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

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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. $\delta^{18}O$ values over the last 300 yr correlate well with reconstructed δ discharge for the Yellowstone River (Graumlich et al., 2003), $\delta^{18}O$ and winter precipitation. δ suggesting 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. $\delta^{18}O$ values suggest dry conditions. From AD δ Between AD 600-900, high $\delta^{18}O$ values and abundant *C. michiganiana* imply wet δ 900 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 $\delta^{18}O$ values match a PDSI wet interval at AD 1300, δ intervals. Low δ 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 $\delta^{18}O$ values δ and poor flowering. Between AD 1400 and 1525, low δ correspond with high CHAR peaks suggesting infrequent severe fire $\delta^{18}O$ δ events during a wet interval. From AD 1500 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, lengthy summer 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 180) near Crevice Lake. Greater seasonality during precipitation (low *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.

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