Perspective

The importance of anabolism in microbial control over soil carbon storage

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Studies of the decomposition, transformation and stabilization of soil organic matter (SOM) have dramatically increased in recent years owing to growing interest in studying the global carbon (C) cycle as it pertains to climate change. While it is readily accepted that the magnitude of the organic C reservoir in soils depends upon microbial involvement, as soil C dynamics are ultimately the consequence of microbial growth and activity, it remains largely unknown how these microorganism-mediated processes lead to soil C stabilization. Here, we define two pathways—*ex vivo* modification and *in vivo* turnover—which jointly explain soil C dynamics driven by microbial catabolism and/or anabolism. Accordingly, we use the conceptual framework of the soil 'microbial carbon pump' (MCP) to demonstrate how microorganisms are an active player in soil C storage. The MCP couples microbial production of a set of organic compounds to their further stabilization, which we define as the entombing effect. This integration captures the cumulative long-term legacy of microbial assimilation on SOM formation, with mechanisms (whether via physical protection or a lack of activation energy due to chemical composition) that ultimately enable the entombment of microbial-derived C in soils. We propose a need for increased efforts and seek to inspire new studies that utilize the soil MCP as a conceptual guideline for improving mechanistic understandings of

the contributions of soil C dynamics to the responses of the terrestrial C cycle under global change.

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