DEVELOPMENT OF SURFACE MONITORING TOOLS

WP 3.3.2 ADVANCED SOIL GAS MONITORING

Tanya Goldberg, TNO

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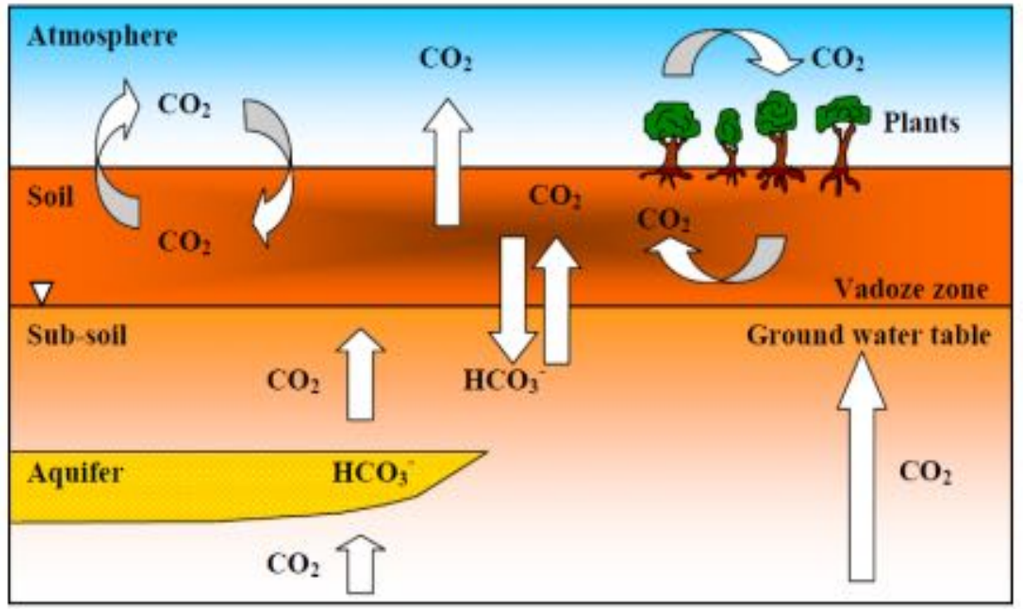
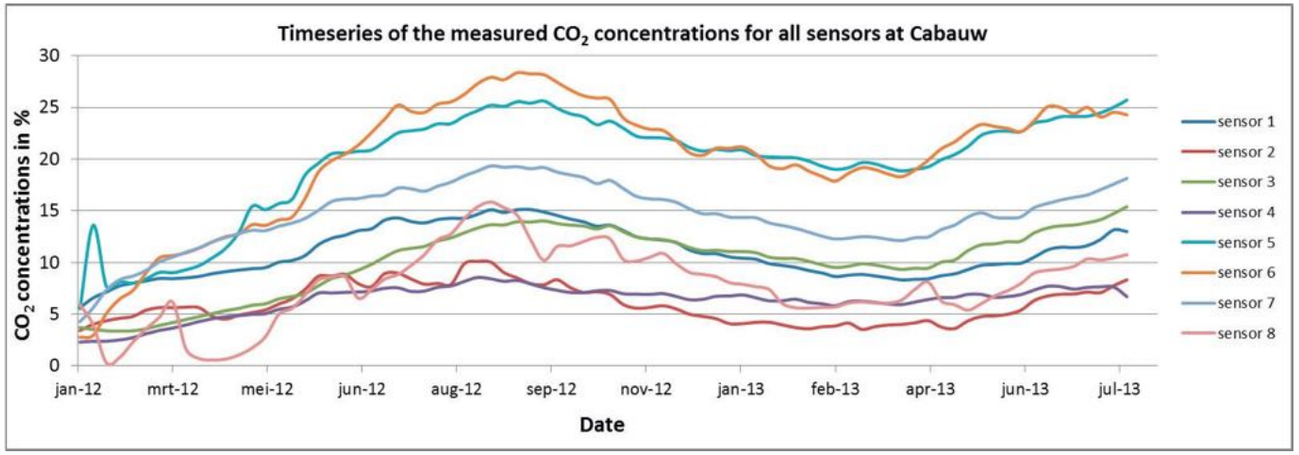
Soil gas monitoring

- If leakage is suspected proof of CO_2 leakage is required
- Differentiation between natural and stored CO_2 source



modified after van Eijndthoven, 2005



Soil gas monitoring at Cabauw, Netherlands (Gaasbeek et al., 2014)

- High CO_2 concentrations can accumulate in soil gas naturally
- CO_2 monitoring can not always unequivocally depict the source

