Compound Specific Isotope Analysis (CSIA) - Internal sources versus subsurface contamination

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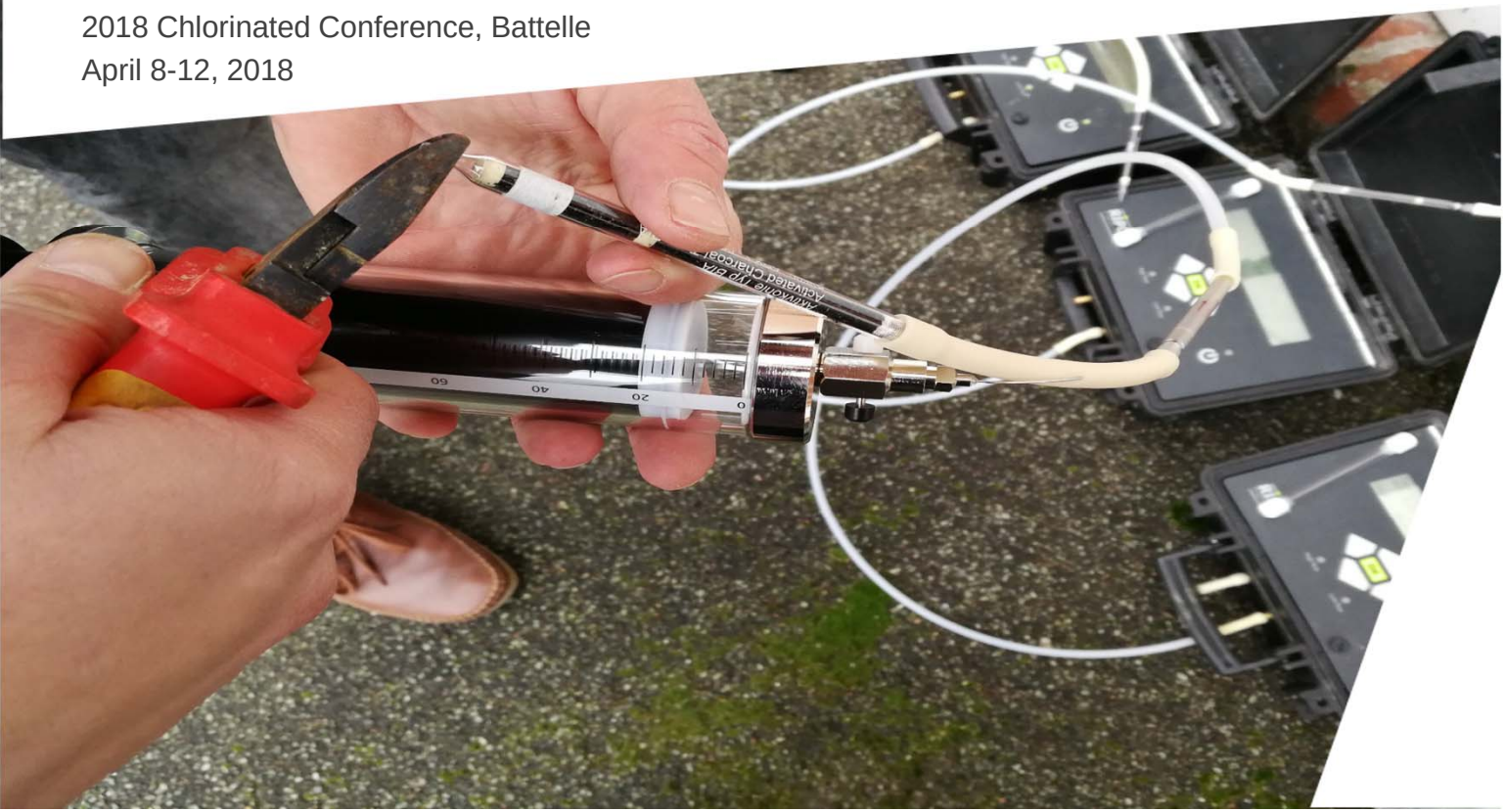

