

## Stabilization of organic matter in soils: role of amorphous mineral phases

Wuhib Zewde Tamrat, Jérôme Rose, Clément Levard, Perrine Chaurand, and Isabelle Basile-Doelsch  
CNRS, IRD, CEREGE UM34, USC INRA, Aix-Marseille Université, 13545 Aix en Provence, France

Soil organic matter (SOM) globally contributes the largest portion of continental carbon stock. One major issue concerning this large C pool includes its instability by mineralization and erosion due to land use. The main hypothesis of this work is that physicochemical stabilization of SOM is mainly driven by interactions of organic compounds, not with mineral surfaces as classically considered, but with amorphous polymers continuously formed by the alteration of soil minerals(1-3). Our objective is to understand how nano-organomineral complexes (nCOMx) are structured at the nanoscale, assess mechanisms of their formation, and quantify the effects of their occurrence on SOM turnovers.

Due to inherent high complexity of natural samples, our methodology is based on the formation of nCOMx from both synthetic systems and natural mineral-weathered components. For the mineral component, biotite (from Bancroft, Canada) was selected. For the organic component, 3,4-Dihydroxy-L-phenylalanine, an amino acid with hydroxyl (pKa=9.95), carboxyl (pKa=2.58), amino (pKa=9.24) and an aromatic functions was chosen. The methodology aimed at developing conditions that generate biotite dissolution and nCOMx precipitation. The second step of the experiment consisted of the precipitation of nCOMx by slowly increasing pH over 3 to 12 hours of hydrolysis. Three final pH conditions were tested (4.2, 5 and 7) with Metal/Carbon ratios of 0.01, 0.1, 1, 10 and 'No Carbon'.

The first results of dissolution rates and congruency, AFM imaging, ICPMS, HR-TEM and XRD as well as XAS characterizations (transmission and fluorescence mode at the Fe K-edge) of nCOMx will be presented. Experiments and analysis techniques were designed to study these synthetic phases with regard to Si, Al, Fe and OM proportions to increase the OM proportion (as in natural soil phases) and also increase the stability of the OM phase (as in increased residence time of OM in the soil). We will focus particularly on the Fe state probed by XAS as a proxy of nCOMx polymerization state. Results showed the Fe atomic structure within the nCOMx was strongly affected by the presence of carbon and the final pH state. Higher pH allowed Fe to polymerize even at a relatively higher carbon content. The increase in concentration of OM led to a decrease in the polymerisation level of Fe amorphous polymers. High carbon composition (M:C=0.1) totally hindered development of Fe-Fe polymers. Whereas, in relatively lower carbon concentrations (M:C=1) iron polymers were exhibited for only highest pH values of 7. For an even lower concentration (M:C=10) iron polymers started to form at lower pH values of 5 and also higher. These suggest the strong dependence of soil OM complexation to inorganic amorphous polymers on pH state and relative availability of these counter parts; and thus giving a better understanding of protection of the carbon from various forms of mineralization.

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