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Application of Phytoforensics and Phytoscreening for a PCE-Contaminated Site

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Background/Objectives. With the development of dendrochemistry and the knowledge of physical characteristics of plants, trees at contaminated sites have proven to provide useful information regarding the presence of contamination (phytoscreening) and possible release histories (phytoforensics). Contaminants can be detected in tree-core samples, and tree-core sampling and analysis is rapid, inexpensive, and does minimal disturbance during a site investigation. Analysis of tree-core samples taken from trees growing above a site characterized by chlorinated solvents can be used to map the distribution of the plume. Combining this contaminant data with variations in tree ring size and chemistry, the history of the contamination can be recorded and contamination history reconstructed. These methods were used at a tetrachloroethylene (PCE)-contaminated site located in Taiwan.

Approach/Activities. We collected 12 tree-core samples from trees located around the boundary of a PCE-contaminated site in Minsyo industrial park in Chayi County, Taiwan. The site was found in 2010 by the Taiwan Environmental Protection Administration. The highest PCE concentration in soil was about 11,000 mg/kg (4.4m ~ 5.6 m bgs). The groundwater was also contaminated with PCE at a concentration of 92.4 mg/L. This study selected four different tree species for comparison, including *Lagerstroemia speciosa*, *Bischofia javanica*, *Terminalia catappa*, and *Terminalia mantalyi*. Tree cores of two different lengths were collected for different purposes. The short tree cores were for observing the VOCs transported with uptake water from the soil, while the long tree cores were analyzed by ITRAX® for the Cl distribution detection.

Results/Lessons Learned. PCE was detected in all of the tree core samples while SH-02 (B. javanica) having the highest concentration. The PCE distribution from tree-core samples were similar to that of the previous soil and groundwater sample results, which indicated that tree-core analysis can reflect the contamination conditions of the subsurface and can help to delineate the contaminated area. However, different trees may have different CVOC transportation and accumulation characteristics. For example, the distance between a SH-11 (*T. mantalyi*) and SH-12 (*T. catappa*) was less than 2 meters. However, the PCE concentration in SH-11 was 10 times higher than SH-12. This difference may indicate the different uptake abilities between different tree species.

For the dendrochemistry, tree-core analysis results from *B. javanica* (SH-01, SH-02 and SH-03) near the hotspot showed the same variation trend on Cl signal which may imply spill issues prior to 2010. However, historical records of tree plantation time on the site is unavailable and the physical characteristics of the transformation and accumulation of Cl are unclear. Hence, more information is required for utilizing this technology to trace back the time of the release.

This was the first successful case of phytoforensics and phytoscreening in Taiwan funded by the Taiwan EPA. A standard sampling and analytical procedure for phytoforensics and phytoscreening was established in this study. More field and experimental data from different trees and contaminated sites should be collected to test the effectiveness of this technology for site screening and environmental forensic purposes.