately 50% of the lake-bottom. Elevated levels of algal biomass and primary productivity are associated with frequent algal blooms and fish kills. Nitrogen-fixation rates were higher in inshore water samples than in those taken at offshore sites. *Heterocytous* blue green algae appeared regularly in the plankton, suggesting nitrogen deficiency.

Rose Mugidde  
Fisheries Research Institute, Jinja, Uganda

## Pollen Studies Begin in Uganda at Makerere University

Although pollen studies have been undertaken on sediments cored from lakes and swamps located in Uganda, there was no laboratory equipped for fossil pollen analysis within the country until this year, when equipment and sediment samples were provided by the IDEAL Program.

Palynology research, which has commenced at the Makerere University Department of Geology, aims at using fossil pollen analysis (1) to interpret human impact in the forest history of Uganda and (2) to provide guidelines for government planners on reforestation policy and on the preservation of humid, forested environments.

This new initiative began with Immaculate Ssemmanda's participation in the IDEAL Program's March-April 1995 cruise on Lake Victoria. Participation gave her an opportunity to learn about the application of seismic reflection profiles to the study of lakes and their underlying strata, and to develop her coring skills.

The two-dimensional profile of the sub-bottom obtained during the initial cruise provided information that was crucial to determining what sites to core. Following this reconnaissance cruise, eight days were devoted to recovering eight cores, most 8-10 m in length. The cores were transported to the Limnological Research Center (LRC) of the University of Minnesota, where they were split and subsampled. Kristina Beuning, a Ph.D student at LRC, and Ssemmanda sampled the cores for pollen analysis. Beuning focused on the older parts of the cores, while Ssemmanda sampled sediments with an age range between 5000 years BP and the present.

The vegetation around Lake Victoria represented by the top meter of piston core V95-2P has been primarily a savanna type, indicated by the abundance of *Gramineae*. Scattered remnants of semi-deciduous forests are reflected by abundant *Celtis* combined with *Holoptelea grandis*. Trace amounts of *Tetrirchidium* indicate the existence of some evergreen forests. Remnants of the forests are better represented in the lower half of the interval investigated than the overlying 50 cm; the lower half includes *Olea*, *Podocarpus*, *Moraceae*, *Celtis*, *Holptelea grandis*, and *Acalypha*, depicting a slightly more forested environment around the lake and a more humid phase than that represented by the above-mentioned upper portion of the core. Radiocarbon dates being obtained by Beuning at the LRC in Minneapolis will allow us to assign ages to this and other vegetation changes recorded in the Lake Victoria cores.

Immaculate Ssemmanda  
Makerere University, Kampala, Uganda  
& Annie Vicens  
CNRS, Aix-en-Provence, France

The IDEAL Bulletin is published twice a year, in the Fall and Spring. To receive a copy or to contribute an article or announcement, please contact Laura Lee Gance, IDEAL Program coordinator, 2954 King James Way, #6, Madison, WI 53719 (608/274-7974). Marty Peale's assistance in copy-editing and layout is gratefully acknowledged.

Publication of the bulletin is made possible by a grant from the National Science Foundation. Opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of NSF.

# Rift Basin Studies on Lake Malawi Focus on Deltas

The sedimentary fill of the large rift valley lakes of East Africa is dominated by fine-grained, commonly organic-rich sediments. Such sediments are the precursors of the black shale hydrocarbon source rocks found in ancient sedimentary basins of lacustrine origin.

Most geological studies of the East African rift lakes over the past two decades have focused on sampling these silt- and clay-sized sediments during the course of sedimentological, geochemical and paleolimnological investigations. Over the past four years, however, our research group has conducted two oil-industry supported projects on Lake Malawi, to investigate the character and distribution of lesser known coarse clastic sediments.

Between 1991 and 1993, we investigated five deltas located in different tectonic settings around the margin of Lake Malawi. We conducted an onshore and an offshore field program in the vicinity of each delta. During a cruise aboard the *S/V Timba*, the research vessel of the Malawi Department of Survey, we acquired 90 sediment cores and more than 4000 km of single channel, digital airgun seismic data and high-resolution seismic and sidescan sonar data.

The observed variability in stratigraphy and sedimentology between the five deltas is remarkable. Deltas on axial and flexural (hanging-wall) margins in the rift concentrate sandy sediments into discrete deltaic lobes, while deltas on border-fault or

accommodation-zone margins distribute their coarse sediments across broad areas and into some of the deepest parts of the lake.

In 1994 and 1995, we undertook a study of deep-water sands and sub-lacustrine fans in Lake Malawi. For the first time, we have been able to recover cores of coarse-grained sediments in deep water, using a modified Rossfelder electric vibra-corer. The system, designed for use in water depths to 1200 m, enabled us to recover full barrels (6 m) of medium/coarse-grained sand and gravel from a variety of deep-water environments (450-650 m) in Lake Malawi.

Initial results of this study reveal a variety of coarse-grained environments of deposition in Lake Malawi, including debris-flow deposits, sandy turbidites, and large slump deposits. The large-diameter core barrel and large percussive forces of the electric vibrohead of this system should allow extended (25 m) penetration and sediment recovery of fine-grained diatomaceous ooze which are ubiquitous in large lakes.

