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From microbial biomass compounds to non-living soil organic matter - Microbial biomass as a significant source for soil organic matter formation

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Soil organic matter is one of the most important pools of the global carbon cycle. Recently, it has been suggested that microbial biomass is a significant source for the formation of refractory organic matter. We tested the relevance of this source by incubation of soil with ^{13}C-labeled *Escherichia coli* cells. We traced the labeled carbon in fatty acids and amino acids, both in the microbial biomass and in the bulk soil. We also localized cells and their debris by scanning electron microscopy. Although we could not detect any living cells after 100 days, about 50% of the carbon remained in the soil after 224 days. The amount of label in the fatty acids indicated that microbial lipids were degraded faster than the bulk microbial biomass. Their labeling pattern showed that they were redistributed from *E. coli* to the microbial food web and from the living biomass to non-living soil organic matter. In contrast, the label in the total amino acids did not decrease significantly during incubation. Proteins are thus surprisingly stable in soil, but they also shifted from microbial biomass to non-living soil organic matter. The scanning electron micrographs showed only isolated intact microbial cells in our soil, but patches of organic material of unknown origin which are about 20 - 50 nm^2 in size were quite abundant. Dying microbial cells therefore are a significant carbon source for the formation of refractory organic material, but the morphology of the cells changes during degradation, as cell structures cannot be found frequently in soils.