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Carbon and nutrient availability in preferential flow paths and in matric soil of a beech forest

Subsoil organic matter (OM) is considered to play a major role in sequestering additional atmospheric CO_2. However, the processes controlling the variability of the formation of stable soil OM are largely unknown. One major pathway of OM accumulation in subsoils is related to the transport of dissolved organic matter (DOM) and its retention on mineral surfaces. A large proportion of DOM (and nutrients) is transported into the subsoil via preferential flow paths. We assume that in preferential flow paths, the large input of easily available OM fuels microbial hot spots on mineral surfaces, thus creating conditions for microbial-controlled formation of stable mineral-associated OM. In matric soil, less DOM should be translocated, and therefore, microbial activity and the availability of carbon and nutrients for microbial processes should be much smaller than in preferential flow paths. During a long-term field experiment in a beech forest, small scale patterns of water and carbon fluxes were monitored using segmented suction plates (see figure 1) installed in different depths of a beech forest. In this field experiment, ^{13}C labelled litter was used to trace the translocation of carbon in the soil profile and to differentiate between preferential flow paths and matric soil. After six years of running this experiment, the soil above the different segments of the suction plates was sampled.

The main objective of this MSc-thesis research is the analysis of these soil samples to determine the carbon und nutrient availability, the amount of the retained ^{13}C tracer and the formation of microbial biofilms as the main controls of the formation of stable mineral-associated OM. The results of the analyses should be linked to known patterns of preferential flow paths and matric soil and the pore size distribution determined by computer tomography.

The MSc-thesis research will be carried out in close collaboration with the Institute of Soil Science at the Leibniz University Hannover (Prof. Georg Guggenberger) and the Martin-Luther-University Halle-Wittenberg (Prof. Robert Mikutta).

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Figure 1: Photographs of the soil profile and a segmented suction plate (16 segments). The soil was sampled above each of the 16 segments