



Visions for a Sustainable Planet

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[Start](#)

[Browse by
Section/Division of
Interest](#)

[Author Index](#)

271-2 Surface Loading and Time Effects On Phosphorus Sorption Mechanism Examined by Extended X-Ray Absorption Fine Structure Spectroscopy At the Goethite/Water Interface.

See more from this Division: [S02 Soil Chemistry](#)

See more from this Session: [Oxyanion Sorption and Speciation: II](#)

Tuesday, October 23, 2012

Duke Energy Convention Center, Exhibit Hall AB, Level 1



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Examining the mechanisms by which P is attached to the soil mineral matrix is imperative as they control the bioavailability, transport potential and cycling of this element in the environment. Surface speciation studies of P have been extensively carried out through the use of spectroscopic techniques, such as Fourier Transform Infra-Red (FTIR) (Tejedor-Tejedor & Anderson, 1990; Arai & Sparks, 2001) and Nuclear Magnetic Resonance (NMR) (Li et al., 2010) spectroscopies. Nevertheless, there have always been controversies surrounding the accurate determination of the P sorption mechanisms by these early techniques due to the lack of direct evidence together with the reliance of the molecular assignments on the analytical approach, which has unavoidably led to questionable conclusions (Arai & Sparks, 2007; Carabante et al., 2010).

We investigated the kinetics of the surface complexes arising at the goethite/water interface over a range of P concentrations, pH and reaction time using Extended X-Ray Absorption Fine Structure (EXAFS) spectroscopy in order to obtain detailed structural information such as next nearest neighbor and bond distance on the P surface complexes formed at the goethite/water interface.

Phosphorus K-edge EXAFS analyses were conducted at the X15B beamline at the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory in Upton, NY. EXAFS spectra were collected in fluorescence mode at the P K-edge at 2,150 eV via scans varying in energy from 2,100 to 2,750 eV.

Our results showed that bidentate surface complexes were the main bonding configuration formed at lower surface coverages, which transitioned to monodentate configuration as surface coverage increased up to 100 $\mu\text{mol m}^{-2}$. Surface precipitates were observed on the basis of calculations performed to the overall amplitude and to the individual shells.

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[<< Previous Abstract](#) | [Next Abstract >>](#)