

Fractionation of $^{15}\text{N}/^{14}\text{N}$ in plant phenology: implications for physiological, ecological, and geochemical studies

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The nitrogen isotope ratios have been widely used for tracing nitrogen fluxes in ecological and geological processes. However, if we apply it to terrestrial environments, we need to figure out the processes that lead to isotopic fractionation associated with degradation and recycling of nitrogen in plant phenology (e.g., the decoloring of leaves, which is a specific process in terrestrial primary producers). In this study, we investigated the fractionation of $^{15}\text{N}/^{14}\text{N}$ for major nitrogenous molecules, chlorophylls and amino acids, in maple leaves during autumn decoloring, to evaluate whether or not the nitrogen transportation during leaf senescence causes significant isotopic fractionation of these molecules.

We found that, during autumn decoloring, there is no substantial change in the $\delta^{15}\text{N}$ values of amino acids, but a large increase in the $\delta^{15}\text{N}$ values of chlorophylls, together with the decreases of concentration for both amino acids and chlorophylls. These results reveal that plants bring nitrogen as amino acids and chlorophyll breakdown products from leaves to stalks during leaf senescence, with no fractionation of $^{15}\text{N}/^{14}\text{N}$ for the breakdown of protein to amino acids but significant for that of chlorophylls. Thus an account of the effects of leaf senescence is required for tracing accurately nitrogen fluxes in the application studies.

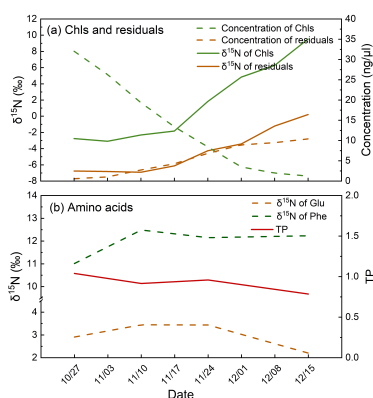


Figure 1
(a) The $\delta^{15}\text{N}$ and concentration of chlorophyll and residuals.
(b) The $\delta^{15}\text{N}$ of amino acids (i.e., Glu and Phe), and TP.