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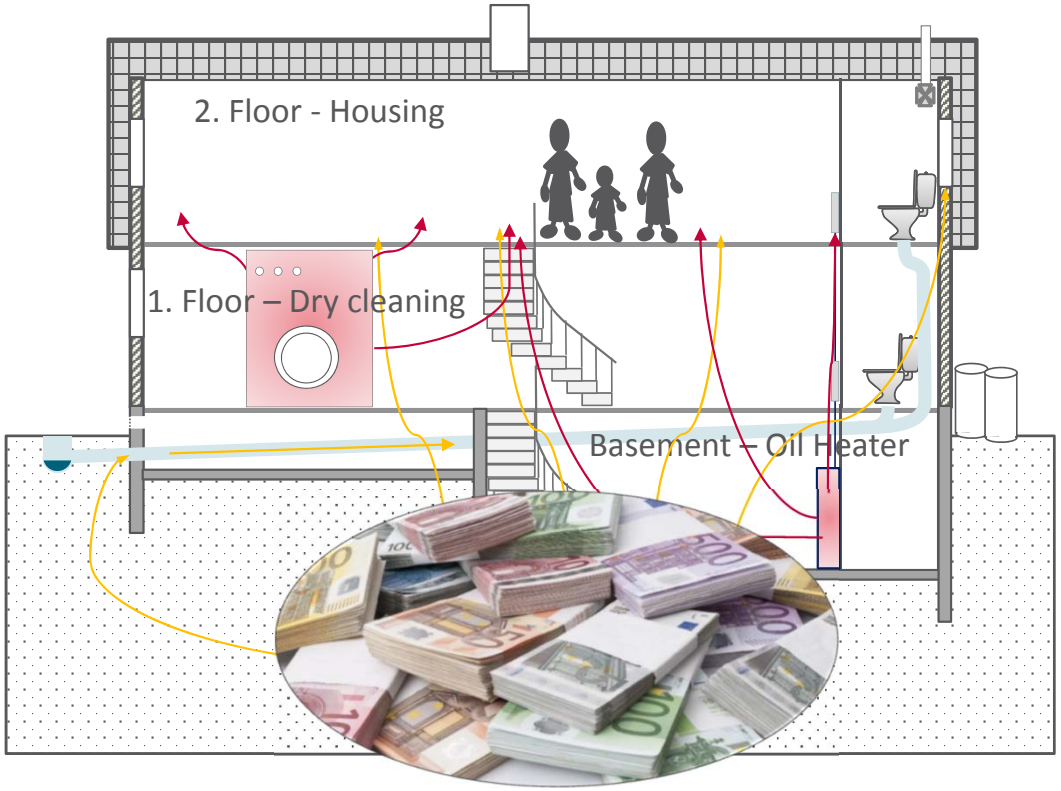
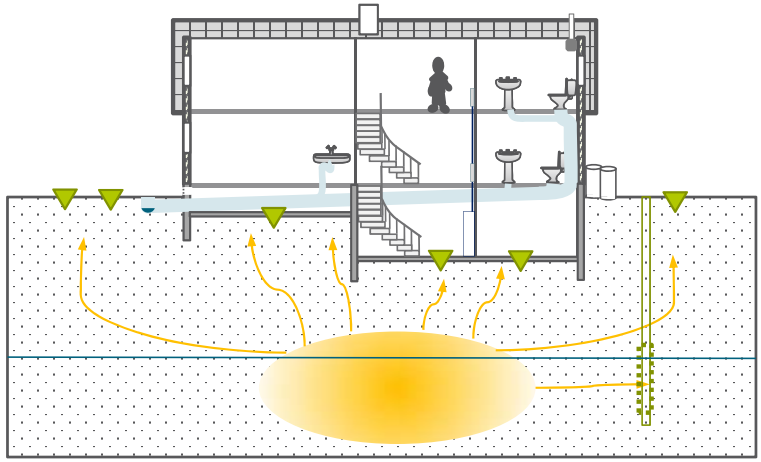
Internal sources versus subsurface contamination



