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Geoderma 128 (2005) 1–2

GEODERMA

www.elsevier.com/locate/geoderma

Editorial

Mechanisms and regulation of organic matter stabilisation in soils

Soil organic matter (SOM) influences all soil functions and represents one of the largest reservoirs of carbon on the global scale. Thus SOM is a central element in the global carbon cycle. Any change in the size and the turnover rate of SOM pools may potentially alter the atmospheric CO_2 concentration and consequently, the global climate. The subject has gained public interest since the Kyoto Protocol on climate change in 1992 which demands for fundamental understanding of mechanisms of SOM stabilisation and their regulating factors. Such knowledge is indispensable for the establishment of a sustainable management of the carbon budget maintaining or even improving at the same time major soil functions. There is a lack of expertise especially for the quantitative understanding of the relationships between formation and decomposition of stable SOM. This causes great uncertainty when simulation models of carbon turnover are used to calculate the development of C pools in soils under changing environmental conditions and different land use management. At the moment an unambiguous prognosis about the development of the different C pools in soils under changing environmental conditions and land use management is not possible.

This special issue contains selected papers from the International Conference, Mechanisms and Regulation of Organic Matter in Soils' which took place at Schloss Hohenkammer near Munich, Germany on October 5th–8th, 2003. The conference aimed to share recent findings from a broad field of different soil science disciplines and research related to this theme. We therefore invited scientists from soil physics, organic chemistry, geochemistry, sedimentology, mineralogy, zoology, microbiology, ecology, agronomy and geography to participate and share their ideas with us. The conference was also a platform for soil scientists from Germany who are currently participating in a priority program of the Deutsche Forschungsgemeinschaft: "Soils as a source and sink for CO_2-mechanisms and regulation of organic matter stabilisation in soils" to discuss results from 3 years of research in Germany with an international audience.

With this issue we present the work from the different disciplines and we point out the advantages of integration of data and the progress achieved by application and combination of some new analytical methods describing structure and turnover of SOM. With these examples we hope to encourage further collaborations between researchers and eliminate existing barriers between the different disciplines.

The volume encloses two contributions focusing on the decomposition of organic substances and the identification of precursors for the highly resistant SOM pool. The paper by Dignac et al. relates the chemical structure of plant macromolecules to their turnover. An important methodological contribution is the paper by Luis et al. which presents a new molecular method to evaluate the gene expression for laccase as a key enzyme for cycling of SOM in forest soil.

The turnover of SOM is addressed in the following five papers. To characterize and identify operational fractions of different stability, Ellerbrock et al. used sequential extraction of SOM and characterized the isolated SOM fractions by FT-IR- and $\delta^{13}C$-measurements. In order to understand the processes of SOM stabilisation, the controls of SOM mineralization have to be known. In this context the paper by Hamer and Marschner examines 'priming effects' induced by the addition of organic substances of low molecular

0016-7061/$ - see front matter
doi:10.1016/j.geoderma.2004.12.021

weight to different forest soils. Swanston et al. looked at physico-chemical controls of SOM turnover and fractionated SOM by density from a unique "field experiment" where a major ^{14}C pulse from accidental industrial emissions has provided for a short-term ^{14}C label in plant biomass to explore the rates of C turnover in temperate forest soils. There are two papers about stabilisation by spatial inaccessibility due to occlusion of organic matter by aggregation but with different foci. The paper of John et al. offers information about SOM contents, carbon ages and turnover in different aggregate sizes and density fractions in soils under different land use. Goebel et al. studied the influence of the formation of hydrophobic surfaces on SOM stabilisation with respect to both SOM mineralisation and aggregate formation.

Pools of different stability are characterized in three papers. Rethemeyer et al. measured the radiocarbon age of humic extracts and density fractions and used further compound-specific radiocarbon analysis of isolated PLFAs as biomarkers for specific carbon sources assimilated by microorganisms. There is one paper about organo-mineral associations by Mikutta et al. providing new results about the importance of poorly crystalline minerals for SOM stabilisation in coarse and fine clay fractions of acid subsoils. The production of charcoal is examined by Brodowski et al. who combined the different sources of Black Carbon, its degree of oxidation and the spatial distribution in the soil.

The following three papers are discussing the role of biological processes in SOM stabilisation. The paper of Rees et al. provides a broad review on the processes and mechanisms how plants and land management affect the carbon accumulation and carbon turnover in arable and grassland soils. Marhan and Scheu examine the effect of earthworms on mobilisation and stabilisation of carbon and nitrogen in soil. In a review by Ekschmitt et al., the apparent discrepancy between the rather omnipotent decomposing abilities of the soil microflora and fauna and a high content of organic C persisting in soil is analysed in detail.

As guest editors, we thank the authors for their presentations at the meeting and for their contribution to this issue. We are also grateful to all colleagues involved in the reviewing process which greatly improved the quality of the papers. The time and effort they devoted to this task is appreciated very much.

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