Holocene Paleoenvironmental Records from the Western Hemisphere: A Workshop

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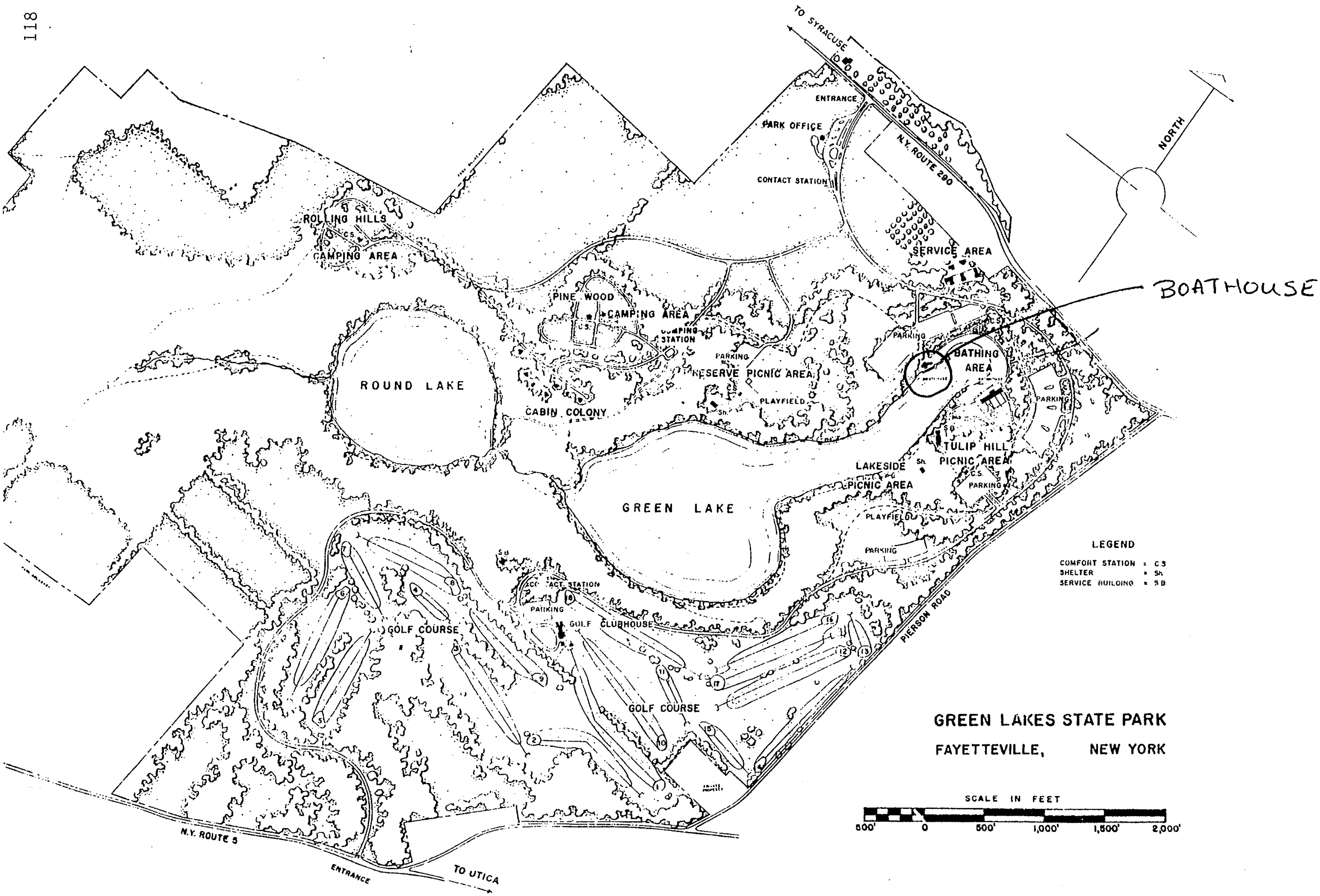
The purpose of the workshop is to bring together a diversity of paleo-proxy records from the southern high latitudes, equatorial South America, and central to northeastern United States. We will compare these records to standard Holocene reference sections, such as the GISP2 ice core from Greenland. In so doing we encourage discussion and exchange of ideas regarding forcing mechanisms, and linkages among the ocean, atmosphere, and cryosphere. We also will discuss the variation in resolution of the different records and what temporal restrictions have to contribute to the large picture of decadal to millennial scale changes.