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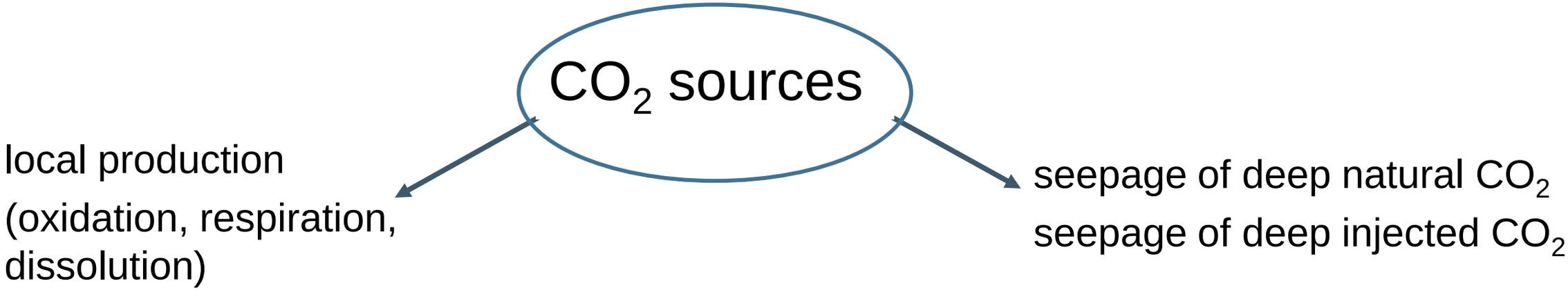
CO_2 source identification in the vadoze zone



combined geochemical approach → processes behind soil CO_2

- CO_2, $\delta^{13}C$, O_2, N_2, $\delta^{15}N$
- CH_4 and higher hydrocarbons (C2-C4) ratios and $\delta^{13}C$ and δD
- Δ_{47} “clumped isotopes” = CO_2 isotopologues

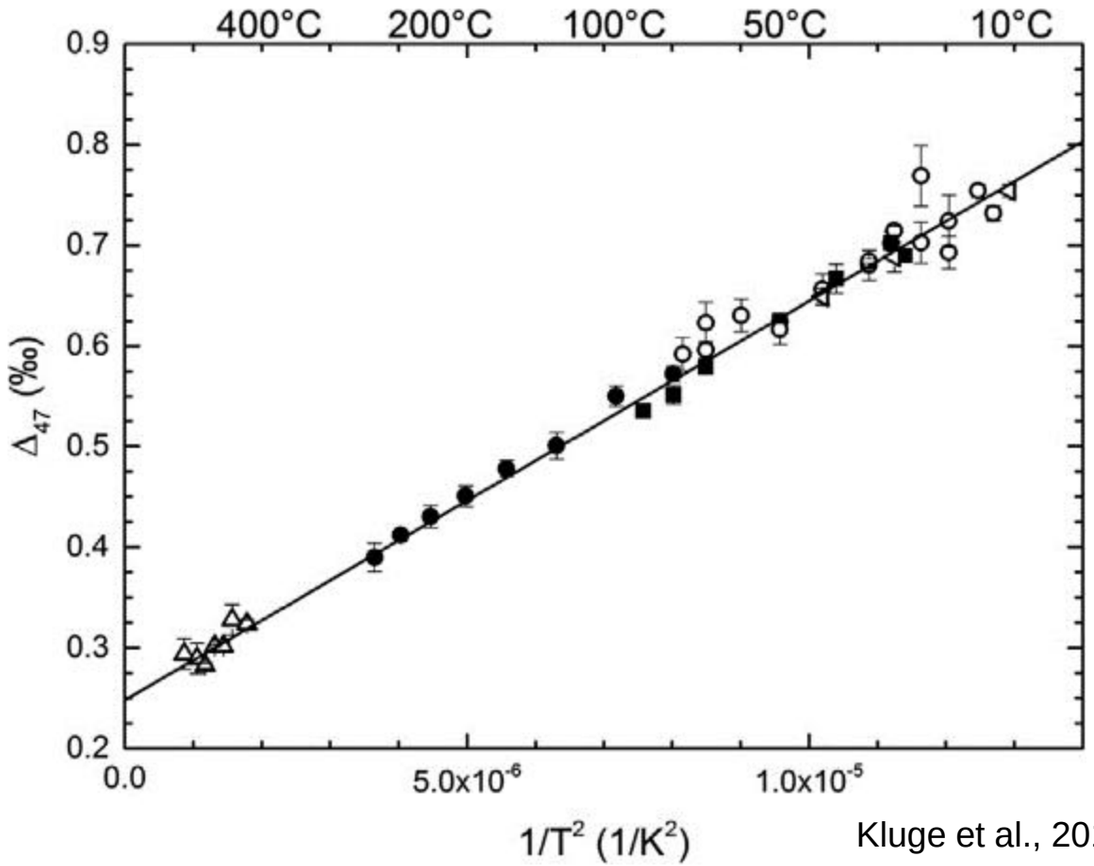
CO_2 source identification with CO_2 isotopologues

- **Deep CO_2 source = high temperature**
- **Shallow CO_2 source = low temperature**

Determination of C-O isotopologues
“clumped isotopes”

