

Turnover time and temperature sensitivity of active soil carbon fractions from alpine soils

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Temperature is one of the most important factors controlling soil organic matter (SOM) decomposition, but the relationship between temperature and SOM decomposition processes under field conditions is still not sufficiently understood. The steep thermal gradients over short distances in alpine terrain provide an opportunity for testing long-term effects of contrasting temperatures in an otherwise similar environment. The aim of this study was to determine the amount of unprotected or active SOM in topsoil samples taken along an elevation gradient in the Swiss Alps, to estimate turnover rates by means of ¹⁴C dating, and to derive a relationship between decomposition rates and site-specific mean temperature. Turnover times calculated using ¹⁴C measurements and atmospheric ¹⁴C records from either England or Austria yielded different results. Estimates of turnover times and temperature dependencies of unprotected OC were more plausible when using atmospheric ¹⁴C records from a site with similar characteristics (Vermunt, Austria). Results obtained with these ¹⁴C data indicated a stronger apparent sensitivity of SOM degradation to temperature than expected from literature data. The fraction of unprotected OC in soil increased with increasing altitude or decreasing mean annual temperature (Figure 1), and it revealed a higher sensitivity to temperature than reported for soils in other regions, possibly due to the high share of belowground input and the low degradability of root litter. Because of the large fraction of highly-temperature sensitive, unprotected SOM at the highest site (86% of total SOM), it is suggested that alpine soils may turn into a considerable CO₂ source with increasing global warming.

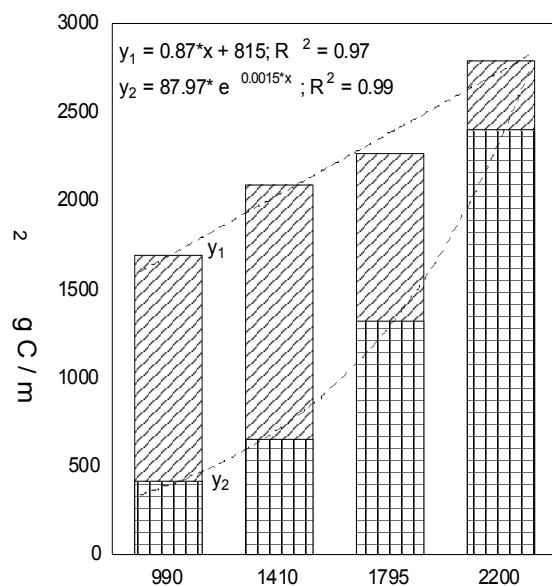


Figure 1: Organic carbon amounts in the top 5 cm partitioned into unprotected (chequered) and protected (criss-cross lined) SOM fractions with the corresponding linear fit equations of total organic carbon and exponential fit equation of unprotected organic carbon.