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Lignin is not preferentially preserved in fine Fractions of Soil

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The shift in stable carbon isotope ratios in soils after introduction of isotopically labeled biomass can be used to assess soil organic matter turnover. While studies on bulk soil turnover rates have been established during the past years, only little work has been done on the turnover times of specific compounds due to the analytical difficulties involved in determining isotope ratios of single compounds within a complex mixture. Lignin is a major plant constituent and is considered to be relatively resistant to decomposition, thus contributing to the slowly mineralising pool of soil organic matter (SOM). We analysed bulk soil and particle size fractions of various agricultural plots that had been isotopically labeled either by conversion from C3 to C4 crops or by fumigation with ^{13}C-depleted CO_2. Using the microwave CuO oxidation method, the lignin macromolecule was converted into its monomer units (acids, aldehydes and ketones of vanillyl, syringyl, and cinnamyl units). These were identified by GC/MS and compound specific $^{13}C/^{12}C$ isotope ratios were determined by GC-C-IRMS.

The samples studied so far indicate a faster turnover time for lignin-derived monomers than for bulk SOM. This is in contrast to the existing assumption that the lignin macromolecule is selectively preserved within SOM. Among the structural units, cinnamyl units turn over faster than syringyl and vanillyl units. Under pasture, lignin turnover appears to be faster than in arable soil. Current work aims at extending the dataset to a forest site.

First lignin analyses in particle size fractions support the view of relatively fast lignin turnover across the size fractions. We observed only small differences in lignin turnover times between the particle size fractions, while the proportion of lignin oxidation products to total organic carbon decreases from fine sand to clay fractions. The

clay fraction is usually considered to contain the oldest and most stable carbon. Thus, the low percentage of lignin oxidation products in this fraction suggests that lignin molecules do not contribute significantly to this selectively preserved carbon pool.