Traditional approach



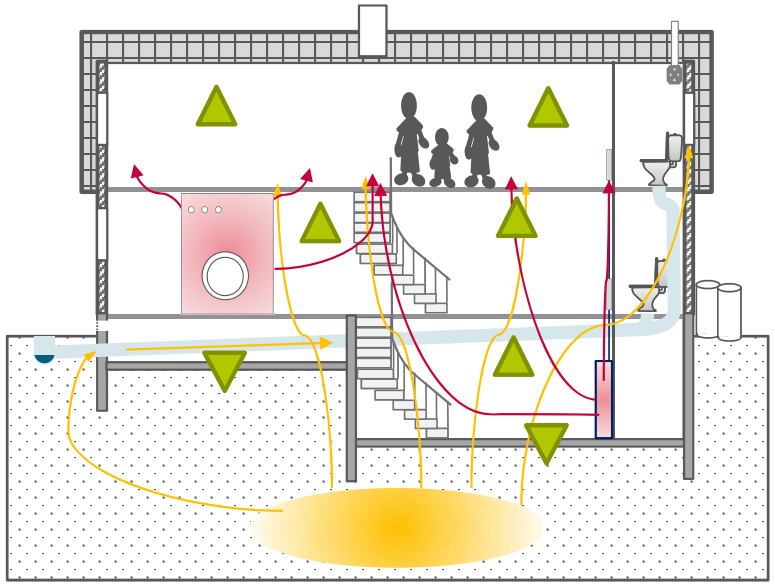
Weaknesses

- Hard to distinguish between internal sources and subsurface contamination.
- Many sampling points resulting in high costs with a long investigation period.
- Risk of unregistered contamination leak through the sewer system.

New approach - Screening of indoor air

Advantages

- Less invasive -> less inconvenience for the homeowner/user of the building
- Fast risk assessment of the indoor air -> Less money spent on investigations

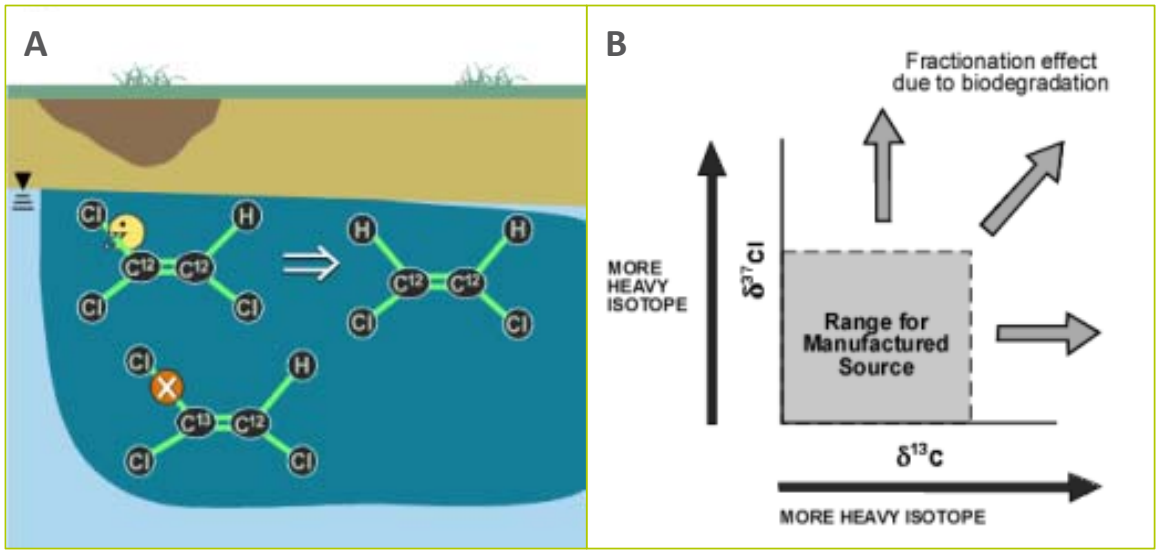


Objective

Compare the new method with the current approach to evaluate the potential for further development.

to examine, evaluate and further develop the use of compound specific isotope analysis (CSIA) for risk assessment of vapor intrusion to indoor air.

Compound Specific Isotope Analysis - CSIA



A: Microorganisms degrade “light” molecules (^{12}C- and ^{35}Cl-molecules) faster/easier then “heavy” molecules (^{13}C- and ^{37}Cl-molekules).

B: Preferred degradation of molecules with lighter isotopes (isotope fractionation) leads to ”heavier” isotope signature at the source.

