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# Examining the role of plant root exudates in formation and disruption of soil organo-mineral associations

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Organic compounds exuded by plant roots can form organo-mineral associations through physico-chemical interactions with soil minerals but can disrupt existing organo-mineral associations by increasing their microbial decomposition and dissolution. The controls on these opposing processes are poorly understood, as are the chemical and spatial characteristics of these associations which may explain gain or loss of organic matter at the root-soil interface termed the rhizosphere. By pulse-labeling with $^{13}CO_2$, we found that maize root exudates increased organic matter in the rhizosphere clay size fraction and decreased organic matter in the silt size fraction, and that organic matter loss was mitigated by dry conditions. The silt and clay size fractions were characterized by contrasting specific surface area and mineral composition, which likely explain the opposing response to root exudates. These findings suggest that lumping silt and clay particles into a single MAOM size fraction may conceal nuanced processes of organic matter dynamics. Using spectromicroscopic techniques - NanoSIMS and STXM-NEXAFS - we found that organic matter associated with rhizosphere clay particles was linked to microbial metabolism of exudates and was more spatially and chemically heterogeneous than non-rhizosphere clay particles. Our findings show that root exudates can simultaneously form and disrupt organo-mineral associations, mediated by mineral size and composition, and soil moisture.