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Acceleration of organic matter decomposition after the input of available substrate in subsoil horizons

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Input of available substrates to soil can alter microbial activity resulting in accelerated turnover of native soil organic matter (SOM), i.e. cause priming effects (PE). Following to Fountaine et al. (2007) we hypothesized that the stability of SOM in deep soil horizons is due to the lack of input of fresh organic substrates. We also hypothesized greater PE in mineral versus organic soil horizons. These hypotheses were checked by the comparison of priming effects induced by 14C-glucose in organic and mineral horizons of modern as well as of paleo-soils (podzol sandy soil Yamalo-Nenezky region, Tumen). The following variables were determined in 50-days incubation experiment: 1) dynamics of CO2 evolution; 2) 14CO2 originated from the added glucose; 3) microbial biomass C by substrate-induced respiration; 4) activities of extracellular enzymes (β-glucosidase, chitinase, cellobiogidrolase and xylanase) with fluorogenically labeled substrates.
Maximal intensity of SOM mineralization as well as of enzyme activities was observed at 2 -7 days after glucose application. The absolute values of PE were 10 times greater in modern as compared with buried horizons of paleo-soils. However, the relative increase in carbon mineralization (as compared with control soil without glucose amendment) was greater in buried than in modern soils, especially in mineral soil horizons. In organic horizons the PE amounted for 20 and 50 % of untreated control in modern and in paleo-soils, respectively. In mineral horizons the PE amount (in % of control) reached 60 % for modern and 250 % for paleo-soils. We conclude that the input of fresh organic matter in paleo-soils as well as in deep soil horizons can induce greater PE as compared with topsoil layers. This conclusion was further confirmed by the increased activity of hydrolytic enzymes during PE in modern and in buried soils.

Reference:
Fontaine S, Barot S, Barre P, Bdioui N, Mary B, Rumpel C (2007) Stability of organic carbon in deep soil layers controlled by fresh carbon supply. Nature 450:277–280