

# Development of a Direct Push/Membrane Interface Probe Technique for Rapid Detection of Mercury-Contaminated Sediments

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**October 2009 Mercury Challenges in the Environment: A Technical Summit**

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# Presentation Outline

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- 1. Identify Priority Needs for Characterization of Hg in Sediments and Soils**
- 2. Description of Membrane Interface Probe System**
- 3. History of Field Application of MIP for VOC's**
- 4. Application to Hg Characterization at OR**

# 1. Mercury Characterization Need

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SRNL/ORNL Continuing Effort funded by EM-31 to Identify Technical Uncertainty and Refine Site Conceptual Model for Hg Contamination at Y-12.

Initial team effort focused on development generalized conceptual model that identified domains grouped according to similar characteristics and processes that affect chemistry and distribution of Hg (January 2008) to support selection of approaches/technologies.

Team activities continued in June 2008 focused on developing comprehensive conceptual model that documents residual sources and transport pathways within Y-12.

# 1. Mercury Characterization Need

Effluent (RMPE) program ... 'mercury discharges arise largely because residual deposits of metallic mercury located in the drainage system are being slowly solubilized or resuspended by uncontaminated groundwater and process water which flows through the system' (Turner et al. 1985).

Subsequent efforts in 2006-2008 focused on cleaning and relining sections of the storm drain systems and rerouting clean water that previously entered those storm drain segments eliminated more than 90% of the Hg export .....

The uppermost sections of the drainage system near the mercury-use buildings were not remediated, and continue to contain metallic mercury deposits within gravel sediments and almost certainly in footers and backfill adjacent to damaged pipes.

# 1. Priority Need for Soil Detection of Hg

Need for characterization of Hg contamination in shallow soils/sediments associated with storm drainage system near buildings. Residual Hg present in storm drain backfill associated with storm drain system.

Follow example of exploration geochemists- lots of inexpensive measurements – to define extent of contamination and support remedial and D&D activities

Produce dense depth-discrete data at a low cost/sample to support remedial decision-making and D&D.

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# 2. Description of MIP System



Cone Sipper



Cone Permeameter

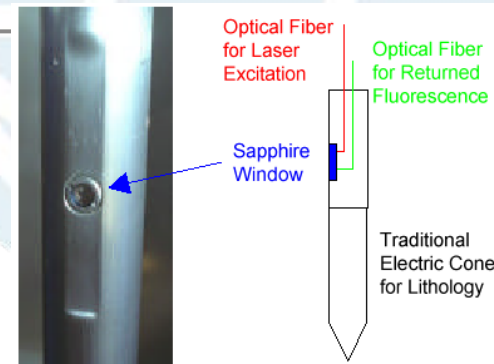


**Cone Penetrometer, GeoProbe, and Direct Push Techniques provide rapid-low-cost access**  
**Baseline measurements such as tip stress and sleeve friction are supplemented by sensors and samplers**



Wireline CPT Soil Sampler

## Direct Push Access Systems



Laser Induced



Raman Spectroscopy



GeoVis (video)

