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Polycyclic Aromatic Hydrocarbon Characterization in Differing Watersheds in Northwest Ohio

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Polycyclic aromatic hydrocarbons (PAH) are ubiquitous contaminants traceable to both pyrogenic (natural) and anthropogenic (human-related) sources. Characterization of their sources can be determined using a modified method described by Stout et al. (2001). PAH contamination was characterized in three unique watersheds in Northwest Ohio. Otter Creek, deemed a dead stream, is an Area of Concern in Lucas County that has been highly altered from its original wooded character by human activities. Seven miles long, it passes through urban and industrial areas to empty into Maumee Bay and Lake Erie. The Maumee River, carrying the highest sediment load in the region, passes through rural, agricultural areas. The Ottawa River, also an Area of Concern, runs through industrial areas and municipal landfills. Sediment samples taken from both the river bottoms and 15 cm depths were collected in late 2004 and early 2005 from several sites along the waterways. The relative abundances of specific branched and unbranched PAH compounds denote their industrial, petrogenic, or biogenic origins.

Heather Clark

Characterization, Speciation and Remediation of Lead in Urban Garden Soils

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Gardening is an important element of community life and food security in the urban communities of Roxbury and Dorchester, MA that is threatened by extensive lead contamination of area soils. Our lab has formed a partnership with The Food Project, a community organization that promotes sustainable and organic agriculture, and we have been able to form relationships with many local residents to educate members of the community about the health of their soil and the potential risks they face as a result of their interactions with the soil. We have used field portable x-ray fluorescence to test over 500 soil samples and have found that 90% of samples contain concentrations of lead greater than the MA Department of Environmental Protection (MA-DEP) reportable level of 300 $\mu\text{g/g}$ lead in soil. The principle goals of our research are to: 1) characterize the spatial variability of the lead at the neighborhood scale, 2) fingerprint the sources of lead in the gardens, 3) assess the chemical speciation and bioavailability of lead and 4) devise and test a phytoremediation scheme for the area. We are using textural-analytical approaches coupled with trace element ratio analysis and lead isotope analysis to evaluate the mass balance and geochemical characteristics of the lead found in garden soils. Preliminary results indicate that lead concentrations are highest in the finest particle size of soil and that lead is often associated with an identifiable suite of trace elements. Initial observations suggest that point and non-point sources, including lead-based paint chips and particulate matter from leaded gasoline, contribute to the overall soil lead burden. Phytoremediation data is still inconclusive but eight gardens of test crops are currently being planned with sunflowers, collards and mustards as heavy-metal hyperaccumulators. A detailed geochemical assessment of lead in urban garden soils will provide insight into the severity of lead contamination in this high exposure setting and help to design a successful remediation scheme.

Xueyuan Yu

Perchlorate Reduction by Autotrophic Bacteria Supported on Zero-Valent Iron

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Recently, the presence of perchlorate contaminated ground water has been a rising concern in the USA. To treat perchlorate contaminated ground water, bioremediation is the preferred strategy as ClO_4^- is converted to chloride and eliminated from the environment. H_2 is the favored energy source for the perchlorate degrading bacteria as it does not result in excess biomass growth and can be more cost-effective than organic compounds. Biofouling is commonly encountered in laboratory and field tests when organic substrates are used. As a remediation technology, zero-valent iron (ZVI) in permeable reactive barriers (PRBs) has shown great potential for the effective treatment of halogenated organic compounds, chromate, uranium, and other oxidized elements. Unfortunately, ZVI has been shown to be ineffective in reducing ClO_4^- , in spite of the fact that the reaction is thermodynamically favorable. In this research, laboratory scale experiments were employed to test the feasibility of a novel technology (ZVI-PRM) using zero-valent iron (ZVI) support perchlorate reducing microorganisms (PRM) to remove perchlorate from water. In this process, H_2 released during corrosion of ZVI is used by the PRMs as an energy source and electron donor. Batch and column experiments were used to demonstrate the efficacy of this process and to quantify factors affecting perchlorate reduction by a *Dechloromonas* sp. supported on granular ZVI. In batch experiments, increasing degradation rates with a maximum reduction rate of 200 mg ClO_4^- /g biomass/hr was observed. In flow through column experiments, with an influent concentration of 500 ppb, effluent perchlorate was below the detection limit at a liquid velocity of 0.17 to 5.57 m/day (HRT = 2.1 to 63 hrs). No reduction of perchlorate was observed at an initial pH of 6 and 9, respectively. The reduction of nitrate was preferred to perchlorate reduction by ZVI-PRM.