# PALEOCLIMATOLOGY OF THE FINGER LAKES REGION

**Henry T. Mullins**
Department of Earth Sciences, Syracuse University, Syracuse, New York 13244

## ABSTRACT

We have recently discovered that the Finger Lakes region central New York State contains a truly exceptional record of climate change over the past 14,000 $^{14}C$ years. Sediments within the Finger Lake basins are characterized by high accumulation rates (>1m/1000 years) and an abundance of calcium carbonate which make them ideal for paleoclimatic studies. During the past five years we have employed a variety of approaches to our study of AMS radiocarbon dated sediment cores from these lakes in order to unravel both regional and global environmental change throughout the Holocene.

Wetland Stratigraphy- The lithostratigraphy of wetlands in the Finger Lake basins has proven to be an extremely valuable proxy for relative lake-level change, and thus climate (precipitation) change. Fossiliferous lacustrine marls (with up to 90% $CaCO_3$) sandwiched between wetland peat deposits document relative changes in lake level. Wellner and Dwyer (1996) first recognized the regional utility of such sequences, and Dwyer *et al.* (1996) used this approach in their discovery that the Holocene Hypsithermal (~9-4 ka $^{14}C$) was a warm-wet interval in the northeastern United States, contrary to the commonly held view of widespread drought. Wetland deposits both north and south of Cayuga Lake have further revealed five cycles of Holocene relative lake-level change with a recurrence interval of ~2000 years (Mullins, in prep.). Abundant fossils in the marls have also been used to identify numerous small-scale relative lake-level fluctuations which may have been driven by solar variability.

Stable Isotopes- The abundance of lacustrine calcite coupled with the relatively short water residence times of the Finger Lakes also makes them ideal for stable isotope studies. $\delta^{18}O$ values are used as a proxy for temperature and/or atmospheric moisture source changes over time, whereas $\delta^{13}C$ values record changes in lake productivity. Isotopic data from deep water cores in Seneca Lake have documented a previously unknown cold/dry interval between ~10-8 ka 14C which followed the well known Younger Dryas period (Anderson *et al.*, 1997); whereas, a littoral zone core from south of Seneca Lake has been used to isotopically define significant century- to millenial-scale climate instability during the Holocene Hypsithermal which may have been driven by latitudinal shifts in the mean position of the polar jet stream (Anderson *et al.*, in prep.)

Calcite Content- Today, calcite precipitates from open waters of many of the Finger Lakes during "whiting events", as it has throughout much of the Holocene. Because this calcite precipitation is mediated by the photosynthetic activity of phytoplankton, simple calcite contents can be used as a proxy for gross photosynthesis over time. Cores received from Cayuga Lake have shown that there is a remarkable correlation between calcite content and Greenland ice core $\delta^{18}O$ values (i.e. temperature) throughout the Holocene (r=0.93), as well as between calcite content and the anthropogenic rise of atmospheric carbon dioxide over the past 200 years (r=0.96). These results strongly suggest that calcite precipitation has been controlled by global change, both natural and anthropogenic over the past 10,000 years. The recent rise of calcite content in Cayuga sediments could be due to global warming and/or $CO_2$ fertilization, but appears to be evidence that anthropogenically linked global change has already begun to affect temperate lacustrine ecosystems (Mullins, submitted).

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