

Assessment of soil organic matter persistence under different land uses applying a physical fractionation procedure

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The understanding of the mechanisms involved in the build-up of soil organic matter (SOM) pools with long residence time is tightly linked to the comprehension of C dynamics. Organo-mineral associations are known to be strongly correlated with the accumulation of selective preserved C forms. Adsorption to minerals, as well as occlusion within aggregates, may affect SOM protection in different ways depending on its molecular structure and pedo-climatic conditions.

In this research, we investigated changes in quantity and quality of SOM pools characterized by different protection mechanisms in coniferous and broadleaved forest soils, grassland soils, technosols and an agricultural soil with different organic amendments, in order to evaluate the influence of both land use and organic matter nature on physical and/or chemical stabilization of SOM. In particular, free (FR), intra-macroaggregate (MA), intra-microaggregate (MI), and mineral-associated (Min) fractions were separated in order to define physical and chemical mechanisms responsible for the SOM protection against degradation. All these SOM fractions were analyzed for organic C and total N concentration, and their stability assessed by thermogravimetric analysis (TD-TGA).

Preliminary data show that, for all land uses, most of the organic C (40-60%) is found in the Min pool, followed by FR (20-40%)>MI~MA. With the only exception of the FR, no significant correlations were found between the C/N ratio and a thermal stability index (H550-400/400-250) of each fraction; at the same time, a highly significant and positive correlation was found between these two parameters in all fractions isolated from agricultural soils. In particular, the thermal stability index measured in all Min fractions may be related to the more marked presence of labile compounds in this pool relative to recalcitrant compounds. Conversely, FR OM could not always represent a fresh and readily decomposable fraction. Furthermore, OM associated with soil minerals exhibits a low C/N ratio, possibly attributed to the association of proteins and peptides with the mineral phase. Future research steps will allow a better understanding of the role of molecular structure on SOM stabilization mechanisms, with a particular focus on the description of C and N compounds in organo-mineral associations.