Contaminated Soils from the Liberty State Park (New Jersey, USA) Brownfield Site

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Background/Objectives. The contaminants present in the soils of an urban brownfield reflect the type of industrial activity formerly conducted at the site. It is necessary to know the composition of such soil contaminants to better understand their potential to impact nearby aquatic systems, as well as plant, animal, and human communities. The overall goal of this study is to characterize the organic and inorganic contaminants of an urban brownfield within the 490 ha Liberty State Park (LSP) in Jersey City (New Jersey). LSP was a major railyard adjacent to the Hudson River and the Statue of Liberty that was abandoned around the year 1969 and subsequently converted to parkland. A large portion (ca. 100 ha) of LSP remains closed to the public and has undergone natural, passive revegetation. Prior studies showed significant heavy metal contamination of soils within this restricted zone. However, the organic compounds in the area have not been previously characterized. Fragments of coal are common in the soil, suggesting that organic contaminants could also be of concern. Most of the restricted zone is now densely forested, while one site (25R) curiously supports no vegetation and appears barren. Soil from a reference site (reforested farmland of similar successional timeframe and likely to be uncontaminated) in the Hutcheson Memorial Forest (HMF), Franklin Township (NJ) was also studied.

Approach/Activities. Composited soil samples from HMF and from four plots within the LSP restricted zone were solvent-extracted, fractionated, and analyzed by gas chromatography-mass spectrometry (GC-MS). The same samples were also subjected to loss-on-ignition, analytical pyrolysis-GC-MS, ICP-MS as well as optical microscopy using standard coal petrographic methods. Historic air photos of the railyard were compared with recent imagery.

Results/Lessons Learned. The forested LSP soils contain four to six times the organic matter (OM) of the reference HMF soil, likely due to the presence of coal, and 6-7 times the amount of solvent extractable OM. Coal microscopy detected both bituminous and anthracite coal, along with coke, pitch, and bottom and fly ash in the LSP soils. Major and trace element distributions in the soils showed significant heavy metal contamination (i.e., Fe, Zn, Cu, As, Pb, Cr) at levels above recommended New Jersey soil standards. Based on the GC-MS and pyrolysis-GC-MS results, we found that all forest soil samples (LSP and reference site HMF) yielded organic molecular markers for higher plants and soil microbes. Unlike the HMF soil, however, the forested LSP soils also contained significant amounts of fossil fuel-derived hydrocarbons including isoprenoids, sesquiterpanes, and hopanes, with evidence of biodegradation. Polycyclic aromatic compound (PAC) distributions indicate both petrogenic and pyrogenic contributions to the LSP soils. In contrast, HMF soils contain low PAC concentrations. Soil from the vegetation-free LSP site 25R is low in OM and its extract is distinctive, being mostly comprised of saturated hydrocarbons. Its pyrolyzate lacks high plant markers but does contain indicators of microorganisms. Investigation of the organic compounds contaminating soils may contribute to a better understanding of the overall challenges associated with an urban brownfield, especially a site adjacent to a major waterway, such as the Hudson River.