# Alpine grassland soils contain large proportion of labile carbon but indicate long turnover times



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Alpine soils are expected to contain large amounts of labile carbon (C) which may become a further source of atmospheric carbon dioxide (CO(2)) as a result of global warming. However, there is little data available on these soils, and understanding of the influence of environmental factors on soil organic matter (SOM) turnover is limited. We extracted 30 cm deep cores from five grassland sites along a small elevation gradient from 2285 to 2653 ma.s.l. in the central Swiss Alps. Our aim was to determine the quantity, allocation, degree of stabilization and mean residence time (MRT) of SOM in relation to site factors such as soil pH, vegetation, and SOM composition. Soil fractions obtained by size and density fractionation revealed a high proportion of labile C in SOM, mostly in the uppermost soil layers. Labile C in the top 20 cm across the gradient ranged from 39.6-57.6% in comparison to 7.2-29.6% reported in previous studies for lower elevation soils (810-1960 ma.s.l.). At the highest elevation, MRTs measured by means of radiocarbon dating and turnover modelling, increased between fractions of growing stability from 90 years in free POM (fPOM) to 534 years in the mineral associated fraction (mOM). Depending on elevation and pH, plant community data suggested considerable variation in the quantity and quality of organic matter input, and these patterns could be reflected in the dynamics of soil C. (13)C NMR data confirmed a relationship of SOM composition to MRT. While low temperature in alpine environments is likely to be a major cause for the slow turnover rate observed, other factors such as residue quality and soil pH, as well as the combination of all factors, play an important role in causing small scale variability of SOM turnover. Failing to incorporate this interplay of controlling factors into models may impair the performance of models to project SOM responses to environmental change.

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