Sampling

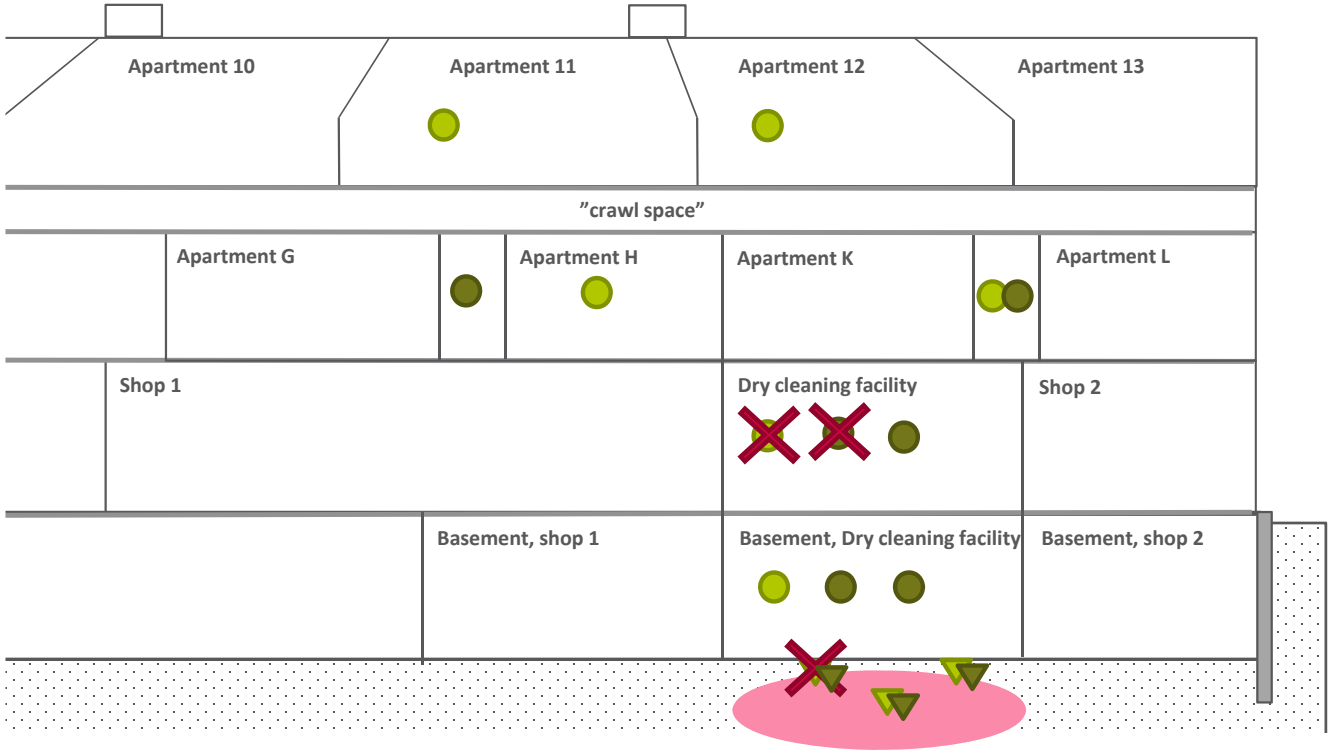
- Mass of contaminant in each tube
  - Benzene: 50-900 ng
  - PCE/TCE: 100-2250 ng
- Flow: 0.1 l/min
- No more then 100 l per tube

Additional restrictions

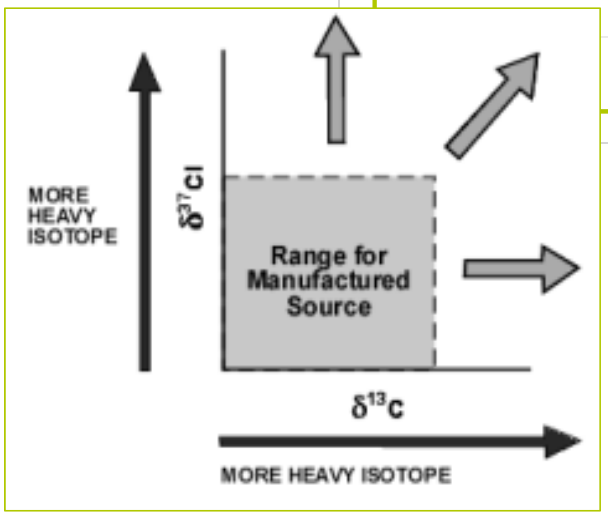
- Special tubes (dimension and sorption material) ~ 1.000 $/pcs.
- 2-3 tubes per sampling point (deviation no more than 30%)

