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Effects of soil erosion and deposition on CO_2 respiration

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Soil erosion, transport and deposition by water and tillage drastically affect the distribution of soil organic carbon (SOC) within terrestrial landscapes. Furthermore, soil redistribution is assumed to impact on the exchange of carbon (C) between the pedosphere and the atmosphere, through its influence on both input rates of C to the soil and accelerated/reduced decomposition of SOC. Attempts to globally asses this latter effect result in the assertion of a large net sink (1.5 Pg C yr^{-1}) as well as a net source of C (1.1 Pg C yr^{-1}). Although the answer to this debate probably resides in studying the integrative effect of the different interacting mechanisms, it remains nevertheless important to describe the basic processes that accompany SOC translocation.

The aim of this study is to provide answers to the yet unresolved question concerning the fate of SOC transported by water erosion processes. Laboratory experiments were carried out using a runoff flume whereby erosion was produced (by controlled inflow of water) on a sloping soil surface (0.8 m^2), and successively deposited on a flat downslope soil bed (1.4 m^2). The setup allowed collection of runoff samples at the in- and outlet of the depositional bed. Six experimental runs were performed, simulating three situations: erosion and subsequent deposition of dry (typical for summer events) versus wet aggregated soil and deposition of dispersed soil (typical for winter events). Evolution of CO2 was monitored with a Licor LI-8100 for 100 days on all depositional areas and one control area. The deposited soil was not disturbed during measurements.

Most of the sediment, eroded from the aggregated soils was deposited on the bed (sediment delivery ratio of 9.4 and 2.9% for wet and dry soil respectively) while up to 16.8% of the dispersed soil reached the outlet of the depositional bed. Total amount of deposited sediment varied from 2288 g m^{-2} to 6156 g m^{-2}. C enrichment ratios of the deposited soil approach unity in case of the aggregated soils. For the dispersed soil, enrichment ratios of the deposited soil vary highly over the depositional bed depending on the distance from the sediment inlet. Cumulative CO_2 respiration measured on the deposited, originally dry, aggregated soil showed an emission of C additional to the emission of the control sites of 9.7% with respect to the amount of deposited C. For the dispersed soil and the originally wet, aggregated soil, this measure amounts respectively 3.8% and –1.2%. These results suggest that erosion-induced mineralization of SOC is dependent on the kind of deposition but the overall effect is rather limited compared to the findings of previous studies on this topic.