



## VI Issues: Lessons Learned- Including Methane



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March 2014



## “Top Ten” List of VI Issues Encountered

- Agency Issues:

- Requiring soil gas data be acquired even though soil and groundwater is clean enough to screen out site
- Requiring all soil gas samples to be collected in Summa canisters and analyzed by TO-15 when TO-14, 8260 or 8021 ok.
- Using guidance for petroleum hydrocarbon issue that was written for chlorinated hydrocarbons.
- Setting inconsistent clean up levels
- Not permitting SVE systems to be shut off prior to collecting soil gas samples
- Requiring deep soil gas samples



## VI Issues Encountered con't.



- **Consultant Issues:**

- Using RBSLs for soil gas for sub-slab or vice-versa.
- Using screening levels as clean-up criteria
- Using non-cancer screening levels for carcinogens
- Using wrong exposure times
- Proposing indoor air sampling before evaluating if the VI pathway is complete
- Incorrect construction of soil gas sampling points



- **Unit Confusion:**

- Assuming ug/L equivalent to ppbv
- Assuming ug/m<sup>3</sup> equivalent to ppbv
- Not knowing how to go from ug/m<sup>3</sup> to ug/L



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## VI Issues Encountered, con't.



- Work Plan Issues:

- Work plans submitted for VI work not needed
- Too many samples recommended for
- Not specifying collection of samples in upper part of vadose zone (e.g., 5' bgs) to demonstrate bioattenuation
- Analyzing compounds that were never used at the site.
- Not analyzing for fixed air gases
- Not using correct analytical method to achieve needed detection limits



6-1 - Remed, 2013

## VI Issues Encountered, con't.

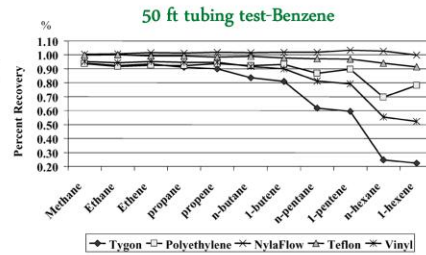


### • Soil Gas Probe Installation Issues:

- Using wrong tubing type
- Pinching off tubes incorrect completion
- Not collecting an equipment blank
- Type of tubing used

### • Field Sampling Issues:

- Not opening Summa canisters or Tedlar bags
- No experience with swagelok connectors
- Applying too much liquid tracer
- Returning Summa canisters with 0 pressure
- Lack of attention to chain of custody details
- Bore hole clearance: hand auger/airknife



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## VI Issues Encountered, con't.



- Probe installation: ground disturbance issues mean no direct push methods can be used
- Avoid air knife
- Sampling open bore holes
- Emergency Response



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## VI Issues Encountered, con't.



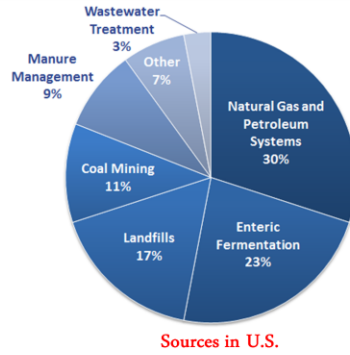
- Smaller samples are better; including Summa canisters
- Flow rate can easily be monitored using hand held syringe
- Tedlar bags have maximum holding time of about 3 days for benzene and 2 days for TEX



# Methane: Potential Safety Hazard



- Colorless-odorless gas: CH<sub>4</sub>
- Ubiquitous
- Value in Air: 1.8 ppmv
- Lower Explosive Limit: 50,000 ppmv
- Upper Explosive Limit: 150,000 ppmv
- Main component of natural gas
- Most abundant organic compound on Earth
- Methanogenesis:  $\text{CO}_2 + 8\text{H}^+ + 8\text{e}^- \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$
- Fermentation: Biogas from biodegradable organic matter: Landfills
- Global Warming: Note manure management and enteric fermentation combined are the largest sources of methane in U.S.



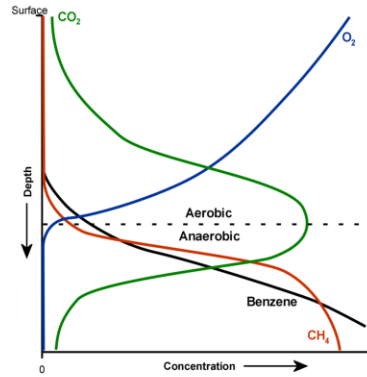
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## Methane: Site Data Required to Assess Hazard and Determine if Action is Needed



- Source concentration
- Volume
- Pressure
- Transport/Preferential Pathways
- Dilution
- Bio-attenuation



The presence of methane in soil gas does not mean there is a hazard

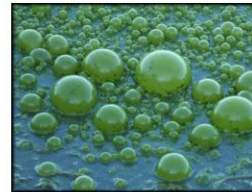
Modified from J. Sepich, 2012

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## Sources of Methane in the Subsurface



- Methane from biodegradation of petroleum is characterized by:
  - Lack of significant concentrations of ethane and propane
  - CO<sub>2</sub> / methane ratios between 0.3 and 0.6
  - Relationship between carbon isotope ratio of CO<sub>2</sub> and methane concentration
  - C<sub>14</sub> age > 50,000 years old
- 'Swamp' gas of poorly identified source can also be distinguished by C-14 age
- Thermogenic methane can be distinguished by molecular composition
  - Geologic considerations and stable isotope ratios may be needed



Modified from R.E. Sweeney, 2011

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Though it is not often that geologic sources of methane are confused with methane generated during the biodegradation of petroleum, these instances usually involve major issues of liability. In contrast, the number of instances for which methane in shallow soil is attributed to degradation of petroleum – but isn't – may be quite common. For these instances, the degradation of petroleum may provide the anaerobic conditions necessary for methanogenesis but the carbon in the methane may be derived from young organic matter.