Investigating Holocene Aquatic Mosses as a Proxy for Lakewater Isotopes in Northeastern Greenland

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Previous studies have found that the $\delta^{18}O$ values of present-day aquatic mosses correlate significantly with the $\delta^{18}O$ values of the lake water they grow in (Puleo et al., 2024; Zhu et al., 2014). This relationship signifies the potential of bulk aquatic mosses as a proxy for past lake water $\delta^{18}O$, yet most paleo-isotopic work on mosses in the published literature has focused on cellulose $\delta^{18}O$ in wetland environments (Daley et al., 2010; Zanazzi and Mora, 2005). In this study, we isolate and analyze the $\delta^{18}O$ values of aquatic mosses (Scorpidium scorpioides) preserved in Holocene sediments from a small lake in northeastern Greenland at 13 different time horizons between 3500 and 7000 years BP to 1) examine the range of $\delta^{18}O$ values of mosses contained within a sediment sample (representing approximately 50 years each); and 2) compare the $\delta^{18}O$ values across this time interval with independent estimates of $\delta^{2}H$ values of lake water from lipid biomarkers. Across all samples, the $\delta^{18}O$ value of mosses average 3.67 $\pm$ 1.40 ‰ (n = 86), with mean $\delta^{18}O$ values among respective sample depths showing high variability (up to 5.61 ‰). The $\delta^{18}O$ values of mosses within the same sample depth also range considerably (up to 5.31 ‰), suggesting that isolated mosses might be useful for defining the range of lake water isotope variability that occurred across the time of sediment accumulation. It is also possible that the range of $\delta^{18}O$ values found in each sample represents the uncertainty induced by vital effects in S. scorpioides. Furthermore, measurements made on different moss parts (leaf-like phyllids versus stem-like caulids) within individual strands show no significant difference in $\delta^{18}O$ values. This finding suggests all isolated moss fragments can be used for $\delta^{18}O$ analysis regardless of phyllid/caulid ratio. Finally, with our limited sample size, bulk moss $\delta^{18}O$ values show only a weak relationship with estimated $\delta^{2}H$ values of lake water across samples, suggesting that one or both systems fails to capture the true isotopic composition of lake water.