



Carbon and nitrogen mineralization are decoupled in organo-mineral fractions

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To improve our comprehension how carbon and nitrogen mineralization are linked in soils, we used a controlled laboratory mineralization approach and compared carbon and nitrogen dynamics in the bulk soil and in soil fractions. Topsoil of a Rendzic Leptosol from a beech forest site near Tuttlingen, Germany, was fractionated into three particle size classes: sand (2000 to 20 μm), silt (20 to 2 μm), and clay (< 2 μm). Bulk soil and particle size fractions were incubated for 40 weeks allowing periodic destructive sampling. We monitored carbon and nitrogen mineralization dynamics, and assessed carbon respiration as well as nitrogen mineralization and microbial biomass carbon and nitrogen contents. Soil organic matter in the incubated fractions was considered by a subsequent density fractionation. The chemical composition of selected samples was qualitatively evaluated by ^{13}C -NMR spectroscopy.

When summing up the mineralization rates of the single fractions, the values for respired carbon equaled the bulk soil, whereas the mathematical recombination of mineral nitrogen in all fractions was significantly less than in bulk soil. Hence, carbon mineralization was not affected by the damage of the aggregated soil structure via fractionation, whereas nitrogen mineralization was reduced. Fractionation increased the surface area providing accessory mineral surfaces, which allowed new binding of especially nitrogen-rich compounds, besides ammonium fixation via cation exchange. Density fractionation revealed that organic matter in the sand fraction contained mainly particulate organic matter present as light material comprising partly decomposed plant remnants. The organic matter in the clay fraction was mostly adsorbed on mineral surfaces. Organic matter in the sand and in the clay fraction was dominated by O/N-alkyl C indicating low recalcitrance, but the C/N ratio of organic matter narrowed with decreasing particle size. These results also imply that the C/N ratio as well as the alkyl C to O/N-alkyl C ratio are not suitable to draw conclusions regarding biological decomposability of plant residues when characterizing soil fractions where organic matter is mainly stabilized by spatial inaccessibility and by organo-mineral interactions.

The specific interactions of both carbon and nitrogen containing components with the mineral matrix strongly modulate the mineralization dynamics, leading to a decoupling of these processes.