Geophysical Research Abstracts, Vol. 8, 06182, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06182

A conceptual model approach to the stable carbon pool

M. v. LÜTZOW (1), I. KÖGEL-KNABNER (1), K. EKSCHMITT (2) H. FLESSA (3),

G. GUGGENBERGER (4), E. MATZNER (5), B. MARSCHNER (6) & B. Ludwig (7)

(1) Lehrstuhl für Bodenkunde, Technische Universität München, D-85350 Freising-Weihenstephan (2) IFZ – Tierökologie, Justus Liebig Universität, D-35392 Gießen, (3) Institut für Bodenkunde und Waldernährung, Universität Göttingen, D-37077 Göttingen, (4) Institut für Bodenkunde und Pflanzenernährung, Universität Halle, D-06108 Halle, (5) Lehrstuhl für Bodenökologie, Universität Bayreuth, D-95440 Bayreuth, (6) Geographisches Institut, Ruhr-Universität, D-44780 Bochum, (7) Department of Environmental Chemistry, Kassel University,D-37213 Witzenhausen, Germany. (luetzow@wzw.tum.de / Fax: +49-8161-714466 / Phone: +49-8161-713679)

Soil organic carbon (SOC) models are required for an improved understanding of C dynamics in soils and for a prognosis at different scenarios. The major weakness of the present modelling approaches is that our knowledge is limited especially about the importance of the different mechanisms which control the formation of the passive pool in which up to 75% of SOC is stabilized.

We developed a conceptual model that integrates recent findings and a range of concepts of stabilization mechanisms especially within the passive pool that are described in the literature. The evaluation of stabilization mechanisms is demonstrated for a Dystric Cambisol soil from Germany by regarding data of pool sizes and turnover times (^{14}C) of operational soil OM fractions in relation to total soil OM and by linking environmental conditions for processes in pedogenesis to stabilization processes. Fractionation concepts include: Light fraction (LF $<$1.6 g cm^{-3}) that is controlled by recalcitrance & aggregation; demineralisation with hydrofluoric acid (HF): HF insoluble OM that is also controlled by recalcitrance & spatial accessibility; Dense fraction (DF $>$1.6 g cm^{-3}) and HF soluble fraction as mineral associated fractions; OM resistant to hydrogen peroxide oxidation (H_2O_2) to describe spatial inaccessible OM.

The analyses show that selective preservation of recalcitrant organic matter and biogenic aggregation are only important during early decomposition and in active surface

soils. Recalcitrance can not explain long-term stabilization of SOC. Spatial inaccessibility and organo-mineral interactions operate at long-term scales and dominate in subsoils. Some postulated stabilization mechanisms that characterize the formation of the passive pool are not or only weakly supported by data (intercalation, polymerization, encapsulation). We conclude that major difficulties in the understanding and prediction of SOM dynamics originate from the simultaneous operation of several mechanisms. We discuss knowledge gaps and promising directions of future research.