We will convene at 9:00 AM at the boat house at Green Lakes State Park, Fayetteville, New York (map next page). If the weather is inclement we will relocate to a sheltered location. Participants are encouraged to bring poster-sized examples of their paleoclimate records and be prepared to explain the limitations and advantages of their particular data sets. Easels will be available for poster presentations. At the start, the organizers will present a short 15-20 minute synopsis of their work. We will try to wrap up the morning session by 12:00 PM, in time for lunch (bring your own bag lunch). Participants can then reconvene at 1:00 PM for the Green Lakes portion of the excursion.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HOLOCENE PALEOENVIRONMENTAL RECORDS FROM ANTARCTIC GLACIAL MARINE SEDIMENTS

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Our NSF funded work at Hamilton College has focused upon the Holocene time frame in order to resolve such issues as the role of sea ice, outlet glacier fluctuation, and productivity in determining sedimentation patterns across the Antarctic continental shelf. We have tried to resolve events in terms of varying resolution from fjords (high resolution) to the inner shelf basins (low to very high resolution). Areas we have worked in include the fjords and inner shelf of the western Antarctic Peninsula, Ross Sea, and East Antarctic margin. We have recognised that the Holocene does indeed contain a variable record of changing paleoenvironments, but one which needs a multiparameter approach to resolve. Chronologic constraints are based upon detailed AMS radiocarbon dating and 210Pb analyses. Records of magnetic susceptibility, grain size, ice rafted detritus, diatom floras, foraminifera, and organic geochemistry have allowed us to recognise both a middle Holocene climatic optimum and a late Holocene cooling or Neoglacial. These long term trends contain within them higher frequency oscillations including a 200-300 year cycle that is most prevalent along the western side of the Antarctic Peninsula. The Little Ice Age is the most severe of the Late Holocene events and is marked by growth of ice shelves within the fjords of the Antarctic Peninsula. Subsequent 20th Century warming has reduced the extent of these ice shelves as documented by other authors.

Our paleoenvironmental records correlate well with lacustrine sequences from the Antarctic Peninsula and in some cases with ice cores (particularly the late Holocene cooling event). The 200-300 years cycles have yet to be fully defined in terms of absolute time but preliminary comparisons with northern hemisphere ice cores (GISP2) and tree ring proxies for solar variability are promising (Leventer et al., 1996; Domack and Mayweski, in preparation).

Collaborating investigators include: Amy Leventer (Colgate University), Scott Ishman (USGS), Patricia Manley (Middlebury College), Charles McClennen (Colgate University), Stefanie Brachfeld (University of Minnesota), Wendy Cunningham (University of Colorado), Stephanie Shipp and John Anderson (Rice University).

Recent publications include:

Shevenell, A. E., Domack, E. W., and Kernan, G., 1996. Record of Holocene Paleoclimatic Change Along the Antarctic Peninsula: Evidence from Glacial Marine Sediments, Lallemand Fjord, In, Banks, M. R., and Brown, M. J. (eds.), Climate Succession and Glacial History Over the Past Five Million Years, Royal Society of Tasmania, Papers and Proceedings, v. 130, p. 55-64.

Leventer, A. R., Domack, E. W., Ishman, S. E., Brachfeld, S., McClennen, C. E., and Manley, P. 1996. Productivity cycles of 200-300 years in the Antarctic Peninsula region: understanding linkages among the sun, atmosphere, oceans, sea ice, and biota. Geological Society America Bulletin, v. 108 p. 1626-1644.

Domack, E. W., and McClennen, C. E., 1996. Accumulation of glacial marine sediments in fjords of the Antarctic Peninsula and their use as late Holocene paleoenvironmental indicators. In, R. Ross, E. Hoffman, and L. Quetin (eds.) Foundations for Ecosystem Research West of the Antarctic Peninsula, Antarctic Research Series, American Geophysical Union, Washington D.C.. p. 135-154.

Domack, E. W., Ishman, S. E., Stein, A. B., McClennen, C. E., and Jull, A.J. T., 1995, Late Holocene advance of the Muller Ice Shelf, Antarctic Peninsula: sedimentologic, geochemical, and paleontological evidence. Antarctic Science, 7, 159-170.

Domack, E. W., Mashiotta, T. A., Burkley, L. A., and Ishman, S. E., 1993. 300 year cyclicity in organic matter preservation in Antarctic fjord sediments. In: Kennett J. P. and Warnke D. A. (Eds.) The Antarctic Paleoenvironment: A Perspective on Global Change (Part 2) Antarctic Research Series, v. 60, American Geophysical Union, Washington D. C., p.265-272.

Domack, E. W., Jull, A. J. T., and Nakao, S., 1991. Advance of East Antarctic outlet glaciers during the Hypsithermal: implications for the volume state of the Antarctic ice sheet under global warming. Geology, v. 19, p. 1059-

CLIMATIC SUCCESSION AND GLACIAL HISTORY OF THE SOUTHERN HEMISPHERE OVER THE LAST FIVE MILLION YEARS

The Tasmanian Division of the Australian and New Zealand Association for the Advancement of Science organised a symposium late in 1995 on the topic noted above. One of the aims of the symposium was to document changes in climate in the region before human activities could have had any influence — to provide a benchmark against which possible Greenhouse effects could be measured.

