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Short and long-term controls of SOM dynamics in a South African Landscape

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We used the variations in parent material, climate and topography found in Kruger National Park, South Africa, to investigate the most important factors controlling carbon dynamics in savannah soils. Carbon dynamics were investigated using radiocarbon signatures of carbon in density-separated organic matter and in CO_2 respired during incubation of surface soils. Carbon respired in incubations of 0-2cm and 2-8 cm depth intervals had a narrow range of 14C signatures regardless of the parent material, topographic position or climate conditions. The 14C values indicated that the C contributing to decomposition was fixed on average <1 to 5 years previously. Vegetation was apparently linked to these variations. The respired C with highest 14C signature also had the lowest 13C signatures, indicating more C3 (woody) plant influence. The 14C signatures of C in the low-density fraction (<1.7 or 1.9 g cm-3) had a larger range of 14C signatures than respired CO_2, again with highest 14C signatures (indicating ages of up to a decade) in C that also had more C3-enriched 13C signatures. Charred material is found in the low density fraction which may explain why its 14C signature differs from that of respired CO_2 in these fire-prone landscapes. The age of carbon in the dense fractions was considerably older (up to several thousand radiocarbon years) and strongly related to soil clay content, which in turn reflects a combination of parent material and landscape position. Overall, the age of all organic carbon in these soils was much less than the age of the soil itself, and also less than the age of pedogenic carbonates found in some of the soils. Parent material and landscape position both play a strong role in the storage of carbon across these landscapes over longer timescales. Indirectly, these factors control vegetation patterns, which in turn influence the age of faster cycling carbon in this savannah system.