Depth Profiles of Forest Soil C Isotope Ratios Are Related to Soil C Turnover Times

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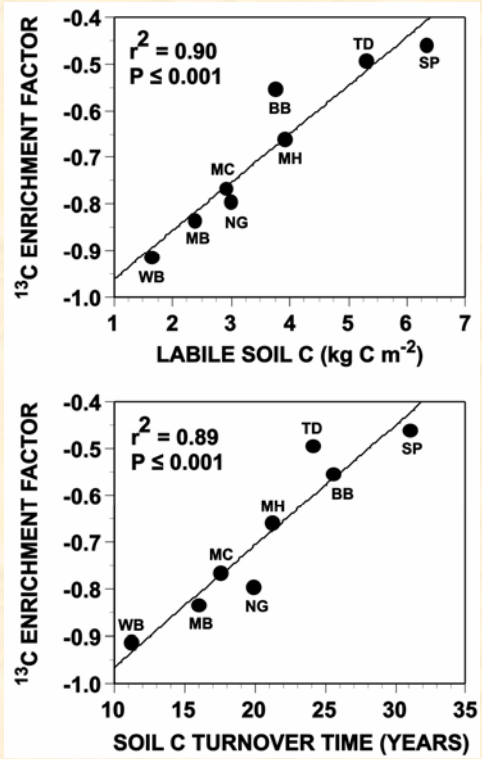
- Increasing ^{13}C natural abundance with soil depth is a well known, but not fully explained, phenomenon in forest ecosystems.
- Recent research along elevation gradients in the southern Appalachian Mountains indicates that widely reported changes in $^{13}C/^{12}C$ ratios in undisturbed forest soils are associated with soil C turnover times.
- A better understanding of soil C turnover rates are fundamentally important to terrestrial C sequestration strategies for partially mitigating future increases in atmospheric CO_2.
- Carbon-13 enrichment factors (a measure of the change in C isotopic composition through the soil profile) are a potential indicator of soil C turnover rates in undisturbed, mature forest ecosystems.



Relationships between ^{13}C enrichment factors and labile soil C (upper panel) or soil C turnover times (lower panel) in forest ecosystems along a climate gradient in the southern Appalachian Mountains

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It is well known that forest soils exhibit increasing ^{13}C natural abundance with soil depth, but the mechanisms causing changes in C isotopic composition through the soil profile are unclear. Some, including this writer, have speculated that the changes are related to C turnover times. A better understanding of soil C turnover is fundamental to terrestrial C sequestration strategies for mitigating future increases in atmospheric CO_2. Recent research in the Environmental Sciences Division (ORNL) has produced estimates of forest soil C turnover times[1] and demonstrated their association with ^{13}C enrichment factors[2] (a measure of change in C isotopic composition with soil depth). In the words of different reviewers, "As the first empirical confirmation of the inferred link between soil $\delta^{13}C$ enrichment factors and soil C dynamics, this result is an important contribution to the literature", and "Changes in ^{13}C with soil depth are commonly reported and discussed, but this work goes a step further in convincingly relating the values to environmental variables and major soil C pools." This new work shows that environmental factors, soil C partitioning, and vertical changes in soil $^{13}C/^{12}C$ ratios are interrelated and that measurements of C isotope ratios are a potential indicator of C dynamics in undisturbed forest soils.

[1]Garten, C.T., Jr., Hanson, P.J. 2006. Measured forest soil C stocks and estimated turnover times along an elevation gradient. *Geoderma* (in press).

[2]Garten, C.T, Jr. 2006. Relationships among forest soil C isotopic composition, partitioning, and turnover times. *Canadian Journal of Forest Research* (in press).