Arising from the symposium 31 authors prepared 13 papers on the Antarctic, sub-Antarctic, New Zealand and Tasmanian climatic and glacial records and, for comparison, present climates in the region. One paper includes reference to possible contemporaneity of Northern and Southern Hemisphere events. The papers were refereed internationally and are now published by the Royal Society of Tasmania as *Papers and Proceedings*, Volume 130, Pt 2. A synopsis of the contents follows:

Quilty — Pliocene environment of Antarctica.
Hill & Jordan — Macrofossils as climatic indicators, Plio-Pleistocene of Tasmania and Antarctica.
Chinn — Glacial record, Antarctica & New Zealand.
Adamson et al. — Palaeoenvironments, Macquarie Island - palaeobeaches and sedimentary deposits.
Colhoun et al. — Late Wisconsin glaciation, Tasmania.
Harris et al. — Late Quaternary history, Mac. Robertson Shelf, East Antarctica.
Shevenell et al. — Holocene climatic changes, Antarctic Peninsula.
Cook et al. — Increases in Tasmanian Huon pine ring widths ... greenhouse warming?
Gibson & Burton — Meromictic Antarctic lakes as recorders of climatic change.
O'Brien & Harris — Past behaviour of Lambert Glacier, Antarctica.
Rao et al. — Skeletal carbonate mineralogy and isotopic composition, Antarctica and Tasmania.
Simmonds — Relationship of sea ice and extra-tropical cyclones.
Salinger & Jones — Modern Southern Hemisphere climates.

This volume is available from the Royal Society for Aus$30 (includes the cost of handling and postage). An order form is appended. Enquiries may be directed to Professor P.G. Quilty, fax number 61-03-62-323351 or email pat_qui@antdiv.gov.au

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Geoffrey O. Seltzer

My approach to paleoclimatic and paleoenvironmental reconstruction involves the analysis and interpretation of glacial landforms and lake sediments in the tropical Andes of South America. High mountains (>5000 m) in the Andes support small, cirque glaciers that expanded well beyond their modern limits to deposit moraines downvalley during the late Pleistocene and Holocene. The climatic interpretation of a past phase of glaciation is a difficult problem because of the mutlitude of factors that can lead to glacial advances. Changes in the mass and energy balances of a glacier include changes in precipitation, temperature, receipt of solar radiation, humidity and wind speed. Thus the recognition of a moraine on the landscape in itself can be interpreted many different ways in terms of possible climate change and it is necessary to have other lines of evidence that can be used to limit the possible range of paleoclimatic interpretations.

An advantage of using the glacial geologic evidence in paleoclimatic reconstructions, if it is possible to determine that the moraines were not deposited by surging glaciers and that the glaciers were not calving into a large body of water, is that it is clear that some climatic change perturbed the energy and mass balance of the glaciers in the past. Furthermore, given the elevations of terminal moraines and/or their extent of weathering and slope modification it may be possible to correlate over broad distances a climatic change associated with a past glaciation. On the other hand glacial moraines record only relative glacial maxima. Moraines deposited during glacial retreat or during periods when glaciers were not as extensive as subsequent glaciations are not preserved on the landscape. Thus what is left is a discontinuous record of glaciation or climatic change. It is also very difficult to uniquely interpret glaciation in terms of a specific climatic change.

The use of records from cores of lake sediments in paleoclimatic analysis helps to circumvent with some of the limitations posed by working with glacial moraines. the approach I use to working with lake sediments includes methods that are common to most limnological and oceanographic studies: seismic reflection work to determine the nature and structure of sediments in the bottom of the lakes; basic physical properties such as magnetic susceptibility, bulk density, organic and inorganic carbon content, color and visual descriptions; detailed analysis of pollen and diatoms to determine past limnic and terrestrial vegetation; and geochemical analysis of the carbonates and organic matter to determine changes in the hydrology of the basin. It is also possible to develop continuous records of change based on radiocarbon chronologies of the lake cores. In many ways the multi-proxy approach of working with lake sediments can yield significant information about paleoclimates, but in conjunction with direct evidence from the surrounding landscape this approach is even more powerful.

Finally, you might ask, "why the tropical Andes?". Work in this region over the last several years has been motivated by two factors: 1) the early work by the CLIMAP group on sea-surface temperatures, which suggested that on glacial-to-interglacial time scales the tropics were relatively complacent from a climatological point of view, and the need to test this hypothesis; and 2) the desire to obtain more information from regions that lack paleclimatic data to look for possible "teleconnections" with higher latitude regions. Establishing whether or not events such as the last glacial maximum, last glacial-to-interglacial transition, the Younger Dryas, and the Little Ice Age were global in extent or not has implications for understanding the mechanisms that produce such changes.

RECENT PUBLICATIONS ON THE GLACIAL GEOLOGY AND PALECLIMATOLOGY OF THE TROPICAL ANDES

Abbott, M., Seltzer, G., Kelts, K., and Southton, J. (1997). *Holocene Climate Variability of the Northern Bolivian Andes*. Quaternary Research, 47:70-80.

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