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A comparison of the carbon isotope composition of whole wood and cellulose within modern and fossil tree rings

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Hundreds of studies have used the carbon isotope value of tree ring tissue as an indicator of environmental change. These studies generally measure the $\delta^{13}C$ value in either whole wood or cellulose; new advances in high-resolution intra-ring analyses have demonstrated the need for more rapid assessment of $\delta^{13}C$ value from large number of samples. Multiple studies have argued both for, and against, the need to extract cellulose in order to obtain a robust record of environmental change. While some studies have shown a constant offset between the $\delta^{13}C$ value of whole wood and cellulose, this has not been investigated across diverse species and wood ages.

Here we present new $\delta^{13}C$ data on cellulose and whole wood from fossil wood samples ranging in age from 55,000,000 to 2,000 years old. These data, combined with another 873 $\delta^{13}C$ values we extracted from the literature, indicate a consistent offset between the $\delta^{13}C$ value measured in whole wood and cellulose, suggesting that cellulose extraction is not necessary for environmental reconstruction.

We further find that cellulose yield decreases with increasing age of the wood; ongoing work will test whether the offset between the $\delta^{13}C$ value of the cellulose and the whole wood changes as a result of cellulose loss during decomposition. Analysis of whole wood, rather than cellulose, would greatly enhance our ability to develop long-term, high-resolution $\delta^{13}C$ chronologies from both modern and fossil wood.