Geophysical Research Abstracts
Vol. 15, EGU2013-2020, 2013
EGU General Assembly 2013

Soil mineral surfaces of paddy soils are accessible for organic carbon accumulation after decalcification

Livia Wissing

Lehrstuhl für Bodenkunde, Department Ecology and Ecosystem Management, Center of Life and Food Sciences Weihenstephan, Technische Universität München, D-85350 Freising-Weihenstephan, Germany (l.wissing@wzw.tum.de, +49.8161.71 -4466)

Livia Wissing a, Angelika Kölbl a, Peter Schad a, Tino Bräuer b, Zhi-Hong Cao c, Ingrid Kögel-Knabner a,d

aLehrstuhl für Bodenkunde, Department Ecology and Ecosystem Management, Center of Life and Food Sciences Weihenstephan, Technische Universität München, D-85350 Freising-Weihenstephan, Germany
bLeibniz-Labor für Altersbestimmung und Isotopenforschung, Christian-Albrechts Universität zu Kiel, Max-Eyth Str. 11, D-24118 Kiel, Germany
cInstitute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, PR China
dInstitute for Advanced Study, Technische Universität München, Lichtenbergstrasse 2a, D-85748 Garching, Germany

Abstract
We studied organic carbon (OC) accumulation due to organo-mineral associations during soil development on calcareous parent material. Two chronosequences in Zhejiang Province, PR China, were investigated; one under paddy cultivation with a maximum soil age of 2000 years, and the other under upland crops where the oldest soil was 700 years old.
Bulk soils and soil fractions of the uppermost A horizons were analyzed for OC concentrations and radio carbon contents. Total pedogenic iron (Fed) concentration was determined by dithionite extraction and the proportion of oxalate extractable iron (Feox) was extracted by using the method of Schwertmann (1964). The specific surface area (SSA) of soil minerals was measured by the BET-N2 method (Brunauer et al., 1938) under four conditions: untreated, after organic matter removal, after iron removal and after removal of both. Within 700/2000 years of pedogenesis, we observed no change in clay mineral composition and no additional formation of the SSA of soil minerals. But the soils differed in the degree of decalcification, OC accumulation and in the formation of iron. Paddy soil management led to an enhanced decalcification and larger OC accumulation. Management-induced redox cycles caused larger proportions of Feox in paddy soils. Their large SSA, added to the surface area of clay minerals, provided additional options for OC covering. Unexpectedly, there was no evidence of formation of secondary minerals during soil development, which could provide new surfaces for OC accumulation. However, the study revealed higher OC coverings of mineral surfaces after decalcification in paddy soils. As carbonate and Ca2+ ions seemed to interconnect clay minerals, making their surface accessible to OC, the faster dissolution of carbonate and leaching of Ca2+ ions in paddy soils made additional clay mineral surfaces available to OC. In contrast, the surface area of minerals in non-paddy soils, in which decalcification was much lower, seemed to be partly inaccessible for OC covering due to strong microaggregation by cementation with carbonate and Ca2+-bridging. The smaller accumulation of mineral-associated SOM in non-paddy soils was additionally confirmed by the retarded replacement of the inherited carbon.
The accelerated decalcification of paddy soils led to enhanced accessibility of mineral surfaces for OC covering, which intensified OC accumulation from the early stages of soil formation onward.

References
Brunauer, S., Emmett, P.H., Teller, E., (1938). Adsorption of gases in multimolecular layers. J. Am. Chem. Soc. 60 (2), 309–319.
Schwertmann, U., 1964. Differenzierung der Eisenoxide des Bodens durch Extraktion mit Ammoniumoxalat-Lösung. Zeitschrift für Pflanzenernährung, Düngung, Bodenkunde 105 (3), 194–202.