Geophysical Research Abstracts, Vol. 9, 02739, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02739

Decomposition of 14C labeled black carbon in soil and loess during two years

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Incomplete combustion of organics by fires of vegetation and fossil fuels leads to accumulation of charred products in the upper soil horizon. Such charred products frequently called black carbon (BC) may act as important carbon sink in soils, because its microbial decomposition and chemical transformation is accepted as very slow. Direct estimations of BC decomposition rates under soil conditions are absent, because the BC content changes are too small for any relevant experimental period and estimations based on total CO2 efflux are unsuitable because of much higher contribution of soil organic matter (SOM) and plant residues to the CO2 compared to BC. We produced BC from 14C labeled residues of Lolium perenne, incubated this 14C labeled BC in i) soil or ii) loess during 2 years at 20 °C and 60% of aWC, and estimated its decomposition rates based on 14CO2 evolved. Additionally we introduced four repeated treatments (i) with addition of glucose as energy source for microorganisms to initiate co-metabolic BC decomposition or (ii) intensively mixed the soil to check the effect of mechanical disturbance on BC decomposition. Black carbon addition amounting for 20% of Corg of the soil or 1000% of Corg of loess did not chang significantly the total CO2 efflux. The decomposition rates of BC calculated according to the 14CO2 efflux were similar in the soil and loess and amounted for about 2.7 . 10-5 d-1 resulting in the decomposition of less than 0.15% BC per year under natural conditions (7-10 °C). This showed at least centenary mean residence time of BC in soil corresponding to the residence time of very recalcitrant SOM fractions. Glucose addition slightly increased BC decomposition rates for 2 weeks in the soil, but for 3 months in the loess. Mechanical disturbance had stronger effect than glucose addition leading to additional

decomposition of 0.4% within 2 years. Considering short duration of the incubation and the common effect of decreasing decomposition rates during the incubation, we conclude that the mean residence time of BC in soils range between centuries and millenniums.