

Associations of organic matter with mineral as affected by anecic earthworm activity: a case study from subtropical forest ecosystem

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Feeding and casting activity of macrofauna in soil may strongly control the interaction of organic matter and soil mineral thereby affecting biogeochemical cycling of biophilic and pedogenic elements. However, the nature of the interaction remains poorly understood. In this study, we hypothesized that earthworms promote the organo-mineral interaction and the degree of the interaction depends on their diet composition. To test the hypothesis, we collected and compared fresh (< 24 hours, n=5) and old casts (n=10) of anecic earthworm *Amyntas yambaruensis*, and adjacent surface soils (n=10) as control in Yona, University Forest, University of the Ryukyus, in the northern part of Okinawa Island, Ryukyu Islands. We measured TOC and TN contents, specific surface area (SSA) by N₂-BET, SSA after removal of organic matter, contents of metals (Fe, Al, Si) extracted by the sequential selective dissolution by acid oxalate (Fe_o, Al_o, Si_o), and by dithionite-citrate (Fe_{dc}, Al_{dc}, Si_{dc}), and C form by solid-state ¹³C-CPMAS NMR. The TOC and TN contents were three times higher in fresh and old casts than in soils, and the C:N ratio decreased in the following order: fresh cast > old cast > soil. Roughly 40% of TOC was present in the form of O-alkyl C in fresh and old casts and its proportion declined with decreasing C:N ratio in soil. While intact soil SSA in fresh and old casts were 80% lower than the control soils, the SSA after organic matter removal was comparable in all samples. These results indicated the coverage or occlusion of mineral surface by organic matter particularly in earthworm casts. Fe_o, Al_o, Si_o, Al_{dc} and Si_{dc} in fresh and old casts were 2-4 times higher than soil, and Fe_{dc} was no differences between casts and soil. These results suggest that the physicochemical property of earthworm cast reflects the diet composition (e.g., litter vs. soil) and earthworm feeding may enhance the organo-mineral interactions and mineral weathering. Current study showed rather rapid and continuous effect of earthworm on soil biogeochemical processes in the studied forest ecosystem.

Keywords: organo-mineral interaction, specific surface area, mineral weathering, earthworm