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Microbial contribution to the bound residue formation in soils

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During degradation of organic pollutants in soil, a significant amount of the C remaining in soil is transformed to so-called bound residues. These residues can only be detected by use of isotope labeled compounds and are considered to consist of the parent compound or metabolites sorbed to the soil matrix. However, biomolecules such as fatty acids and amino acids were also found in the residue fraction indicating that C from the pollutant has been assimilated by microbial biomass. In order to estimate the extent of this biogenic residue formation, we investigated the fate of microbial biomass in soil using a ^{13}C-labeled *Escherichia coli* strain (RFM 443). Although the added *E. coli* cells died fast, about half of the C remained in soil even after 224 days. The remaining C was about equally distributed between microbial biomass different from *E. coli* and non-living soil organic matter. Hence, the latter fraction contributes to the "bound residue" formation from pollutants in soil.

In addition, CO_2 originating from mineralization of the pollutants may also be incorporated by soil microorganisms as found in previous experiments after microbial degradation of 9-[^{14}C]-anthracene. In order to study this effect, we incubated soil under $^{13}CO_2$-enriched atmosphere resulting in biogenic formation of residues accompanied by the appearance of the label in amino acids and fatty acids. The labeling pattern of these compound groups indicated that a wide range of organisms was involved in the CO_2 fixation, and that oxaloacetate was an important fixation product. The CO_2 fixation was correlated to respiration suggesting that this process is a heterotrophic process via anaplerotic reactions to replenish the TCC. Already after 60 days, part of the labeled C of the biomolecules was transferred to the non-living soil organic matter. These results suggest that labeled C may be introduced into soil via CO_2 after min-

eralization of a labeled pollutant. Soil microorganisms may thus contribute in three ways to the formation of bound residues: they convert the pollutant to metabolites which can bind to the soil matrix, they use the C for the formation of biomass which then partly is transformed to non-living soil organic matter, and they assimilate CO_2 from pollutant mineralization to form biomass and later on soil organic matter. The relative contribution of these three pathways has to be taken into account for proper risk assessment of residues in soils.