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Adsorption and structural fractionation of dissolved organic matter (DOM) by soil mineral surfaces

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Dissolved organic matter (DOM) represents a small but highly reactive fraction of the soil organic matter (SOM). One of the important processes affecting the fate of DOM in soils is its interactions with mineral phases. Adsorptive fractionation of DOM by soils and minerals has been observed previously, however detailed changes in composition of DOM due to its interactions with mineral soils were not yet elucidated. In this research the adsorption and physico-chemical fractionation of DOM by soil poor with organic matter and rich with iron oxides and clay fraction was investigated.

The changes in DOM structural composition were studied using separation with polymeric resins. The following fractions were obtained: hydrophobic acid (HoA), hydrophobic neutral (HoN), hydrophilic acid (HiA), hydrophilic base (HiB), and hydrophilic neutral (HiN). Two types of DOM were studied: DOM extracted from composted biosolids (compost DOM) and DOM from Suwanee River (SRNOM).

Sorption affinity of DOM to soil mineral surfaces was source and chemistry dependent. SRNOM, which was characterized by higher content of aromatic and carboxylic groups demonstrated higher affinity to the studied soil than compost DOM. For both DOM samples preferential adsorption of HoA by soil (50-85% from adsorbed carbon) was observed. Desorption of both DOM types demonstrated significant hysteresis (up to 90-100% of dissolved organic carbon was retained by the soil after 3 cycles of desorption stages). This suggests that DOM desorption behavior was affected by HoA dominant adsorption to the soil mineral fraction, and not by DOM source.

Results of this study indicate that interactions of different types of DOM with mineral soil may result in similar changes in composition and properties of DOM both in the supernatant as well as in the adsorbed phase. The change in DOM composition due to its interaction with soil minerals may influence the interactions of pollutants with DOM and soil particle surfaces.