Chris Scholz  
University of Miami, Florida

## Highlights of the IDEAL Steering Committee Meeting

North American Members of the IDEAL Steering Committee met at the Limnological Research Center of the University of Minnesota, Minneapolis in July 1995. They addressed three main topics.

The Steering Committee discussed whether the program should focus on sequential, one-lake-at-a-time studies or be broadened to include research activities on other lakes. They concluded that studies at other lakes would complement the intensive studies on designated lakes, as well as increase the base of participation and research activities in the program.

The Steering Committee also discussed development of East African lakes drilling proposals for submission to the PAGES Lake Drilling Task Force (see article, this page), and priorities for drilling among the lakes being proposed.

A new initiative in training was presented by Curt Stager of Paul Smith's College, New York. The Steering Committee was enthusiastic about the new initiative, a four-week pilot program for up to eight Africans and eight American or European undergraduates in Uganda or Tanzania. The goals of the training course are to train students and technicians in limnology of large lakes and in field techniques, while providing them "hands-on" research and cross-cultural experiences. The Steering Committee encouraged Dr. Stager to develop a proposal for financial support of the initiative.

## The PAGES Lake Drilling Task Force Sets Global Priorities

The Past Global Changes program (PAGES) Lake Drilling Task Force was established at a PAGES workshop on continental paleoclimates held in Potsdam, Germany in August 1995 (S. Colman, *EOS*, Sept. 1995). The task force met in October 1995 in Washington, DC to review nearly 60 planning proposals received from the scientific community to drill various lakes around the world for paleoclimate records extending back through two full glacial-interglacial cycles.

The task force prioritized these proposals based on several criteria, including (1) presence of high quality, multiple proxies in lakes sensitive to climatic forcing, (2) likelihood of accurate, high-resolution geochronology, (3) logistical feasibility, (4) availability of background information from previous geological/geophysical surveys, (5) strengths of the collaborating scientific team, (6) regional distribution of sites in relation to gaps in existing paleoclimatic information on the three Pole-Equator-Pole (PEP) Program transects, and (7) assessment of which sites are ready to begin immediately and which need additional site-survey information.

A preliminary five-year plan will be presented to the scientific community within a month. Among the East African lakes, site surveys are recommended immediately for Lake Edward and one of the Ethiopian lakes in the Ziway-Shala basin, with drilling operations recommended for 1997. Lakes Malawi and Tanganyika are recommended for drilling in 1999 and 2000, respectively, once drilling operations in East Africa are sufficiently developed for these deep-water systems.

PAGES is a core project of the International Geosphere-Biosphere Programme.

## Field Work in Kenya and Tanzania Includes Small Lakes

Along with a focus on the large lakes, the IDEAL Program has been involved in sampling small lakes in East Africa during the past two years.

Water and surficial sediments were collected from each lake for two main purposes. The first is to determine the oxygen isotopic composition of the waters and of the carbonates forming in these waters. The second is to determine the chemical composition of the waters and the occurrence of ostracod species with the water types.

Eric Odada at the University of Nairobi and I are using these data to interpret carbonate isotope profiles and ostracod species assemblages in long cores from Lake Turkana, and the lake's response to climate change.

This work is sponsored by the International Atomic Energy Agency as part of its project, "Isotope Techniques in Lake Dynamics Investigations."

The main objectives of this past summer were to obtain water and surface-sediment samples from small lakes in Tanzania and water samples from the main rivers that drain into Lake Turkana in northern Kenya.

I was accompanied in Tanzania by Stephen Mathai from the National Museums of Kenya and Sebastian Shana from the Tanzania Petroleum Development Corporation. The town of Arusha in northern Tanzania was our base of operations. In four days, we covered over 1600 km, a trip that took us south to Tarangire and Babati, then to central Tanzania, past Mount Hanang to Singida, and back through Murti, Karatu, and Lake Manyara, to Arusha. We sampled Lakes Babati, Singidani, Kidai, Manyara, and Duluti, as well as the Momela Lakes around Mount Meru.

Lake levels are falling in the region. Lake Burungi is completely dry. Lakes Balangida and Eyasi have salt brines, and Lake Manyara is tending in that direction.

I concluded my summer field work by teaching stratigraphy to a group in Koobi Fora on the eastern shore of Lake Turkana. This trip provided an opportunity to sample the Turkwell and Omo Rivers, which are the main tributaries draining into Lake Turkana. These river samples are currently being analyzed for isotopic and major ion composition.

Patrick Ng'ang'a  
Duke University, Durham, North Carolina

### IDEAL Symposium Volume in Press

The symposium volume, *The Limnology, Climatology and Paleoclimatology of the East African Lakes*, edited by Thomas Johnson of the University of Minnesota and Eric Odada of the University of Nairobi, is at the publishers (Gordon & Breach Publishers, Inc., Newark, New Jersey) and is scheduled for distribution in February 1996.

The volume includes 36 articles on the physics, chemistry, biology, and geology of the East African lakes, as well as the climatology of the lakes region.

The publication is dedicated to the memory of Dr. William Kudhongania, former director of the Uganda Fisheries Research Organization and a highly respected fisheries biologist and limnologist in East Africa.

IDEAL Program Office  
c/o Large Lakes Observatory  
University of Minnesota  
Duluth, MN 55812-2496 USA

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