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ALKENONES IN LACUSTRINE SEDIMENTS AS PALEOCLIMATE INDICATORS

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Long-chain alkenones (LCAs) are a key class of biomarkers for certain members of the algal class Prymnesiophyceae (i.e., prymnesiophytes). These compounds are ubiquitous in ocean sediments where they are extensively used for paleotemperature reconstructions. Alkenones have also been reported in about 20 lakes around the world, but their paleoclimate significance is only beginning to be realized. In this study we report the occurrence of alkenones in sediments from a series of lakes in Greenland, western United States, western China and Alaska and discuss their paleoclimate applications.

We have previously reported unusually high concentrations of long-chain alkenones (LCAs) in sediments from a suite of laminated lakes in the Sondre Stromfjord region of southwestern Greenland (D'Andrea and Huang, 2005). Decadal-scale alkenone unsaturation UK37 records from three of these lakes depict remarkable coherence, providing unique records of regional temperature variability for the mid- to late Holocene. Comparison of these records with other highly-resolved temperature reconstructions from the North Atlantic suggests millennial-scale oscillations in the dominant mode of NAO over the past ~6000 yrs. Records of sedimentary LCA concentration from the lakes also imply regional control over the productivity of prymnesiophyte algae. While total organic carbon (TOC) records can yield clues to the overall productivity of a lake basin, LCAs are purely aquatic in origin and therefore represent ideal biomarkers for autochthonous productivity and facilitate refined paleolimnologic and paleoclimatic interpretation. Sediment traps were deployed in the saline lakes in April 2006, collecting discrete seston samples during spring and summer at 10 day intervals. We are presently using water temperature data collected over the same time interval (which included the spring thaw) to create an absolute UK37 temperature calibration specific to the Greenland lakes.

We established a quantitative reconstruction of temperature and salinity changes over the past 3500 years, based on alkenone distribution patterns in Lake Qinghai sediments (Liu et al., 2006). We show that alkenone proxies $U^{k'}_{37}$ and $\%C_{37:4}$ faithfully record temperature and salinity changes in Lake Qinghai, China (Fig.1). During the late Holocene, our $U^{k'}_{37}$ record indicates up to a 1ºC change in mean annual air temperature or a 2ºC change in summer lake water temperature, in which the 20th century warm period, LIA, MWP, DACP

and RWP have been identified. As suggested by $\%C_{37:4}$, warm periods are associated with periods of lake water freshening. The coupled surface temperature and salinity changes in Lake Qinghai suggest that Asian monsoons strongly influenced regional climate, and experienced significant changes in their strength during the late Holocene. Alkenones provide a rare opportunity to study the relationship between climatic and hydrological changes independent of chronology. A regional salinity calibration using surface sediments from Tibetan Plateau allows a robust quantification of salinity changes based on $\%C_{37:4}$ values.

We are also establishing downcore records from Brush Lake, Montana, and several Alaskan lakes where we have found alkenones in lake surface sediments. The sediments of Brush Lake are varved, allowing high resolution reconstruction of lake water temperature for the entire Holocene.

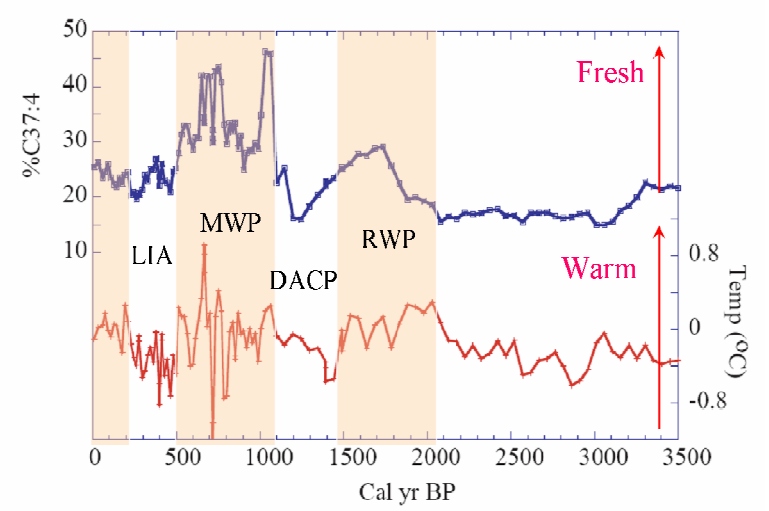

Figure 1. Late Holocene temperature and salinity records from Lake Qinghai, west China.

(Top) Salinity change based on %C37:4.

(Bottom) Temperature reconstruction based on $U^{k'}_{37}$. LIA = Little Ice Age; MWP = Medieval Warm Period; DACP = the Dark Ages Cold Period; RWP = Roman Warm Period.

REFERENCES

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