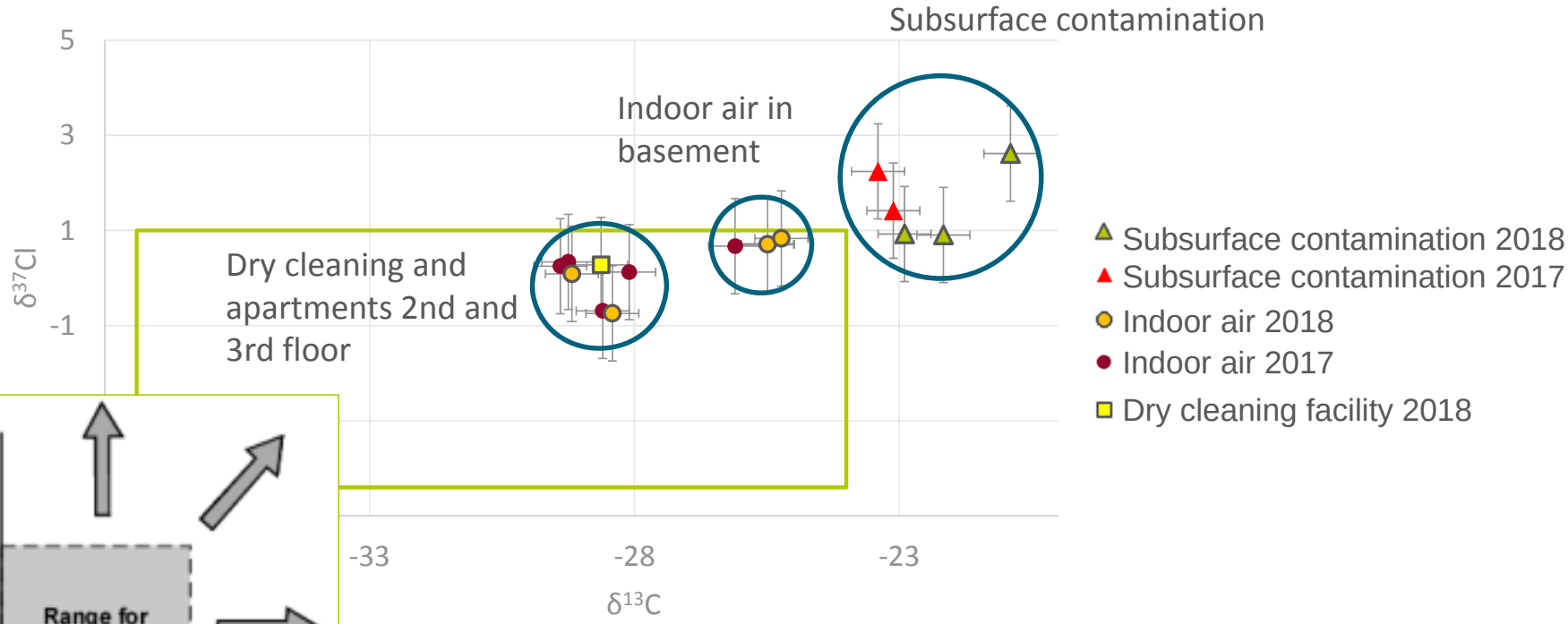
Case 1

- An active dry cleaning facility



Case 1

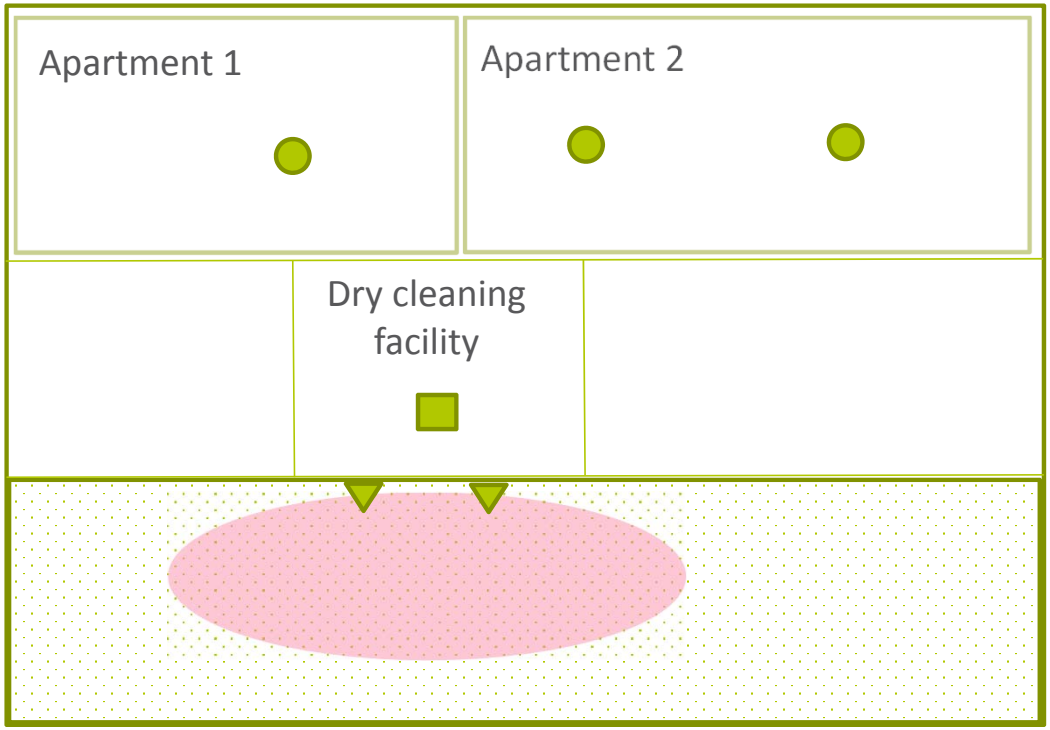




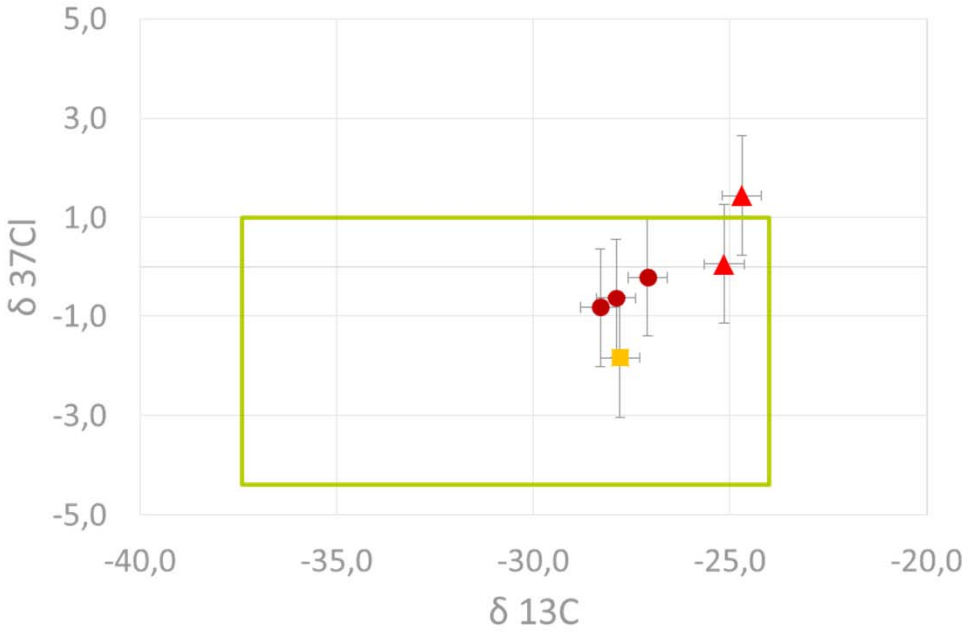
- Indicates influence of internal source to the apartments ($\delta^{13}C$)
- Indicates influence of mixed sources in the basement ($\delta^{13}C$)
- $\delta^{37}Cl$ shows the same tendency

