The background of non-crystalline materials and its role in soil organic matter turnover in subtropical volcanic soils

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The high levels of soil organic matter (SOM), frequently found in soils with large content of non-crystalline minerals, are traditionally considered the result of strong organo-mineral interactions. Amorphous oxides are likely to provide active sites for SOM sequestration at the colloidal level. Considering that preservation of SOM is favoured by adsorption of humic colloids onto mineral surfaces, as well as by physical inaccessibility of particulate SOM fractions after encapsulation in the mineral matrix, some authors have recently correlated the complex fractal structure in allophane particles with the low availability of SOM to microbes and enzymes. Apart from the above extrinsic SOM stabilization factors, some studies have also considered the intrinsic recalcitrance of SOM derived from its condensed three-dimensional structures with large amounts of disorderedly arranged aromatic “building blocks”.

In order to obtain information about the role of non-crystalline minerals in the concentration and the quality of the SOM, the mineralogical composition was studied and humic substances were analyzed by 13C NMR and analytical pyrolysis in 30 sites from Tenerife Island (Spain). The sampling plots embraced a variety of progressive concentrations of amorphous materials, including seminatural and agricultural (vineyard) soils. The content of these materials (g . kg soil⁻¹) was measured from AlO + ½ FeO index, as well as in terms of P retention. In order to distinguish inorganic forms of amorphous Al, the Alp/Alo ratio was calculated, and the allophane content was estimated from (Alo – Alp)/SiO ratio.

The humic substances were isolated by alkaline extraction fielding different fractions: humic acids, fulvic acids and humin. Up to 90 main analytical descriptors of the SOM were analyzed by statistical treatments mainly non-linear multidimensional scaling and factorial discriminant analysis. Our results reveal mutual relationships between the variables to greater extent explaining the accumulation of SOM, and showed conspicuous correlations between soil mineral composition and molecular characteristics of the main SOM fractions.

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