Soil organic carbon dynamics of an alpine chronosequence

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Soil Organic Carbon (SOC) is a vastly complex mixture of biomolecules that can theoretically be divided into various chemical and physical 'pools'. These form in reality a continuum of size, functionality, degree of association with the mineral fraction, aggregation, or protection against water-soluble microbial enzymes. Knowledge of SOC turnover rates is very important for the quantification of soils as sources and sinks of atmospheric CO2 - the recalcitrant or stabilized fraction being ultimately responsible for long-term terrestrial carbon storage. Molecular scale analysis of soil organic compounds and their stable and radio-isotopic composition has been an effective tool to increase the still limited understanding of the processes and mechanisms that lie behind SOC dynamics [1]. Newly formed or exposed landscapes provide a natural experiment to investigate the build-up of the soil organic matter and its composition through time, and the roles various mechanisms of OM stabilization may play. We present insights in the early development of high Alpine soils that were gradually exposed after glacier retreat in Central Switzerland. An exponential increase in TOC content along the 150 year long chronosequence clearly shows initial SOC accumulation. Chemical and physical separation techniques combined with chemical fingerprinting techniques of size and density fractions along the chronosequence gives a first insight in the build-up and relative importance of such-defined SOC pools through time. Analysis of a suite of specific biomarkers that can be detected using various analytical techniques gives further insight in the sources of SOC, e.g. plant input and fungal or bacterial (re)cycling, and their relative importance in younger and older soils. More specifically, the use of radiocarbon analysis as natural tracer for the age of various organic carbon pools and compounds is explored. Comparison of the radiocarbon content of physically and chemically separated fractions already gives insight in the mean residence time (MRT) of these fractions.

References [1] Amelung, W., Brodowski, S., Sandhage-Hofman, Bol, R. (2008). In: Sparks, D.L. (Ed) Advances in Agronomy Vol. 100, Academic Press, Burlington, USA, pp. 155-250.