Geophysical Research Abstracts, Vol. 7, 07487, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07487

Comparison of diatom-inferred lake level changes in Alaska using a regional vs. intercontinental diatom calibration set

C. Bigler (1), I. Grégory-Eaves (2), W. Tinner (3) and F. S. Hu (4)

(1) Department of Ecology and Environmental Science, Umeå University, KBC plan 5, S - 90187 Umeå, Sweden (2) McGill University, Department of Biology, Stewart Biology Building, 1205 Docteur Penfield, Room: W6/5, Montreal, Quebec H3A 1B1 (3) Institute of Plant Sciences, University of Bern, Altenbergrain 21, CH-3013 Bern, Switzerland (4) Department of Plant Biology, University of Illinois, 505 S. Goodwin Avenue, Urbana, IL 61801, USA (christian.bigler@emg.umu.se / Fax +46 90 786 67 05)

Sedimentary remains of diatoms (single-celled siliceous algae) are widely used as proxy indicators to reconstruct past environmental conditions such as acidification, eutrophication or climate changes in lakes (Stoermer & Smol 1999). The need to quantify proxy-based reconstruction has lead to a large number of modern calibration sets (based on the diatom record in surface sediments and prevailing environmental conditions), particularly in remote regions where monitoring data records are sparse, thus hampering a long-term assessment of environmental changes.

In subarctic Fennoscandia, several diatom calibration sets showed good prediction ability, allowing the development of transfer functions for lake-water pH, climate-related variables, such as ambient water temperature, air temperature or ice-cover duration, lake depth and total organic carbon (Pienitz et al. 1995; Weckström et al. 1997; Rosén et al. 2000; Bigler & Hall 2002). However, the calibration sets were successfully applied for paleoenvironmental reconstructions basically on a regional scale (e.g., Bigler et al. 2002), without assessing their potential on a continental or intercontinental scale.

Here, we present a comparison of diatom-inferred lake level changes in Alaska applying a regional vs. an intercontinental calibration set. The test is performed using a sediment core from Grizzly Lake, located in the Copper River Basin, south of the

Alaska Range, a small lake (surface 11 ha, catchment 125 ha) without any major inlet or outlet. The sediment core covers the past c.800 years, including major changes in climate and precipitation such as during the Medieval Warm Period and the Little Ice Age, as evidenced by other proxies such as pollen, tree rings, glaciers and oxygen isotope measurements (e.g., Hu et al. 2001).

The patterns of lake level changes in Grizzly Lake in Alaska are similarly reconstructed by both a regional diatom calibration set from Alaska (Gregory-Eaves et al. 1999) and the Swedish calibration set (Bigler & Hall 2002). Whereas the trends are similar, the regional Alaska calibration set suggests slightly higher magnitude of lake level changes than the Swedish one.

A prerequisite for such comparison is a harmonized and compatible taxonomical resolution, which was achieved by determining the lowest common taxonomical denominator. In this study, it included a few nomenclature adaptations only, and no re-counting of slides was necessary.

Transfer functions were developed using weighted averaging (WA) and weighted averaging partial least square (WA-PLS) regression and calibration (ter Braak & Juggins 1993), using log-transferred lake depth data. The summary statistics of the original Alaska lake-depth transfer functions (WA with classical deshrinking) yielded a bootstrapped coefficient of determination (r^2_{boot}) of 0.53 and a root mean square error of prediction ($RMSEP_{boot}$) of 0.31, respectively (Gregory-Eaves et al., 1999), including 47 lakes. After taxonomical harmonization, we used WA-PLS regression and calibration, and the Alaska lake depth transfer function showed similar overall prediction abilities, i.e. an r^2_{boot} = 0.54 and an $RMSEP_{boot}$ = 0.28, including one WA-PLS component. The prediction ability of the Swedish lake-depth transfer function was somewhat weaker, yielding r^2_{boot} = 0.27 and an $RMSEP_{boot}$ = 0.45.

Overall, the good agreement between the two reconstructions performed with two different calibration sets clearly demonstrates the large spatial relevance of diatom calibration sets, under the basic assumption that ecological and climate conditions are comparable in both regions. Similarly, this has been shown for chironomid-based inferences that were compared between European and North American sites (Lotter et al. 1999). In addition, this study may illustrate the potential of circumpolar diatom calibration sets, including for example sites from the North American Arctic, Svalbard, Fennoscandia and Russia, leading to a common tool for reconstructing past environmental changes using lake sediments in subarctic and arctic regions.

References

Bigler, C. and R. I. Hall (2002): Diatoms as indicators of climatic and limnological change in Swedish Lapland: a 100-lake calibration set and its validation for paleoecological reconstructions. *J. Paleolim.* **27**(1): 97-115.

Bigler, C., I. Larocque, S. M. Peglar, H. J. B. Birks and R. I. Hall (2002): Quantitative multiproxy assessment of long-term patterns of Holocene environmental change from a small lake near Abisko, northern Sweden. *Holocene* **12**(4): 481-496.

Gregory-Eaves, I., J. P. Smol, B. F. Finney and M. E. Edwards (1999): Diatom-based Transfer Functions for Inferring Past Climatic and Environmental Changes in Alaska, U.S.A. *Arct. Antarct. Alp. Res.* **31**(4): 353-365.

Hu, F. S., E. Ito, T. A. Brown, B. B. Curry and D. R. Engstrom (2001): Pronounced climatic variations in Alaska during the last two millennia. *Proceedings of the National Academy of Sciences of the United States of America* **98**(19): 10552-10556.

Lotter, A. F., I. R. Walker, S. J. Brooks and W. Hofmann (1999): An intercontinental comparison of chironomid palaeotemperature inference models: Europe vs North America. *Quaternary Science Reviews* **18**(6): 717-735.

Pienitz, R., M. S. V. Douglas, J. P. Smol, P. Huttunen and J. Meriläinen (1995): Diatom, chrysophyte and protozoan distribution along a latitudinal transect in Fennoscandia. *Ecography* **18**: 429-439.

Rosén, P., R. I. Hall, T. Korsman and I. Renberg (2000): Diatom transfer-functions for quantifying past air temperature, pH and total organic carbon concentration from lakes in northern Sweden. *J. Paleolim.* **24**: 109-123.

Stoermer, E. F. and J. P. Smol, Eds. (1999): The diatoms: applications for the environmental and earth sciences. Cambridge, Cambridge University Press.

ter Braak, C. J. F. and S. Juggins (1993): Weighted averaging partial least squares regression (WA-PLS): an improved method for reconstructing environmental variables from species assemblages. *Hydrobiologia* **269/270**: 485-502.

Weckström, J., A. Korhola and T. Blom (1997): Diatoms as quantitative indicators of pH and water temperature in subarctic Fennoscandian lakes. *Hydrobiologia* **347**: 171-184.