

Turnover of organic matter in soils – ¹⁴C analysis of individual compounds

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Soil microbial communities derive their carbon from two locations: organic carbon (C) transported down from overlying litter and O horizons, and in situ sources, including roots, rhizosphere or soil organic matter. We took advantage of an experiment that manipulated the ¹⁴C signature of leaf litter inputs in a temperate forest at the Oak Ridge Reservation, Tennessee, USA to quantify the contribution of surface leaf litter C to microbial respiration, microbial biomass and biomarker compounds. Radiocarbon signatures in microbial phospholipid fatty acids (PLFA) isolated from the top 10 cm of mineral soil at forested sites that had experienced 3 years of elevated- versus low-¹⁴C leaf litter addition showed that less than 10% of the microbial C was derived from 1-4 year-old surface litter. A mesocosm experiment confirmed that DOC leaching from labeled surface litter was not a detectable source of C in underlying mineral soil microbes eight months after litter addition. We conclude that roots are the primary carbon source for microbes and therefore soil organic matter in this forested ecosystem. It is now possible to routinely measure radiocarbon in samples as small as ~10 micrograms of carbon. However, great care must be taken to establish and quantify potential sources of contamination in samples, like PLFA that are highly processed. In our lab, these issues increase the uncertainties and limit some of the questions that can be addressed with compound-specific radiocarbon for natural-level samples.