

Poster# 101

How Soil Depth Affects Decomposition

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The Lawrence Berkeley National Laboratory Terrestrial Ecosystem Science Scientific Focus Area has performed several experiments tracing isotopically-labeled plant litter as it decomposes into soil organic matter at various soil depths, in a Mediterranean annual grassland and a montane coniferous forest. Here we synthesize the results of those studies to show when and how depth affects decomposition of root litter inputs. We inserted ¹³C-labeled fine-root litter into three depths (15, 50, and 90 cm) of a coniferous forest Alfisol and measured the carbon remaining in particulate (>2 mm), bulk (< 2mm), free light, and mineral soil fractions over 2.5 years. Similarly, we inserted the same litter into the A and B horizons of a grassland Mollisol and measured the carbon remaining over two growing seasons. Finally, we inserted ¹³C- and ¹⁵N-labeled fine root and needle litter in O and A horizons of a coniferous forest Alfisol and measured the C remaining over 10 years. In the coniferous forest soil, depth did not control initial rates of decomposition, with similar rates across 90 cm of depth in the first year and among the O and A horizons in the first 5 years. In contrast, initial decomposition was faster in the B horizon of the grassland due to increased water availability. Over longer periods of time, decomposition slowed at depth in both the grassland and coniferous forest soils. In the A horizon, this was due to the microbial-processed, litter-derived organic matter becoming mineral-associated. In the deeper horizons, decomposition ceased after only a year or two, which could imply that the remaining litter became less accessible or the microbes had become energy or nutrient-limited. In all three experiments, we found surprisingly little downward movement and retention of litter-derived C within the soil profile. A follow-up laboratory study using soil columns confirmed that after 6 months of decomposition and leaching, nitrogen from litter placed at the surface was found throughout the soil profile, while carbon from that litter was not. This is consistent with a large role of preferential flow paths in transport, but appears inconsistent with common soil-model assumptions of homogeneous incremental transport between horizons.