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Soil microbial carbon turnover decreases with increasing molecular size

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It is well established that soil microorganisms play an important role in respiration of newly fixed plant carbon. Recent results show that they also contribute significantly to soil organic matter (SOM) formation. We hypothesized that different molecular size classes of compounds in soil microbial biomass (SMB) have variable turnover time and in consequence influence SOM formation differentially. Here we used natural differences in carbon stable isotope signatures (δ^{13}C values) after C3-C4 vegetation change to track newly fixed C4 plant carbon into SMB molecular size classes. SMB was obtained by chloroform fumigation extraction and δ^{13}C values of its size classes were measured using size exclusion chromatography coupled online to liquid chromatography-isotope ratio mass spectrometry (SEC-LC-IRMS). Resolved SMB was assigned to 5 size classes: 1800-9800 Da, 800-1800 Da, 380-800 Da, 180-380 Da and 50-180 Da. The contribution of recent C4 plant carbon to size classes of SMB decreased with increasing molecular weight (MW). It ranged from 77$\pm$19% in the lowest MW size class size class to 41$\pm$14% in the 1800-9800 Da size class in 'Sandy' soil and from 59$\pm$18% in the lowest MW size class to 8$\pm$15% in the highest MW size class in 'Clayey' soil. A decreasing carbon turnover of compounds in SMB extracts along a continuum of molecular size from small to large implies that low molecular weight microbial compounds are rapidly metabolized products that link to fast respiratory carbon fluxes, whereas high molecular weight ones could be products of microbial synthesis like structural compounds that have slower turnover rates and link to slower SOM formation.