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Drivers of intra‐seasonal $\delta^{13}C$ signal in tree‐rings of *Pinus sylvestris* as indicated by compound‐specific and laser ablation isotope analysis

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Carbon isotope composition of tree‐ring ($\delta^{13}C_{Ring}$) is a commonly used proxy for environmental change and ecophysiology. $\delta^{13}C_{Ring}$ reconstructions are based on a solid knowledge of isotope fractionations during formation of primary photosynthates ($\delta^{13}C_P$), such as sucrose. However, $\delta^{13}C_{Ring}$ is not merely a record of $\delta^{13}C_P$. Isotope fractionation processes, which are not yet fully understood, modify $\delta^{13}C_P$ during sucrose transport. We traced, how the environmental intra‐seasonal $\delta^{13}C_P$ signal changes from leaves to phloem, tree‐ring and roots, for 7 year old Pinus sylvestris, using $\delta^{13}C$ analysis of
individual carbohydrates, $\delta^{13}C_{Ring}$ laser ablation, leaf gas exchange and enzyme activity measurements. The intra‐seasonal $\delta^{13}C_P$ dynamics was clearly reflected by $\delta^{13}C_{Ring}$, suggesting negligible impact of reserve use on $\delta^{13}C_{Ring}$. However, $\delta^{13}C_P$ became increasingly ^{13}C‐enriched during down‐stem transport, probably due to post‐photosynthetic fractionations such as sink organ catabolism. In contrast, δ13C of water‐soluble carbohydrates, analysed for the same extracts, did not reflect the same isotope dynamics and fractionations as $\delta^{13}C_P$, but recorded intra‐seasonal $\delta^{13}C_P$ variability. The impact of environmental signals on $\delta^{13}C_{Ring}$, and the 0.5 and 1.7‰ depletion in photosynthates compared ring organic matter and tree‐ring cellulose, respectively, are useful pieces of information for studies exploiting $\delta^{13}C_{Ring}$.