Case 2

- An active dry cleaning facility



Case 2

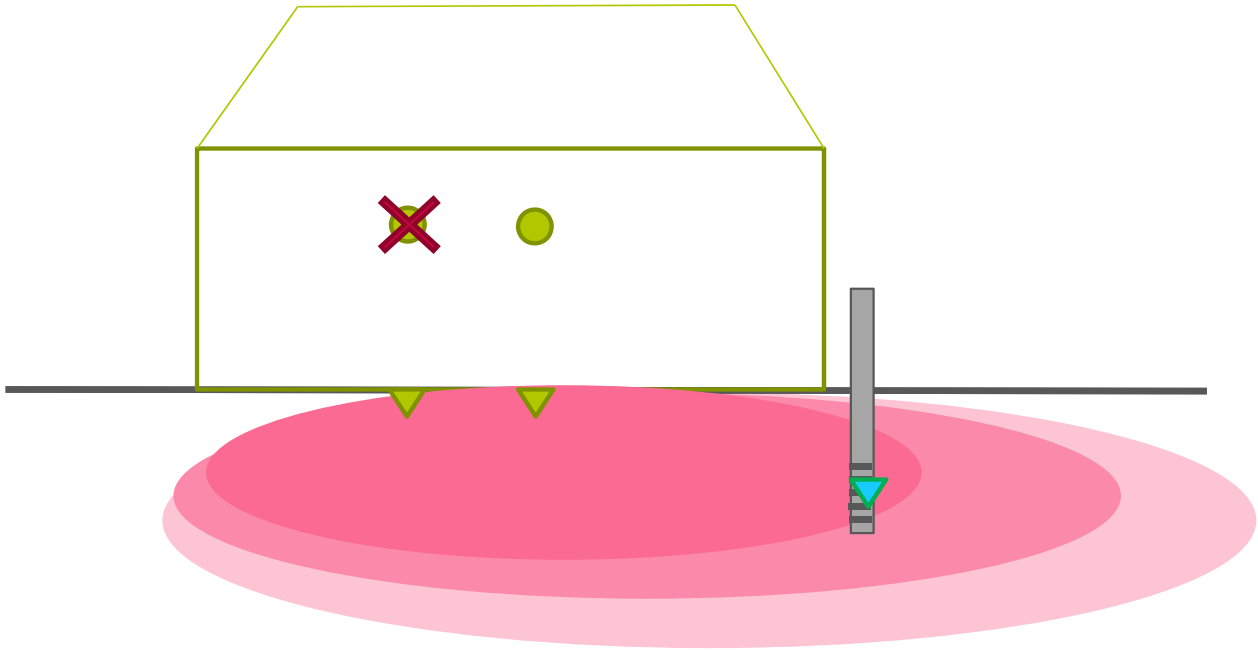


- Subsurface contamination
- Dry cleaning facility
- Indoor air in apartments

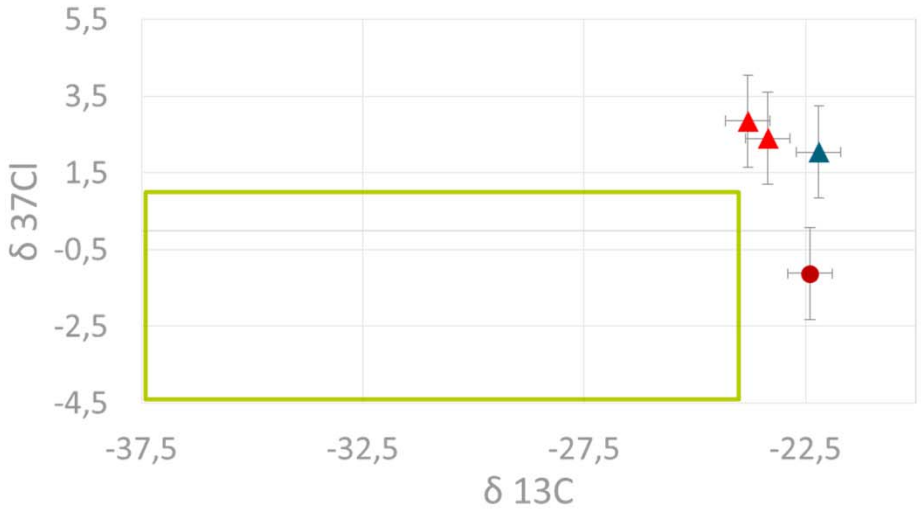
- No clear indication of source ($\delta^{37}Cl$)
- Indicates influence of internal source ($\delta^{13}C$)

