Biological controls of organic matter stabilisation by mineral interactions

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The amount of persistant soil organic matter is important for many ecosystem functions. The aim of this paper is to investigate the impact of soil biota on its formation and residence time. We investigated the effect of earthworms on organic matter (OM) degradation and the formation of organomineral complexes, known to protect OM from microbial decay. We carried out a laboratory experiment using a model system consisting of fresh OM incubated with and without epigeic worms (*Eisenia Andrei* and *foetida*) in presence of different amounts of phyllosilicates (kaolinite, montmorillonite) and an iron oxide (goethite) or their mixture. We monitored CO_2 mineralization during 196 days, investigated the chemical composition of the end products and characterised the microstructure of organomineral interactions. Moreover, we tested the stability of these materials after exposure in soil.

During the decomposition experiment, earthworms enhanced C mineralisation in all treatments. Reduction of C emissions as compared to the control could be achieved by mineral addition. In earthworm treatments, this reduction depended on the type and amount of minerals added, with greatest reductions occurring after addition of montmorillonite or a mixture of goethite/kaolinite. The presence of worms also decreased the contribution of water soluble C (WSOC) and impacted the chemical composition of the final product, through increasing contribution of aromatic C. Observations with transmission electron microscopy showed that worms also influenced the microscale organisation of organomineral complexes. Our data suggest that clay-sized minerals stabilized carbon mainly through associations with degraded organic matter, while worm presence also favoured the adhesion of intact OM onto mineral surfaces. Consequently the endproducts formed with earthworms were more stable after exposure in soil.

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