Geophysical Research Abstracts
Vol. 21, EGU2019-6782-1, 2019
EGU General Assembly 2019

Organic matter decomposition during long-term podzol development

Melanie Brunn (1,2,3) and Yvonne Oelmann (1)

(1) University of Tuebingen, Institute of Geography, Department of Geoscience, Germany (melanie.brunn@uni-tuebingen.de), (2) Karlsruhe Institute of Technology (KIT), Institute of Geography and Geoecology, Germany, (3) University of Koblenz-Landau, Institute for Environmental Sciences, Germany

Soil Organic matter (SOM) decomposition in soil decisively controls the sink and source function for carbon (C) in soil and is increasingly important in discussions on C sequestration. So far, little attention has been paid to investigate decomposition of SOM during long-term pedogenesis. Evidence suggests that decomposition of SOM decreases during soil development lasting millennia, although inverse trends occur. The aim of this study was to investigate decomposition of SOM during podzol development in a long-term Baltic Sea dune chronosequence spanning 60 to 4,280 years of soil formation from Arenosol to Podzol. We applied three different approaches and tested whether i) decomposition assessed by gradients in stable carbon isotope ratios (δ^{13}C) of soil profiles, ii) depth dependent CO_2 evolution during soil incubation and iii) litter nutrient stoichiometry, specifically carbon to nitrogen (C:N) ratios and manganese (Mn) concentrations in litter, relate to podzol development.

As expected for podzol formation, we found increasing C stocks, increasing thickness of organic horizons and increasing acidification over time of podzol development. In addition, the enrichment of ^{13}C with depth decreased with proceeding soil development, indicating declining decomposition of SOM. Carbon dioxide released from soil also decreased with soil age and was positively related to the estimated decomposition. In deeper soil, CO_2 release was higher and had higher $\delta^{13}CO_2$ values compared to the more shallow soil layers, suggesting that ^{13}C enriched SOM is decomposed in greater soil depth. We discuss a possible impact of soil inorganic C on SOM formation and on the development of δ^{13}C depth profiles. No significant trends of C:N ratios or in Mn concentrations in litter could be found, indicating that C:N ratios and Mn concentrations are not related to C accumulation across this Baltic Sea chronosequence. This might be due to the homogeneous, pine-dominated vegetation across the chronosequence.

In summary, SOM decomposition and loss of C as CO_2 from soil decreased with soil age and therefore, we conclude that mature podzol soils may be less severely prone to CO_2 losses. Although developed podzols may not fulfill the United Nations´ aim to increasing world's soil C stocks by 4‰ annually, they store fundamental amounts of C that seem well protected in undisturbed podzols.