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^{13}C-natural abundance of soil organic carbon decomposition shows a significant difference in decomposition rates of C3- and C4-derived organic matter in mixed C3/C4 soils

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It is often assumed that C3- and C4-derived organic carbon can be traced separately as naturally ^{13}C-labeled materials. Here we report on long-term incubation experiments that demonstrate a two-fold difference in the rate of decomposition of C3- and C4-derived "active" soil organic carbon (total SOC minus oxidation resistant elemental carbon, OREC). We applied natural abundance ^{13}C-labelling to soils collected from across Australia's major environmental gradients to separately quantify decomposition rates of SOC derived from C3 and C4 biomass. Comparison of stable isotope data from pre- and post-incubation samples show that the average decomposition rate for C4-derived active ASOC is, on average, twice that for C3-derived ASOC. These results have important implications for many aspects of carbon cycle science and paleoecology. The difference in decomposition rates accounts for measurements of anomalously ^{13}C-depleted SOC in many regions of Australia otherwise modeled as C4-dominated ($>$80% C4 photosynthesis). The experiments also suggest that the fractional representation of C4-biomass in the heterotrophic CO_2 flux from soil to atmosphere is more than twice the C4 representation in the ASOC pool, which should be considered in global models of biosphere-atmosphere C exchange. Finally, the fraction of C4 photosynthesis and its fractional representation in the SOC pool cannot be assumed to be equivalent by studies that use the ^{13}C/^{12}C ratio of SOC in modern soils or paleosols to infer past changes in vegetation or climate.