February 2006

The last 2000 years in Northern Yellowstone National Park Based on Multiproxy Data from Crevice Lake

Cathy Whitlock

Sherilyn C. Fritz
University of Nebraska-Lincoln, sfritz2@unl.edu

Brandi Bracht
University of Nebraska-Lincoln

Lora Stevens
University of Nebraska-Lincoln

Mitchell Power
University of Nebraska-Lincoln

AMQUA 2006 Meeting

Cathy Whitlock, Sherilyn Fritz, Brandi Bracht, Lora Stevens, Mitchell Power, and Walter Dean,

The last 2000 years in Northern Yellowstone National Park Based on Multiproxy Data from Crevice Lake

Abstract:

Pollen, charcoal, diatoms, stable-isotope, and geochemical records were analyzed in high-resolution in cores obtained from Crevice Lake, a varved-sediment lake in northern Yellowstone National Park. The objective was to reconstruct the vegetation, fire, and ecohydrologic history of the watershed for the period from AD 0-1917 and compare the results with the PDSI reconstructions of Cook et al. (2004). Pollen percentages and accumulation rates provide information on vegetation and flowering season conditions. Charcoal accumulation rates (CHAR) provide information on fire activity, including fire size or intensity and fire frequency. Diatoms disclose the nature of spring nutrient status, time of ice off, and duration of lake stratification, with Cyclotella bodanica as an indicator of prolonged summer stratification. 18O values over the last 300 yr correlate well with reconstructedδ discharge for the Yellowstone River (Graumlich et al., 2003), 18O and winter precipitation.δsuggesting a relationship between Organic carbon (Corg) is a qualitative indicator of organic productivity, and certain elements such as sulfur (S) and molybdenum (Mo) are indicators of anoxia and sulfate reduction.

Prior to AD 1150, high values of C. bodanica suggest long periods of summer stratification, and more oxygen-deficient bottom waters are indicated by higher S and Mo concentrations and pyrite formation. High concentrations of Corg imply higher organic productivity or low degradation due to anoxia. Low charcoal and high pollen accumulation rates imply small and/or frequent, fires and long flowering periods. 18O values suggest dry conditions. From ADδBetween AD 600-900, high 18O values and abundant C. michiganiana imply wetδ900 to 1100, low winters, and warm summers with prolonged stratification. Charcoal and pollen data indicate continued frequent or small fires and long flowering periods, and upper treeline was at a higher elevation at this time (K. Pierce, unpubl. data). The period from AD 1150-1700 features high variability in PDSI values, including extreme dry and wet 18O values match a PDSI wet interval at AD 1300,δintervals. Low suggesting high winter precipitation. A shift from C. bodanica to Stephanodiscus medius and S. minutulus indicates longer or cooler springs than before, and low CHAR and PAR indicate low fire activity 18O valuesδand poor flowering. Between AD 1400 and 1525, low correspond with high CHAR peaks suggesting infrequent severe fire 18Oδevents during a wet interval. From AD1500 to 1700, an

increase in values and a slight rise in C. bodanica indicate warmer spring conditions, prolonged summer stratification, and perhaps shorter winters, with less precipitation, than before. From AD 1700 to 1800, 18O), lengthy summerδthe proxy data indicate dry conditions (high stratification (high C. bodanica), large or severe fires (high CHAR), and increased forest cover (high PAR and arboreal pollen percentages). PDSI reveals modest drought event in mid 1800s, associated with winter 18O) near Crevice Lake. Greater seasonality duringδprecipitation (low this period may explain the diatom mixture of C. bodanica, S. medius, and S. minutulus. A large fire event was recorded at ca. 1850 and fires have been small or absent since then.

REFERENCES

Cook, E.R et al. 2004. Long-term aridity changes in the western United States. Science 306: 1015-1018.

Graumlich, L.J. et al. 2003 Upper Yellowstone River flow and teleconnections with Pacific basin climate variability during the past three centuries. Climatic Change 59, 245-262.
