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Stabilization Mechanisms of Soil Organic Matter in Eroding Watersheds: Implications for Erosion induced Terrestrial Carbon Sequestration

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The terrestrial biosphere is dominated by sloping landscapes where biogeochemical cycling of essential elements is controlled by the geomorphic, pedogenic, and ecological processes that shape them. Soil organic matter (SOM) dynamics in such dynamic landscapes is greatly influenced by process of soil erosion Here we determine the contribution of three classes of stabilization mechanisms (physical isolation inside aggregates, chemical interaction with soil minerals, and changes in molecular architecture of SOM) for protection of SOM from decay in different types of eroding and depositional landform positions. We found that the depositional positions have high C inventory, and are generally more effective in C stabilization than the eroding positions. But, the effectiveness of different stabilization mechanisms greatly depends on the nature of the landform positions considered. Our findings show that protection of SOM by physical isolation inside aggregates and chemical association of organic matter (OM) with soil minerals are more effective in poorly drained depositional settings, compared to the well-aerated ones. Using ^{13}C-NMR we showed that SOM in depositional settings is less transformed, better preserved, than SOM in eroding landform positions. In this study, we demonstrate that the nature of landform position where eroded SOM is deposited on exerts a critical control on its stability and mechanisms of its stabilization post-deposition.