Preferential “clumping” of heavy isotopes (^{13}C and ^{18}O) at low temperature = high Δ_{47}

At high temperature movement towards stochastic distribution = low Δ_{47}



Kluge et al., 2015

$$\Delta_{47} = \left[\left(\frac{R^{47}}{R^{47*}} - 1\right) - \left(\frac{R^{46}}{R^{46*}} - 1\right) - \left(\frac{R^{45}}{R^{45*}} - 1\right)\right] \times 1000$$

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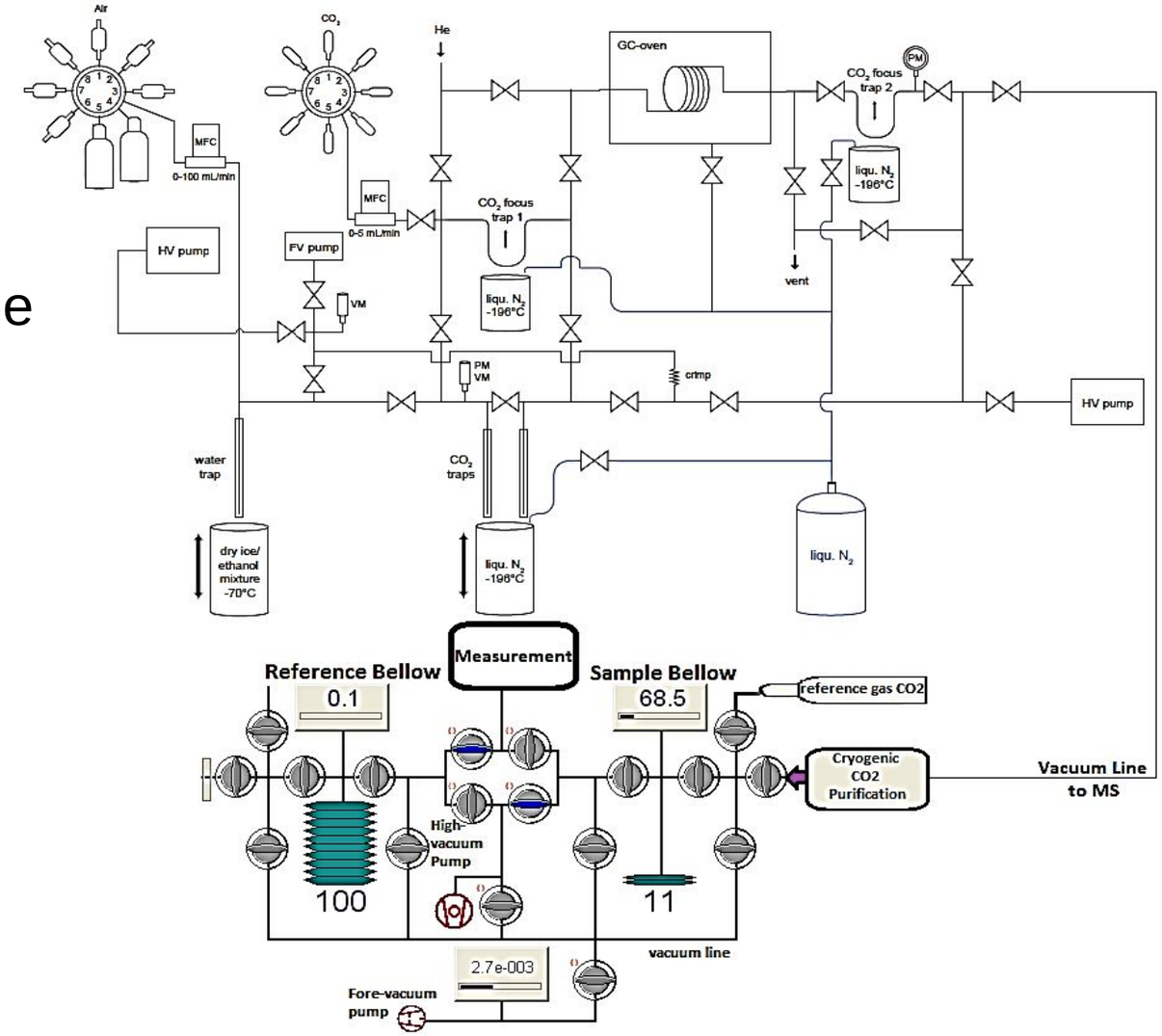
CO_2 isotopologue analysis

Automated CO_2 Purification line

Mass spectrometer



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CO_2 isotopologue analysis

1) Natural das sampling

- Natural gas escape areas: San Vittorino, Latera, Ailano, Fiumicino

~90% CO_2, ~0.3 CH_4, N_2, traces of H_2S

2) Induced leakage

- GeoEnergy Test Bed (GTB) and Sulcis Fault Lab (SFL)

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Thank you for listening

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Enabling Onshore CO_2 Storage

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