NORTH AMERICAN CONTINENTAL SEASONALITY DURING THE LAST MILLENNIUM: HIGH-RESOLUTION ANALYSIS OF SAGITTAL OTOLITHS

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Abstract

$\delta^{18}O_{(CaCO3)}$ values of late Holocene sagittal fish otoliths from Lake Erie provide a record of seasonal temperature variation for mid-western North America. Freshwater drum (*Aplodinotus grunniens*) sagittal otoliths obtained from PaleoIndian middens, ranging in age from ≈AD 985 to AD 1530 as well as a recent specimen, were sampled at a resolution representing time-averaging of as little as 3-5 days to estimate seasonal climatic variation over the last thousand years.

Regional differences in climate, as well as asynchronous variation inferred by comparison with historical records of Europe, Greenland and Iceland, suggest that the climate trends of eastern North America may not always correspond to those of Europe or even the North Atlantic. Results suggest that summer temperatures of the Laurentian Great Lakes region at the beginning of the millennium were 2-6°C warmer, while winter temperatures may have been nearly 2°C cooler than the 20th-century average. By the late 1200's, summer temperatures decreased to nearly modern values. In the 1400's and through the 1500's, summer maxima exhibited enhanced intra-annual variation as well as temperatures which were as much as 8°C cooler, while winter temperatures were 0.4-2.7°C warmer than 20th-century values.

An additional outcome of this research is the estimation of lake water $d^{18}O$ values for several time periods throughout the Holocene. Mean annual temperatures inferred from $\delta^{18}O_{(H_2O)}$ values display a decrease from AD 985 through at least AD 1530, concomitant with summer temperature trends. The long residence time of these large lakes suggests that secular trends in $\delta^{18}O$ values must represent long-term variation in climate which can be used in concert with the short-term, high-resolution temperature record for a comprehensive estimation of climatic trends. Temperature variation and paleohydrology of the Great Lakes region is discussed in terms of variation in storm tracks and source region with time. $d^{18}O$ values of lake water coupled with paleotemperature data suggest that changing climate is the result of secular variation in the position, shape, and strength of the circumpolar vortex.

Key words: Otoliths, paleoclimatology, precipitation, seasonality, stable isotopes

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