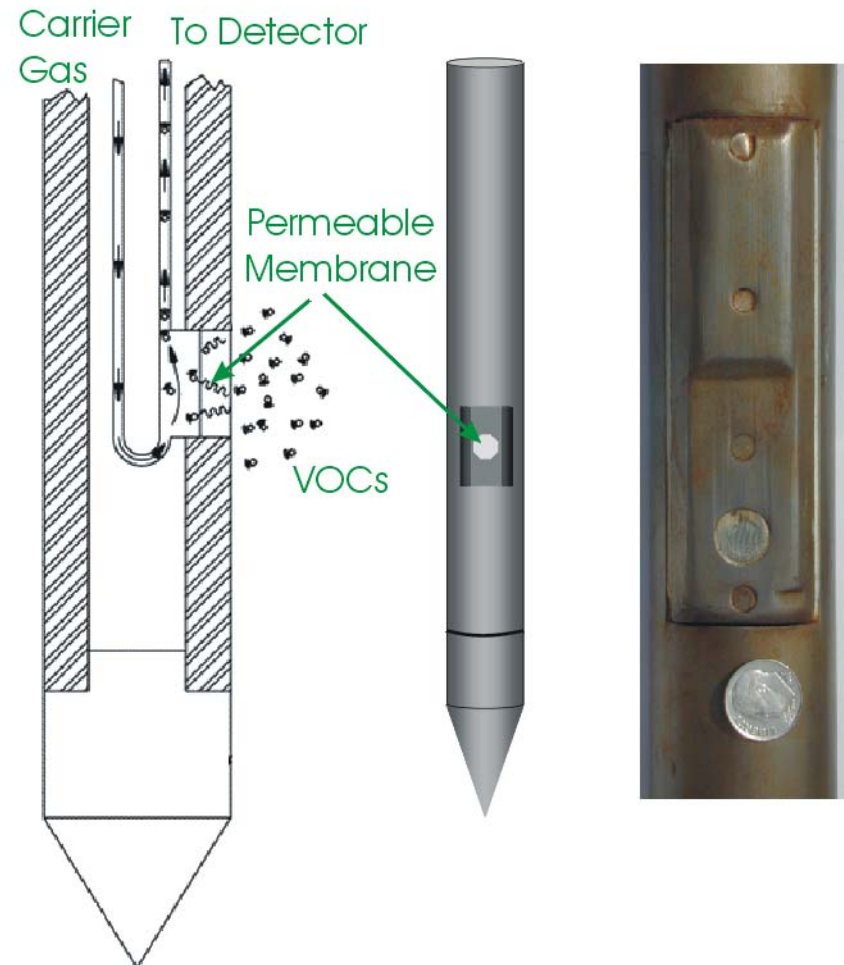


In Situ Gamma Detector

And more ...

## 2. Description of MIP System

- Screening tool designed by Geoprobe Systems for use with cone penetrometer or Geoprobe system**
- Semi permeable membrane that thin film impregnated into stainless steel screen**
- Heated probe volatilizes contaminants in the subsurface (operates at 80 - 120 degrees C)**
- Volatile components cross the membrane and are carried to a detector through a heated transfer line to the surface for analysis**



## 2. Description of MIP System

Analyzer at surface  
in CPT or field  
support vehicle

Use of IT-MS, GC-  
MS, or total VOC's  
using FID or PID.  
Mercury analysis  
will require different  
detector

Will use heated  
transfer line to  
transport to surface  
to prevent  
condensation



Detector located in CPT or support van

## 2. Description of MIP System

Standard sensors provide different responses that can be used to identify different sediment types

Heating zone studies and concentration to sediment correlation studies completed for VOC's

Provides an efficient screening tool



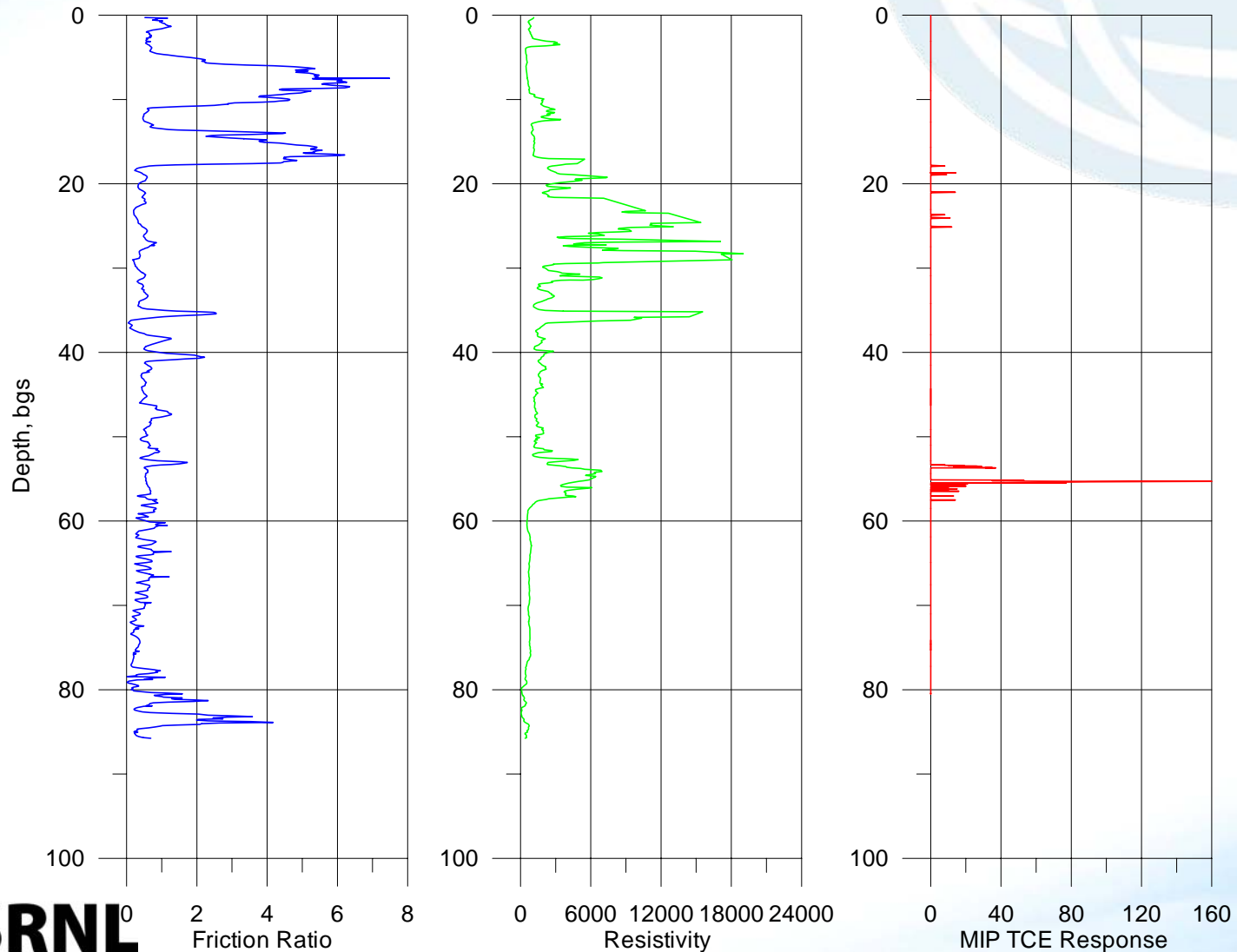
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# 3. Field Application of MIP for VOC's

