Mechanisms of soil C and N transformations

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Soil organic matter (SOM) is the biggest terrestrial carbon (C) pool on Earth. Climate change and soil overuse by inadequate agricultural practices lead to SOM losses and therefore, increase atmospheric CO_2 concentrations. Additionally, loss of SOM leads to decline of soil quality with respect to nutrient and water supply. Therefore, understanding of SOM transformation is crucial for maintaining or enhancing SOM levels and thus for sustainable land management options.

Conventional biomarker analysis suggested that during the first phase of organic matter transformation in soil, rapid mineralization of labile compounds such as sugars and polysaccharides dominate whereas in a second phase mineralization is slowed down and refractory compounds accumulate. Stable compounds of SOM identified by this way comprise a variety of chemically defined natural biopolymers including lignin, waxes, tannins, pigments and pectins. New analytical tools such as stable isotope labeling followed by compound-specific stable isotope analysis allows differentiating between soil-inherent (old) and new molecules revealing that most SOM constituents are turned over within decades. There are only a few components with turnover times of centuries to millennia such as black carbon, being a management option both for long-term C sequestration and soil fertility enhancement.

Within the planned collaboration in the CN cluster "C and N in Terrestrial Ecosystems of Baikal Area", it is intended to study changes in SOM transformation upon land use change (agriculture, natural forest, forest plantations) and climate change (thawing of permafrost layers). The studies will include manipulations on plot level with $^{13}C/^{15}N$ labeling experiments and will be carried out in collaborative ecosystem approach including rhizosphere (Kuzyakov), DOM (Guggenberger), trace gases (Kiese).