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# Process-oriented modelling of organo-mineral interactions in a depth resolved microbial SOC model

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The research on soil organic matter dynamics has seen a paradigmatic shift regarding which processes determine the persistence of soil organic matter in soils. The interaction between microbial decomposition and association of organic matter with the soil mineral matrix has been identified as pivotal for understanding the formation of soil organic matter. Yet, the stabilization of organic matter on soil minerals is currently not explicitly considered in the soil modules of earth system models. Using a vertically integrated SOM model (COMISSION, Ahrens et al. (2015), Soil Biology and Biochemistry, 88, 390-402), we investigate the effect of a limited organo-mineral association capacity and its interaction with microbial processes, such as microbial decomposition and microbial necromass production.

We defined a maximum organo-mineral association capacity based on quantile regressions between the observed organo-mineral fraction and the clay + silt content. With the COMISSION model we model organo-mineral associations equivalent to a dynamic Langmuir sorption model. We suggest that plant- and microbe-derived dissolved organic matter and dead microbial cell walls can form organo-mineral associations that are protected from microbial decomposition. With this global modelling study, we show that the inclusion of organo-mineral associations provides a mechanism for long residence times of organic matter in soils. Globally, at ESM grid cell level (200 km) COMISSION captures patterns of soil organic carbon and apparent radiocarbon ages in the top- and subsoil. While COMISSION reproduces mean radiocarbon profiles across the most dominant soil orders of the compiled database, missing processes such as pelo- and cryoturbation or mineralogical control in Oxisols and Andisols explain mismatches between modelled and observed radiocarbon profiles for certain soil orders.