# Planting Carbon in Soil: How Mineral Interaction with Plant-Derived Carbon May Lead to Carbon Persistence

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The persistence of carbon (C) in soil is a fundamental ecosystem property, yet the mechanisms that regulate the soil C pool remain elusive. Mineral surfaces provide key sites for C stabilization in soils, protecting soil organic matter (SOM) from microbial degradation. Plant roots are a dominant source of C in soil, via exudation by living roots, or, when they die, decomposition. Here, we examine the persistence of SOM on mineral surfaces in soil on different mineral types and with two root C sources: $^{13}$C labeled fresh rhizodeposits and $^{13}$C root detritus. Our work takes a microbe-centric approach, examinging how microbial tranformation of SOM and microbial cells as a component of SOM are key factors in the persistence of SOM on mineral surfaces. We grew *Avena barbata*, a Mediterranean annual grass, with 99 atom% $^{13}CO_2$ and traced $^{13}$C from roots into soil microcosms where we incubated density-fractionated soil minerals and three pure minerals: Iron-oxide coated quartz, kaolinite, and quartz. After senescence, $^{13}$C roots were collected, dried, and incubated in soil microcosms with the same mineral types. Mineral-associated microbial communities and C associations were characterized by 16S and ITS Illumina sequencing, total C, $^{13}$C, $^{13}$C-NMR, ICP-MS, STXM, and NanoSIMS. SOM associated with minerals incubated in the rhizosphere had a distinct composition, with a clear enrichment in aromatic compounds. These aromatics are likely derived from the bulk soil, suggesting that active root growth and exudation may stimulate remobilization of SOM. In sequential extractions, targeting specific mineral-SOM associations, $^{13}$C labeled SOM persisted on kaolinite minerals, but not on iron-oxide coated quartz or quartz. Thus, kaolinite appears to be effective at retaining recent, plant-derived C.