

Mercury Source Zone Identification using Soil Vapor Sampling and Analysis

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U.S. DOE EM32 Remediation of Mercury and Industrial Contaminants Applied Field Research Initiative

TECHNOLOGY NEED

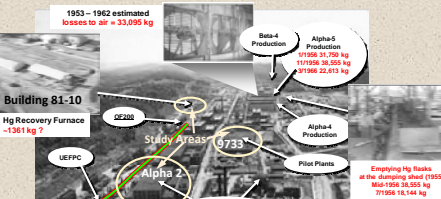
Where is the mercury?

•Large releases of elemental mercury at the Department of Energy (DOE) Y-12 National Security Complex (Y-12), has created extensive soil, groundwater and surface water contamination.

•Magnitude and spatial distribution of the Hg spills is poorly understood.

•Uncertainty in the nature and extent of Hg releases makes it difficult to design remedial actions and assess 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.



Use of Hg in U production activities at Y-12 has resulted in total known accidental losses to ground ~194,100 kg



Hg found in pipelines and building structures



Hg beads in soil cores collected from the Building 81-10 former Hg retort facility



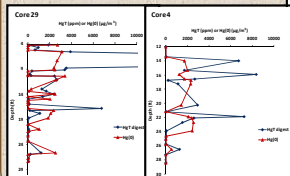
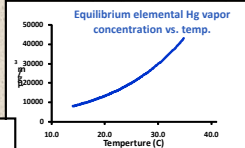
Hg migrates to East Fork Poplar Creek and accumulates in biota and food chain

MERCURY SOURCE ZONE LOCATION

The concept

•Elemental Hg vapor pressure at 20°C = 0.0012012 torr which equates to a saturated equilibrium vapor concentration of 13,200 ug/m³.

•Reliable real-time Hg field instruments have low detection limits and should provide a good indication of subsurface Hg vapor concentrations.
-Lumex @ 1ug/m³
-Jerome Meter @ 6 ug/m³



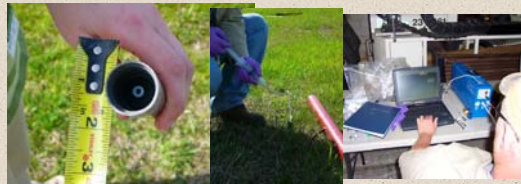
•Analysis of contaminated soil cores containing elemental Hg show elevated Hg soil vapor readings in the lab are associated with elemental Hg in the samples.

Mapping the extent of surface and subsurface Hg spills using soil gas sampling and analysis techniques should be possible.

SAMPLING AND ANALYSIS TECHNIQUES

•A 1.9 cm diameter rigid PVC pushprobe assembly, was driven into the ground approximately only 30cm deep to avoid utilities and the need for obtaining penetration permits.

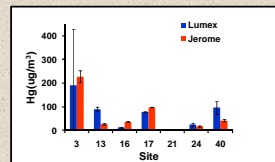
•Soil gas samples were collected through a sealed inner tube of the assembly and analyzed immediately in the field with a Jerome or Lumex Hg analyzer.



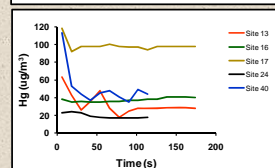
INITIAL METHOD AND FIELD TESTING

•Field testing was conducted to determine comparability and repeatability of field measurements using Lumex and Jerome Hg analyzers.

•Field testing was conducted with the Jerome meter to determine if soil vapor sampling and analysis results are sensitive to purge volume.



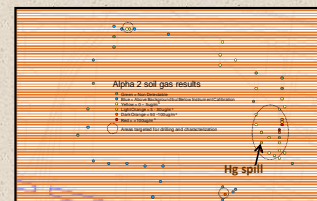
Field testing and analysis of soil vapor split samples shows good comparison of results between Jerome and Lumex analyzer at multiple field sampling sites.



Time series sampling using Jerome meter and built in purge pump shows that steady state concentrations of Hg are reached within 30 seconds and remain constant for 3 minutes.

MAPPING MERCURY SOIL VAPORS

Over 200 samples from 3 sites with known mercury spills



Building 9102-2 (Alpha 2) pilot plant – Site of initial soil vapor testing and known Hg spill and Hg beads observed in cores.

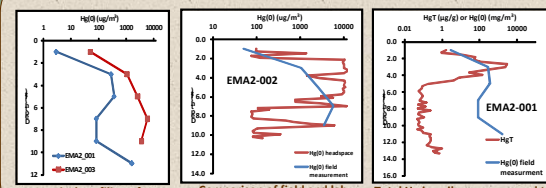


Hg retort building 81-10 – Known Hg spills and Hg beads observed in cores. Soil vapor data suggests the extent of elemental Hg spill has not been defined to the north.



9733 Engineering building – Hg beads observed during excavation activities in an area used as a loading dock for Hg.

ONGOING EFFORTS – VERTICAL PROFILING



Vertical profiling of Hg soil vapor in the field Comparison of field and lab determination of Hg soil vapor Total Hg in soil core compared to field soil vapor concentration

CONCLUSIONS

•Laboratory and field tests at Y-12 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.

•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.

•Controlled head space analysis of Hg contaminated core material in the laboratory provided data on the Hg vapor concentrations that indicate the presence of Hg(0).

•Hg vapor data collected at over 200 pushprobe locations at 3 different release sites correlated well to areas of known Hg(0) contamination.

•These results suggest that soil gas sampling and analysis can be conducted rapidly and inexpensively at a large scale to help identify areas contaminated with elemental Hg