Characterizing the mechanisms of soil organic matter stabilization as organo mineral complexes

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Terrestrial soils constitute the principal pool of terrestrial carbon with 2300 Peta g organic carbon in the top 3 m of which 50-75% exists as < 2 μm sized organo-mineral complexes [1]. It is therefore critical to uncover mechanisms of SOC stabilization in organo-mineral complexes. Because C K- NEXAFS (Near edge x-ray absorption fine structure) spectroscopy has shown that SOC is composed of individual biopolymers of plant and microbial orgin such as lignin, polysaccharides and lipids [2], our goal was to characterize the mechanism of sorption of organic biomolecules on a dominant, and well-characterized Fe-oxide mineral, hematite.

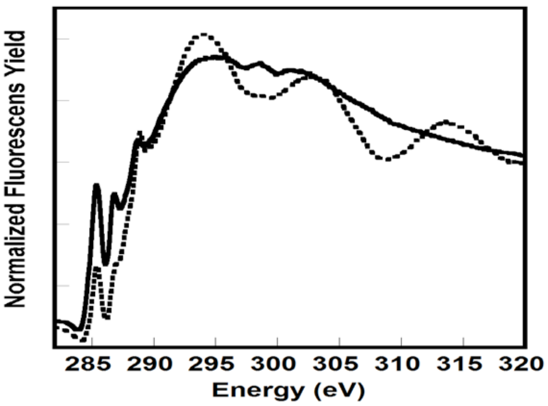
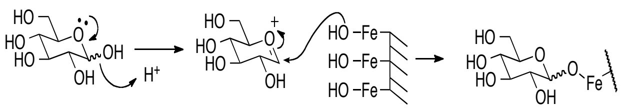


Figure 1: C K-XANES spectra of dextrose (black) and dextrose sorbed on hematite (grey) obtained in electron yield mode at Synchrotron Light Source, Wisconsin.

The C K-XANES spectrum of dextrose sorbed on hematite show marked differences compared to the spectrum for free dextrose. These changes could be attributed to C-O-Fe bonding through hydroxyl groups on heamtite as shown below. This bonding upon soprtion is hypothesized to shield organo-mineral complexes from enzymatic mineralization.



[1] Christensen (2000) *Eur. J. Soil Sci.* **52**, 345-353. [2] Lehmann *et al*, (2008) *Nat. Geosci.* **1**, 238-242.

Combining life cycle (LCA) and risk (RA) assessments of TiO_2 nanomaterials: Use of a Bayesian network

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Nanomaterials are more and more present in consumer products, and are released into environmental compartments at every stage of their life cycle. Consequently, risks associated with nanoparticles need to be characterized, even if they still include a lot of uncertainties. We will focus in this communication on the production of TiO_2 nanoparticles and their insertion in cements. An assessment tool combining lifecycle and risk assessments would allow stakeholders to make decisions based on absolute results that could be compared from one life cycle to another (e.g. comparison of the sulfate process with the chloride process for the manufacturing of TiO_2 nanoparticles). Furthermore, a wider range of impact/risk categories (e.g. terrestrial ecotoxicity, aquatic ecotoxicity, or impact on human health) would be assessed, giving a comprehensive view of the system under study.

Bayesian networks are used in the risk assessment of contaminants, especially regarding ecotoxicity [1,2]. Major advantages of these networks are that they can provide satisfying results even under high uncertainty, and that they can be readily updated as new information becomes available. Given the little knowledge acquired at present regarding environmental impacts of nanomaterials, both these points make Bayesian networks very useful for their risk assessment.

The objective of this commuication is to present a Bayesian network as a tool for the combined risk and lifecycle assessment of TiO_2 nanomaterials. A new methodology for a combined risk and lifecycle assessment could be presented, including a primary modeling structure and a new score combining the results of life cycle assessment and risk assessment.

[1] Borsuk, Stow & Reckhow (2004), *Ecological Modelling* **173**, 219-239. [2] Money, Reckhow & Wiesner (2012), *Science of the Total Environment* **426**, 436-445.

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