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Is Soil Carbon Protection Controlled by the Intermittent Nature of Anoxic Microsites?

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Reduction-Oxidation (redox) conditions are known to be a limiting factor on carbon mineralization in hydric soils. However, their influence on carbon cycling in upland soils has been largely overlooked. Increasingly, redox heterogeneity in upland soils, defined by anoxic microsites, has been suggested to slow carbon mineralization in bulk oxic soils. Yet, anoxic microsites have also been observed to host reductive iron dissolution, which may liberate mineral-associated organic carbon and accelerate soil carbon mineralization. The balance between these processes and whether they are influenced by the intermittent nature of anoxic microsites has yet to be defined. Anoxic microsites often form around particulate organic matter and are subject to fluctuating redox conditions with wet/dry cycles. In this study we consider the long term effects of varied redox fluctuations on soil carbon cycling via repeated wetting of particulate organic matter-based anoxic microsites. Using soil mesocosms integrated with planar optode sensors, we observe the formation of anoxic microsites following repeated wetting events at various intervals. We monitor mineral-associated organic carbon loss through microdialysis-based solute sampling of reduced Fe and dissolved organic carbon, while greenhouse gas measurements reveal the climate mitigation potential (or lack thereof) of anoxic microsites. Our results have implications for soil carbon cycling under changing precipitation regimes.