Tree Sampling as a Screening Tool for Vapor Intrusion Potential to Protect Human Health

Jordan Wilson (jlwilson@usgs.gov) (U.S. Geological Survey and Missouri University of Science and Technology, Rolla, MO, USA)
Matt Limmer (Limmer@udel.edu) (University of Delaware, Newark, DE, USA)
V.A. Samaranayake (vsam@mst.edu) (Missouri University of Science & Technology, Rolla, MO, USA)
John Schumacher (jschu@usgs.gov) (U.S. Geological Survey, Rolla, MO, USA)
Joel Burken (burken@mst.edu) (Missouri University of Science & Technology, Rolla, MO, USA)

Background/Objectives. The vapor intrusion (VI) pathway has recently (2017) been implemented into the Hazard Ranking System for inclusion on the National Priorities List as a clear indication of the health impacts of VI. Assessing VI over areas is difficult and is time-, cost-, and labor-intensive, and results are temporally and spatially variable. The growing need for improved assessment efficacy poses a great challenge in protecting human health. Sampling trees is noninvasive and, unlike current VI sampling methods, does not require entry into residences and the construction of sampling ports, decreasing impact and increasing the ease in obtaining property access and greater data density. Trees are thought to be ideal screening tools for VI because they are ubiquitous active samplers of subsurface vapor and shallow groundwater in populated areas and because they are thought to sample over large spatial and temporal scales.

Approach/Activities. Tree coring was conducted at two Superfund sites (Missouri and Nebraska) contaminated primarily with perchloroethylene (PCE). In Missouri, over 600 tree-core samples were collected at the Vienna Wells Superfund site and used with over 1,000 soil, 100 soil-gas, and 50 groundwater samples to assess the environmental subsurface volume sampled by trees (footprint and depth) as well as to assess the efficacy of directional tree sampling in estimating the direction of shallow subsurface contamination. Over 100 tree-core samples were collected from the PCE Southeast Contamination Superfund site in York, Nebraska, spatially interpolated using conservative methods, and correlated to over 1,100 groundwater, 200 soil, 10 soil-gas, 250 indoor-air, and 450 sub-slab samples to assess tree sampling as a screen tool for VI potential.

Results/Lessons Learned. This work indicates tree sampling is a viable screening tool for VI potential. Results from the Vienna Wells Superfund site indicate that tree samples are representative of the shallow subsurface and of a large area similar to the footprint of a residential building. Directional tree sampling was also demonstrated to elucidate shallow subsurface contamination using *in-planta* concentration gradients, and tree sampling was shown to be correlated with VI samples, especially when environmental samples are averaged over months and years. Although these findings demonstrate that tree sampling can fill information gaps left by traditional VI assessment methods, tree sampling is best applied as a screening tool to indicate VI potential, as many site- and plant-specific uncertainties exist, which can control mass transfer of contaminants in the subsurface and in the built environment.