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Surface interactions of black carbon and soil minerals

J. Lehmann, K. Heymann, and B. Nguyen
Cornell University, Crop and Soil Sciences, Ithaca, United States (CL273@cornell.edu)

An important mechanism for stabilization of organic matter in soils is its interaction with mineral surfaces. Studies that investigate the nature and strength of such interactions have focused on non-pyrogenic materials, and examination of interactions between minerals and black carbon are scarce. In a chronosequence of black carbon ages, we can show that aluminum and silicon rapidly accumulates on black carbon surfaces after deposition to soil and reaches equilibrium after about 20 years in an Oxisol in Western Kenya. In an attempt to investigate the nature of the interaction between black carbon and mineral surfaces, we utilized near-edge x-ray fine structure (NEXAFS) spectroscopy of black carbon particles in soil aggregates and artificial mixtures of minerals and black carbon. Cluster analyses of the stack images using scanning transmission x-ray microscopy (STXM) revealed greater amounts of carboxyl contents, but also accumulation of aliphatic compounds. The latter may not stem from oxidized surfaces of black carbon particles themselves but adsorbed non-black carbon material. Mixing black carbon and minerals clearly showed changes in peak intensities of the C(1s) NEXAFS spectra indicating a chemical interaction between black carbon and mineral surfaces.