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Early evolution of the soil organic matter pool as measured on a high alpine chronosequence using organic geochemical and (radio)isotopic techniques

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Knowledge of soil organic matter (SOM) turnover rates is very important for the quantification of soils as sources and/or sinks of atmospheric CO_2 and other greenhouse gases. One of the main factors limiting our knowledge of organic matter cycling in soils is its complexity, which ranges from fresh fragments to recalcitrant phases. Hence an understanding of soil organic matter dynamics requires the separation of distinct phases of different stability. Refractory organic matter makes up approximately half of the SOM pool due to its resistance to degradation and it is this pool that is ultimately responsible for long-term terrestrial carbon storage. Reasons for its recalcitrance may be intimate association with the mineral fraction, caused by adsorption, or physical protection against water-soluble microbial enzymes by micropores inside soil aggregates. Protection may also be provided by the hydrophobic nature of some organic matter. To investigate the roles these variable mechanisms play, the location and composition of SOM is analyzed from soils along a chronosequence in a glacial forefield. Over the course of around 150 years a clear succession of the vegetation has occurred and the general pattern of soil carbon content increase is exponential through time. Chemical and physical separation techniques combined with general chemical profiling, as well as analysis of specific compounds, gives insight in the buildup and relative importance of the various pools of SOM over time, when analyzed over the course of the chronosequence. Special attention is given to the use of radiocarbon analysis of the various fractions as well as of specific compounds, as a tool to elucidate the stability

of the various components and fractions that make up SOM.