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Aligning earthworm activity and microbial necromass formation in mineral soil

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Microbial necromass is regarded as a central pool of soil organic carbon, whose management is critical in efforts to reduce atmospheric CO₂ concentrations and mitigate climate change. However, recent concepts on soil organic matter formation have ignored one of the most important factors for the formation and stabilization of microbial necromass in many soils: earthworms. Based on recent evidence, we conceptualize how the ingestion and mixing of mineral particles and organic matter by earthworms temporarily convert the egested soil to a hotspot of quick and efficient microbial growth and turnover, in which increased amounts of necromass tightly bind to mineral surfaces and stabilize within aggregates. We further stress the low dependence of this process on the quality of pre-existing soil organic matter (in contrast to the assumptions of recent concepts) and its high relevance to the resilience of soil carbon to external disturbances in extensive regions of the soil remote from classical hotspots of microbial necromass formation. We finally provide suggestions on how to close remaining research gaps.