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Differences in organic matter properties and microbial activity between bulk and rhizosphere soil from the top- and subsoils of three forest stands.

Michael Herre (1), Bernd Marschner (1), Julian Heitkötter (1), and Janet Rethemeyer (2)

(1) Ruhr-University Bochum, Institute of Geography, Chair for Soil Science and Soil Ecology, Bochum, Germany (michael.herre@rub.de), (2) University of Cologne, Institute for Geology and Mineralogy, Organic Geochemistry & Radiocarbon, Germany (janet.rethemeyer@uni-koeln.de)

Very little is known about C-dynamics in subsoils, where more than 50% of the global carbon stocks are stored. The distribution of carbon in the lower soil layers is much more heterogeneous than in the topsoil due to a lower root density and preferential flow paths. Thus, the input of fresh C into these areas is limited and restricted to smaller areas, forming hotspots of microbial life. One suggested hotspot is the rhizosphere where the physio-chemical properties of the soil are directly altered through the influences of the roots.

In our ongoing study, we are investigating the differences of organic matter degradation, microbial activity distribution and the differences in the microbial community in bulk and rhizosphere soil. Samples from two depths (0-10 cm and 30-50 cm) were taken from three beech forest sites with different parent materials (Pleistocene sand, Triassic sandstone, Loess). Rhizosphere soil was considered as soil material adhering to the roots after gently shaking.

For all bulk and rhizosphere samples, basic soil properties, basal respiration, microbial biomass (Cmic) and 14C age were determined. Further, extracellular enzymes involved in C-, C/N-, N- and P-cycle were analyzed. Differences in the microbial community were analyzed using a taxon specific real time qPCR approach.

Results, showed significant differences between bulk and rhizosphere in top- and subsoil. The microbial biomass (Cmic) in the rhizosphere was up to 80% higher in the topsoil and an average 200% higher in the subsoil (SOC normalized), compared to the respective bulk samples. The biggest differences were found at the Loess site where the subsoil rhizosphere contained around 450% more Cmic than the bulk soil (SOC normalized). We also found an average 100% and 300% higher SOC content in the rhizosphere in both top- and subsoil. The microbial community structure changes significantly with increasing soil depth. The qPCR results for all sample sites showed a higher diversity and abundance in the rhizosphere compared to the respective bulk samples in both topsoil and subsoil. Contrary to our initial thoughts, the SOC-normalized basal respiration at the Triassic sandstone and the Pleistocene sand site showed no significant differences between bulk and rhizosphere in both depths. At the Loess site however, a significant higher respiration in the subsoil bulk compared to the rhizosphere soil was detected.

These results show that the rhizosphere is a hotspot for microbial activity, which is more pronounced in the subsoil where the relevance of these hotspots is important for the C-turnover.