

## **Characteristics of organic matter fractions separated by wet-sieving and differences in density from five soils of different pedogenesis under mature beech forest.**

Svendja Vormstein, Michael Kaiser, and Bernard Ludwig

University of Kassel, Faculty of Organic Agricultural Sciences, Department of Environmental Chemistry, Witzenhausen, Germany

Forest top- and subsoil account for approximately 70 % of the organic C (OC) globally stored in soil reasoning their large importance for terrestrial ecosystem services such as the mitigation of climate change. In contrast to forest topsoil, there is much less information about the decomposition and stabilization of organic matter (OM) in subsoil.

Therefore, we sampled the pedogenetic horizons of five soils under mature beech forest developed on different parent material (i.e. Tertiary Sand, Loess, Basalt, Lime Stone, Red Sandstone) down to the bedrock. The bulk soil samples were characterized for texture, oxalate and dithionite soluble Fe and Al, pH, OC, microbial biomass C and basal respiration (cumulative CO<sub>2</sub> emission after 7 and 14 days). Furthermore, we analyzed aggregate size fractions separated by wet-sieving (i.e. >1000 μm, 1000-250 μm, 250-53 μm, <53 μm) and density fractions separated using NaPT (i.e. light, occluded light, and heavy fraction) from the soil horizon specific samples.

The OC of the topsoil (Ah horizon) on Lime Stone and Red Sandstone was predominately stored in the larger macro-aggregates (>1000 μm). In contrast, the major part of the topsoil OC on Basalt and Tertiary Sand was found in the smaller macro-aggregates (1000-250 μm). For the topsoil samples, we found that the basal respiration as well as the microbial biomass C were positively correlated ( $p \leq 0.05$ ) with the OC amounts associated with the free and occluded light fraction and with the macro-aggregates (1000-250 μm) and micro-aggregates (250-53 μm) suggesting these fractions to store the major part of the easily decomposable OM. The OC amount associated with the heavy fraction and the fraction <53 μm was correlated with the contents of oxalate and dithionite soluble Fe and Al suggesting interactions between organic compounds and Fe- and Al-oxides to be highly important for the OM stabilization in forest topsoil.

In the subsoil (horizons below the Ah), the contribution of the OC associated with the aggregate size fractions <250 μm to the OC stored in the subsoil increased with depth. The OC contents associated with the free and occluded light as well as the heavy fraction and with the aggregate size fractions >53 μm were positively correlated with basal respiration and the microbial biomass C. This suggests, in contrast to the topsoil, the easily decomposable OM to be distributed more homogeneously among fractions. Only the OC content of the <53 μm fraction showed positive correlations to soil mineral characteristics such as the contents of clay oxalate and dithionite soluble Fe or Al and no relationship to the basal respiration and microbial biomass C. This indicates the OM associated with this fraction to be most diagnostic for the amount of OC stabilized against microbial decay in the subsoil and interactions between OM and oxides as well as layer silicates to be relevant stabilization mechanisms.

The results point toward similar OM stabilization mechanisms in the analysed forest top- and subsoils but revealed differences in the distribution of easily decomposable OM within the soil matrix.