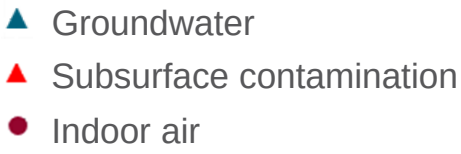
Case 3

- No internal source



Case 3



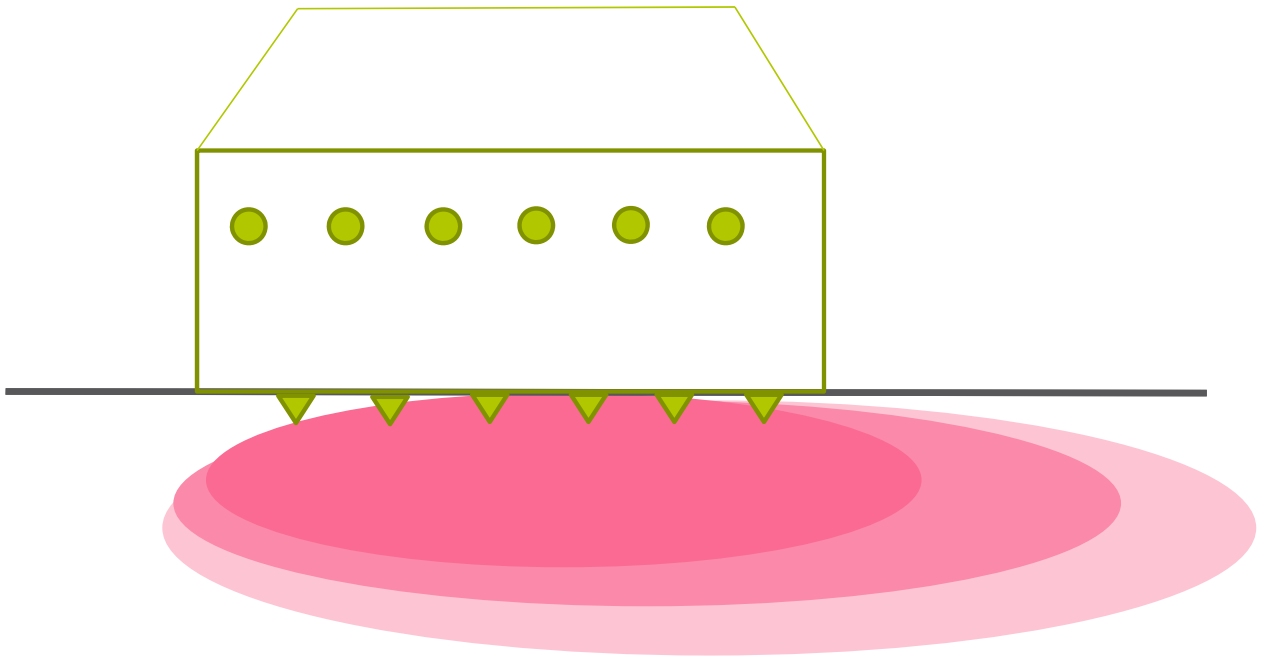


- Subsurface contamination and groundwater has same isotopic signature
- Indicates influence of subsurface contamination ($\delta^{13}C$)
- Indicates influence of internal source ($\delta^{37}Cl$)

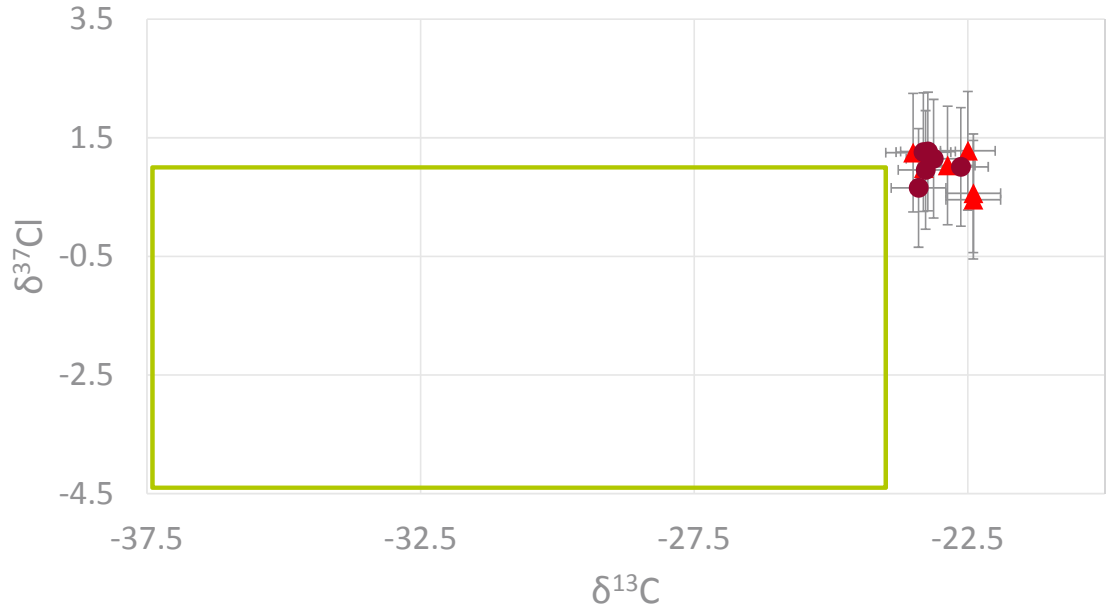
-> No clear indications - Mixed sources?

Case 4

- No internal source



Case 4



- Indicates that contamination of indoor air is from subsurface contamination ($\delta^{37}Cl$ and $\delta^{13}C$)

Conclusion – Case studies

- CSIA is a fast and accurate method to determine the origin of contaminants in indoor air
  - Sites showing clear indications of large influence from internal sources
  - Site showing clear indications of large influence from subsurface contamination
  - Sites showing indications of mixed sources
- The difference between isotope ratios of indoor air and subsurface contamination is small
- The isotope ratio between soil air and groundwater is identical

CSIA generates data for a fast and noninvasive approach for risk assessment regarding unacceptable vapor intrusion from subsurface contamination to indoor climate.

Questions…