Novel spectroscopic techniques to examine soil phosphorous speciation

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Determination of soil phosphorus (P) speciation is vital for understanding P retention and transport in soils. Current methods for soil P speciation rely heavily on sequential chemical extractions which are ex situ and can introduce artifacts during the analysis procedure. To overcome limitations of current methods for examining the P speciation,non-invasive spectroscopic techniques can be used to analyze soils in situ. This study evaluates synchrotron-based techniques to elucidate mechanisms for P bonding in soils. Agricultural soils have been collected throughout the Chesapeake Bay watershed (USA) to examine P speciation. Micro-scale X-ray fluorescence (XRF) imaging and X-ray absorption near-edge spectroscopy (XANES) at the P K-edge has been performed at the X15B beamline at the National Synchrotron Light Source and the 14-3 beamline at Stanford Synchrotron Radiation Lightsource. Initial studies have used XRF to correlate the presence of P with Fe, Ca, and Al. Micro-scale XANES spectra were compared to spectra of standards with known chemical composition to identify mineral Ca phosphates and adsorbed phosphate to Al-oxides. Future studies will seek to identify additional chemical information using extended X-ray absorption fine-structure (EXAFS) spectroscopy.