Nanoporous clay with interesting environmental properties: carbon sink and pesticides trapping

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Abstract

A thorough understanding of the mechanisms and factors involved in the dynamics of organic carbon in soils is required to identify and enhance natural sinks for greenhouse gases. Some tropical soils, such as andosols, have 3-6 fold higher concentrations of organic carbon than other kinds of soils containing classical clays. In the tropics, toxic pesticides permanently pollute soils and contaminate cropsecosystems. Andosols retain and trap more pesticides, thereby reducing the transfer of pesticides to ecosystems, water resources, and crops. Andosols thus have interesting environmental properties in terms of carbon sequestration and pesticide retention. Andosols contain a nano porous clay (allophane) with unique structures and physical properties compared to common clays; these are large pore volume and a tortuous and fractal porous arrangement. The aim of the study is to discuss the importance of the allophane fractal microstructure for CO2 sequestration and pesticide trapping in the soil.
We show that the C content is positively correlated to the allophane content. We also measured the part of organic matter transformed in CO2 is lowered as the soils allophane content increases. In parallel the study shows that the allophane clay favor pollutants accumulation in soils, soils containing allophane release less pesticides to percolating water and crops. We show that the tortuous microstructure (which resembles a labyrinth) of allophane aggregates and the associated low accessibility inside allophane aggregates partly explains the CO2 sequestration and the poor availability of any pesticides trapped in andosols.

Keywords: pesticide soil contamination, organic matter sequestration, allophane clay, fractal soil porosity

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