

Subsoil organic carbon dynamics in temperate grassland floodplains

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The awareness about floodplain soils being an important reservoir of deep soil organic carbon (SOC) is growing and there is an increasing number of research dedicated on SOC in these ecosystems. Due to its inherent OC stocks, floodplains are highly productive sites. Most of them are regulated, drained and agriculturally used in Central Europe, but processes in the subsoils of agriculturally used floodplains have not been fully understood yet and the chemical characteristics of subsoil OC are largely unknown. We therefore wanted to bring some light into this research gap and examined the distribution and composition of the SOC in an agriculturally used floodplain in Bavaria, Southeast Germany. We used a combined methodological approach to monitor the diverse responses of SOC on the environmental modulations of the system.

Radiocarbon analysis of the bulk soil revealed a young OC fixation age in deep soil layers, confirming the relatively young formation of the site by the deposition of OC-rich sediments. We used density fractionation to separate particulate organic matter (POM) from organo-mineral fractions and found that the floodplain stored surprisingly high proportions of POM in the subsoil. The composition of this POM was analyzed by solid-state ^{13}C NMR spectroscopy and ranged from weakly decomposed OC in the topsoil to strongly decomposed, lipid-rich and charred OC in the less-aerated subsoil. For a better insight into the prevailing redox conditions we measured the ratio of oxalate-soluble Fe oxides to total Fe oxides and found an increasing proportion of poorly crystalline iron oxides with soil depth, showing the direct impact of recent drainage measures in the deeper subsoil layers. With this approach we were able to reconstruct the transition of the study site from a highly dynamic natural ecosystem to an anthropogenically highly modulated and agriculturally used land form. The amount and composition of subsoil OC found in these soils display that its OC stocks are highly vulnerable for oxidation in case of further disturbances, such as erosion or drainage.