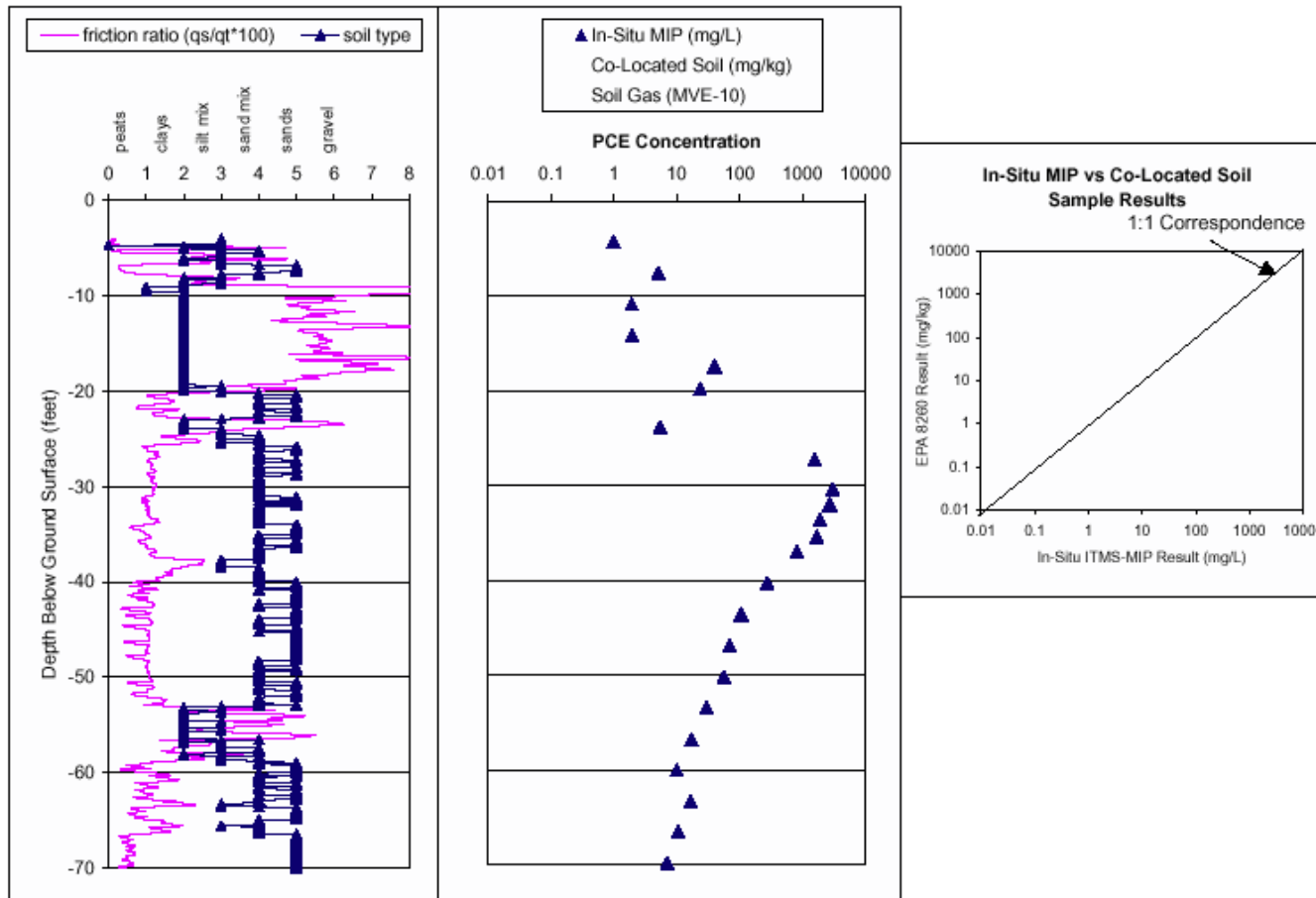
## CPT Lithology Data and MIP Response to TCE



