Lacustrine carbonate records of Holocene climate from the North American Mid-Continent

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Seasonal shifts in cycles of temperature and precipitation are manifestations of climate change that may have profound regional effects. The chronologic precision and biogeochemical sensitivity of annual layers of endogenic carbonate (varves) make them an ideal archive for recording such seasonal climate shifts. Here I present calcite abundance results from the annually-laminated (varved) Holocene sediments of Derby Lake, Michigan. Variations in endogenic calcite abundance display a long-term (millennial-scale) decrease in burial punctuated with frequent short-term (decadal-scale) oscillations due to carbonate dissolution. Since 6,000 cal yr BP, sediment carbonate abundance followed a decreasing trend while organic-carbon abundance increased. The correlation between organic-carbon abundance and the sum of March-April-October-November insolation has an r^2 of 0.58. We interpret these trends to represent a precession-driven lengthening of the Holocene growing season that reduced calcite burial by enhancing net annual organic matter production and associated calcite dissolution.

This record, along with other high-resolution carbonate records from the North American Mid-Continent, demonstrates the potential of lacustrine carbonate systems to respond to and record long-term seasonal shifts in climate as well as short term environmental changes. The continuing importance of perspectives from paleoclimatic observations to increase our knowledge of climate system changes over interannual to millennial time scales is well established. Here I also present context that paleoclimate observations are increasingly relevant in informing and educating students and citizens about the basics of the climate system in general and human impacts in particular.