Mercury Source Zone Identification and Characterization

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During past operations at industrial facilities like the Department of Energy (DOE) Y-12 National Security Complex (NSC), Oak Ridge, Tennessee, large quantities of elemental mercury (Hg) were inadvertently released to the environment resulting in extensive soil and groundwater contamination. Subsequent transport of Hg into nearby surface water has resulted in uptake by fish and other biota. The spatial distribution and forms of Hg present in the subsurface at these sites is poorly understood, making it difficult to select effective remedial actions and assess their potential effectiveness and cost. Development and demonstration of reliable measurement tools that can detect and help quantify the nature and extent of mercury in the subsurface are needed to reduce these uncertainties and increase the effectiveness of remedial actions. Our recent laboratory and field tests at the Y-12 NSC have shown that sampling and analysis of Hg vapors in the shallow subsurface (<0.3 m depth) can be an excellent indicator of the location and extent of Hg(0) releases in the subsurface. Several analytical methods including total Hg digest/Zeeman atomic absorption detection, sequential extraction, and SEM were used to quantify and characterize Hg in soil samples (n>75) collected from an area with known Hg contamination. Controlled head space analysis of this Hg contaminated material in the laboratory indicates that even very low level Hg vapor concentrations are indicative of the presence of Hg(0). We constructed a pushprobe assembly, which was driven into the ground. Soil gas samples were collected through a sealed inner tube of the assembly and analyzed immediately in the field with a Jerome or Lumex Hg analyzer. Time-series sampling showed that Hg vapor concentrations were fairly stable over time suggesting that the vapor phase Hg was not being depleted and that the results were not very sensitive to the purge volume. Hg vapor data collected at over 200 pushprobe locations at 3 different release sites correlated well to areas of known Hg(0) contamination in the subsurface. These results suggest that soil gas sampling and analysis can be conducted rapidly and inexpensively on a large scale to help identify areas contaminated with elemental Hg.