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Diatom-Based Paleoenvironmental Reconstruction of Lake Telmen for the Last 6230 Years

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Abstract

The preserved diatom flora in a 14C dated (0-6230 yBP), 343 cm long core sequence from Lake Telmen, Mongolia, was investigated to determine the nature of the lake-ecosystem and watershed response to Late Holocene climate change. Modern Lake Telmen is a slightly saline (presently 4 g L-1) closed-basin lake located along a N-S and E-W aridity ecotone in north-central Mongolia, making it sensitive to climate-driven changes in effective moisture balance. Diatoms were not preserved regularly in two areas of the Lake Telmen sediment record (5380-4150 yBP and 1050-425 yBP) possibly due to high carbonate preservation; however, diatom preservation between these areas was good to excellent. Diatom-based paleosalinity reconstruction using species-specific salinity optima from the Northern Great Plains of North America and community analysis suggests the following climate-lake response model during the Late Holocene. From 6230 to 5520 radiocarbon years ago, warm-dry climate resulted in a small salty (20 g L-1) lake in the Telmen basin that was dominated by high salinity indicator species (e.g. *Cyclotella caspia, Navicella pusilla, Brachysira aponina*). From 3860 to 1200 radiocarbon yBP, Lake Telmen recorded a period of a modulating climate that resulted in regular fluctuations in paleosalinity from 2 to 4 g L-1 in conjunction with lake level changes. Dominance in the diatom flora fluctuated between the freshwater planktonic form *Cyclotella bodanica* var. *affinis* and the salinity-tolerant benthic taxon *Anomoeoneis sphaerophora* f. *costata* during this period characterized by generally more humid climatic periods interspersed with dry-as-present conditions. The most modern samples (0-250 yBP) preserve floristic assemblages similar to those found between 3860 to 1200 radiocarbon yBP and indicate that as recently as 250 years ago Lake Telmen had lower salinity values than modern day.

Key words: Diatoms, saline lake, paleosalinity, paleoclimate reconstruction

Introduction

The assemblages of diatoms preserved in lake sediments can directly reflect the floristic composition and productivity of the lake diatom communities, and can indirectly reflect lake water quality, especially pH, alkalinity, nutrient status, and salinity (Battarbee, 1991). Among the fossils contained in lake sediment, diatoms are probably the most sensitive indicators of limnological change because of their widespread distribution, diversity, and rapid response to water chemistry change (Fritz *et al.*, 1993). Variation in moisture balance results in lake level changes, concentration or dilution of ionic composition, and changes in groundwater inputs. Among the common ecological gradients in aquatic systems, diatom distribution is especially responsive to gradients of conductivity, salinity, and ionic composition (Cumming *et al.*, 1995), thus responses to climate change are often faithfully recorded in closed basin systems.

Lake Telmen (in Khangai Province, Mongolia) has two characters especially suitable for paleoclimate study. First, hydrological closed lakes represent a sensitive balance between climate parameters such as evaporation, precipitation, and temperature. Small changes in these parameters can result in large sedimentary, biological, and geochemical changes in closed basins (Kelts, 1997;

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