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Aerial decay influence on the stable oxygen and carbon isotope ratios in tree ring cellulose

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Abstract
Sub-fossil wood is often affected by the decaying process that introduces uncertainties in the measurement of oxygen and carbon stable isotope composition in cellulose. Although the cellulose stable isotopes are widely used as climatic proxies, our understanding of processes controlling their behavior is very limited. We present here a comparative study of stable oxygen and carbon isotope ratios in tree ring cellulose in decayed and non-decayed wood samples of Swiss stone pine (*Pinus cembra*) trees. The intra-ring stable isotope variability (around the circumference of a single ring) was between 0.1 and 0.5 ‰ for $\delta^{18}O$ values and between 0.5 and 1.6 ‰ for $\delta^{13}C$ values for both decayed and non-decayed wood. Observed intra-tree $\delta^{18}O$ variability is less than that reported in the literature (0.5-1.5 ‰), however, for $\delta^{13}C$ it is larger than the reported values (0.7-1.2 ‰). The inter-tree variability for non-decayed wood ranges between 1.1 and 2.3 ‰ for $\delta^{18}O$ values, and between 2 and 4.7 ‰ for $\delta^{13}C$ values. The inter-tree differences for $\delta^{18}O$ values are similar to those reported in the literature (1-2 ‰ for oxygen and 1-3 ‰ for carbon) but are larger for $\delta^{13}C$ values. We have found that the differences for $\delta^{18}O$ and $\delta^{13}C$ values between decayed and non-decayed wood are smaller than the variation among different trees from the same site, suggesting that the decayed wood can be used for isotopic paleoclimate research.

Keywords oxygen isotope ratios; carbon isotope ratios; tree rings; decayed wood