Geophysical Research Abstracts
Vol. 12, EGU2010-3470, 2010
EGU General Assembly 2010

Development of bulk density, total C distribution and OC saturation in fine mineral fractions during paddy soil evolution

Livia Wissing (1), Angelika Kölbl (1), Zhi-Hong Cao (2), and Ingrid Kögel-Knabner (1)

(1) Lehrstuhl für Bodenkunde, Department Ecology and Ecosytem Sciences, Center of Life and Food Sciences Weihenstephan, Technische Universität München, Freisng-Weihenstephan, Germany (l.wissing@wzw.tum.de), (2) Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China

Paddy soils are described as important accumulator for OM (Zhang and He, 2004). In southeast China, paddy soils have the second highest OM stocks (Zhao et al, 1997) and thus a large proportion of the terrestrial carbon is conserved in wetland rice soils. The paddy soil management is believed to be favorable for accumulation of organic matter, as its content in paddy soils is statistically higher than that of non-paddy soils (Cai, 1996). However, the mechanism of OM storage and the development of OM distribution during paddy soil evolution is largely unknown. The aim of the project is to identify the role of organo-mineral complexes for the stabilization of organic carbon during management-induced paddy soil formation in a chronosequence ranging from 50 to 2000 years of paddy soil use.

The soil samples were analysed for bulk density, total organic carbon (TOC) and total inorganic carbon (TIC) concentrations of bulk soils and the concentration of organic carbon as well as the organic carbon stocks of physical soil fractions. First results indicate distinctly different depth distributions between paddy and non-paddy (control) sites. The paddy soils are characterized by relatively low bulk densities in the puddled layer (between 0.9 and 1.3 g cm-3) and high values in the plough pan (1.4 to 1.6 g cm-3) and the non-paddy soils by relatively homogeneous values throughout the profiles (1.3 to 1.4 g cm-3). In contrast to the carbonate-rich non-paddy sites, we found a significant loss of carbonates during paddy soil formation, resulting in decalcification of the upper 20 cm after 100 yr of paddy soil use, and decalcification of the total soil profile in 700, 1000 and 2000 yr old paddy soils. The calculation of the organic carbon stocks of each horizon indicate that paddy sites always have higher values in topsoils compared to non-paddy sites, and show increasing values with increasing soil age. The capacity of fine mineral fractions to preserve OC was calculated according to Hassink (1997). The potential capacity of paddy soil fraction to preserve OC is independently from soil age between 30 and 35.4 g OC (kg soil)-1.
However, the calculated saturation level increases from 11.7 to 19.9 g OC (kg soil)-1 from 50 to 2000 y old paddy sites respectively. With increasing duration of paddy soil use, the fine fractions indicate an increasing saturation level from 33.1% to 56.2% of the potential capacity to preserve OC. This underlines the importance of fine fractions for increasing OC storage during paddy soil evolution.
Conclusively, paddy soil management leads to an accelerated soil development compared to non-irrigated cropland sites. In addition, increasing OC stocks, especially in the fine mineral associated OM fractions underline the relevance of paddy soil management for OC sequestration.

References

Cai Z. (1996). Effect of land use on organic carbon storage in soils in eastern China. Water Air Soil Pollut 91, 383-393.
Hassink J. (1997). The capacity of soil to preserve organic C and N by their association with clay and silt particles. Plant and Soil 191, 77-87.
Zhang M., He Z. (2004). Long-term changes in organic carbon and nutrients of an Ultisol under rice cropping in southeast China. Geoderma 118, 167-179.
Zhao C. (1996). Effect of land use on organic carbon storage in soils in eastern China. Water Air Soil Pollut 91, 383-393.