# 3. Field Application of MIP for VOC's

SRS MIP4 A14

30 August 1999

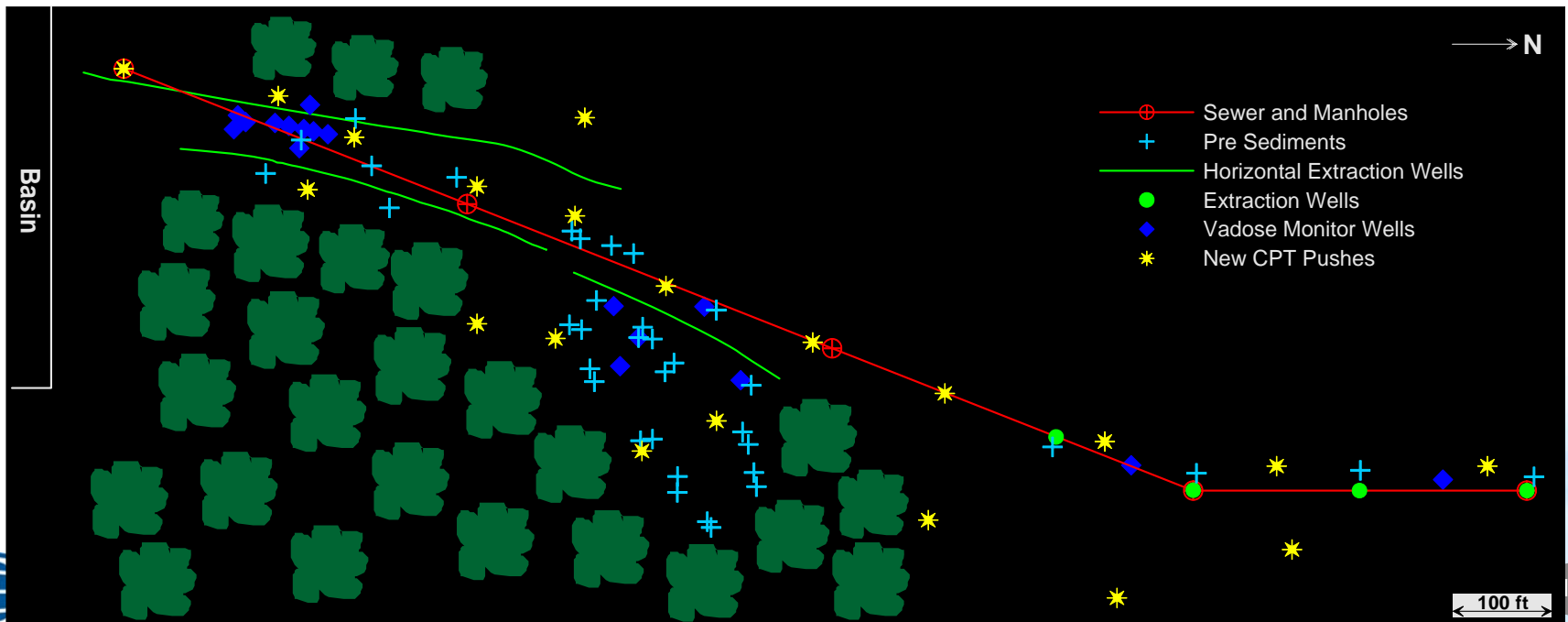


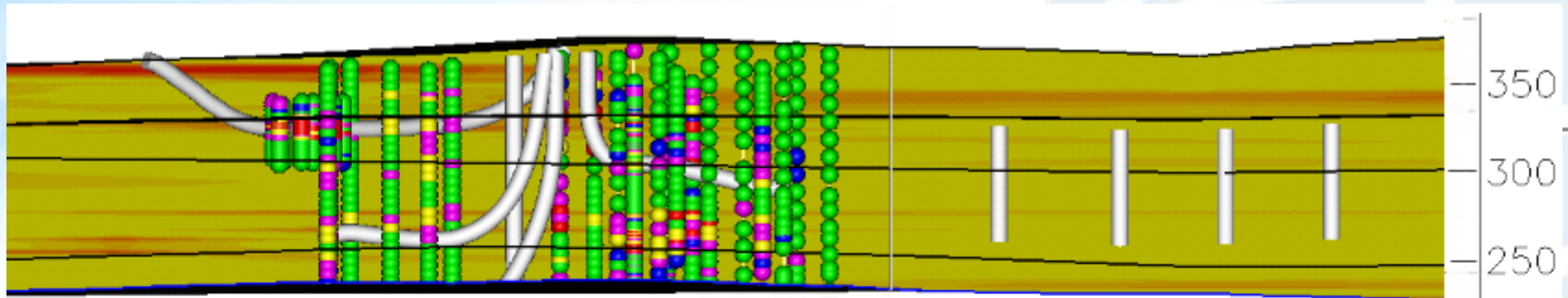
ESTCP Validation Study

# 3. Field Application of MIP for VOC's

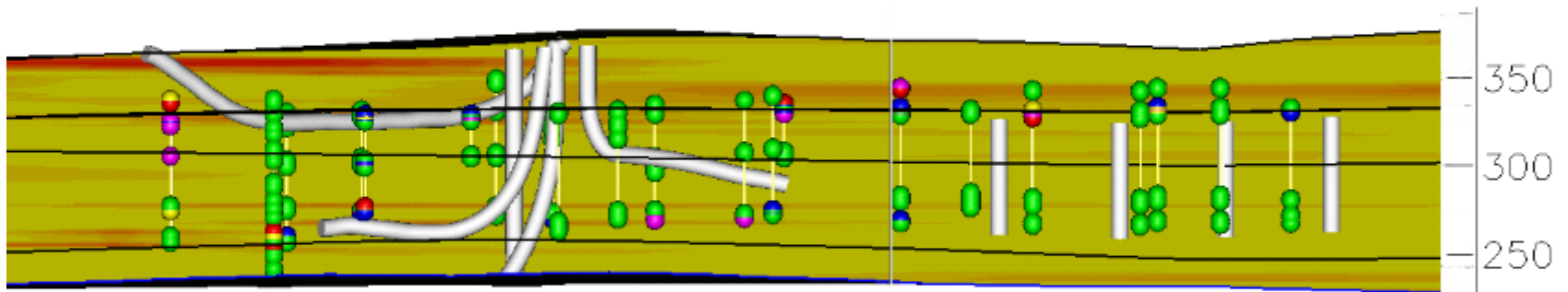
## Evaluation of SVE DNAPL Remediation along the M-Area Sewer Line

- 20 wireline pushes made to 100 ft depth
- 155 soil gas samples collected and analyzed in the field
- 282 sediment samples collected
- Work completed in 8 days

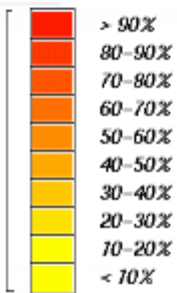




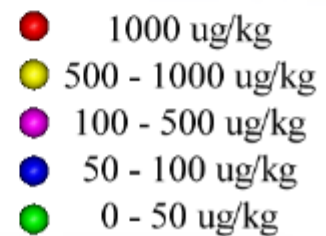
Initial Distribution:



Current Distribution:



### Tetrachloroethylene Sediment Concentrations Associated with Operation of Soil Vapor Extraction.



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## 4. Application to Hg Characterization

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- ✓ Design and field test a MIP system that can be used to support environmental remediation and D&D activities (IFDP) to characterization shallow soils and sediments.
- ✓ Initial focus will be for detection of Hg(0) in shallow sediments.
- ✓ Initially propose to couple Geoprobe system with heated transfer lines, and commercial detector.

## 4. Application to Hg Characterization

- ✓ Evaluate Lumex RA15+ and/or Arizona Instruments gold film detector
- ✓ Develop sampling protocol and calibration protocols
- ✓ Validate results with analysis of samples using traditional sampling/analysis methods

