

# Detection of mantle CO<sub>2</sub> in an underground salt mine via long-term and high-resolution monitoring by laser-based isotope techniques

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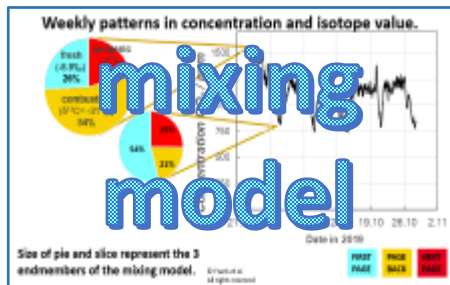
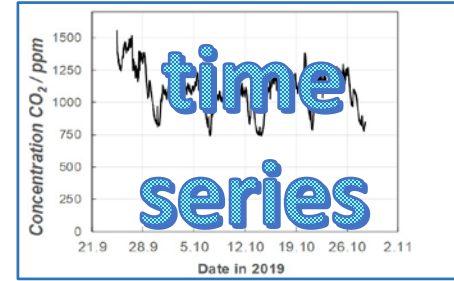
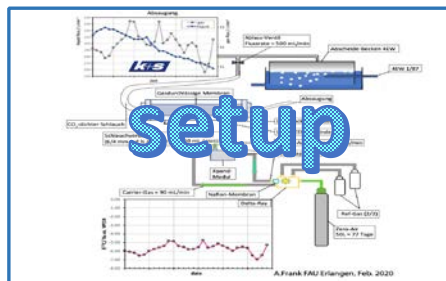
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**Salt deposits may be affected by geogenic CO<sub>2</sub> intrusions that may have technical and operational implications.**

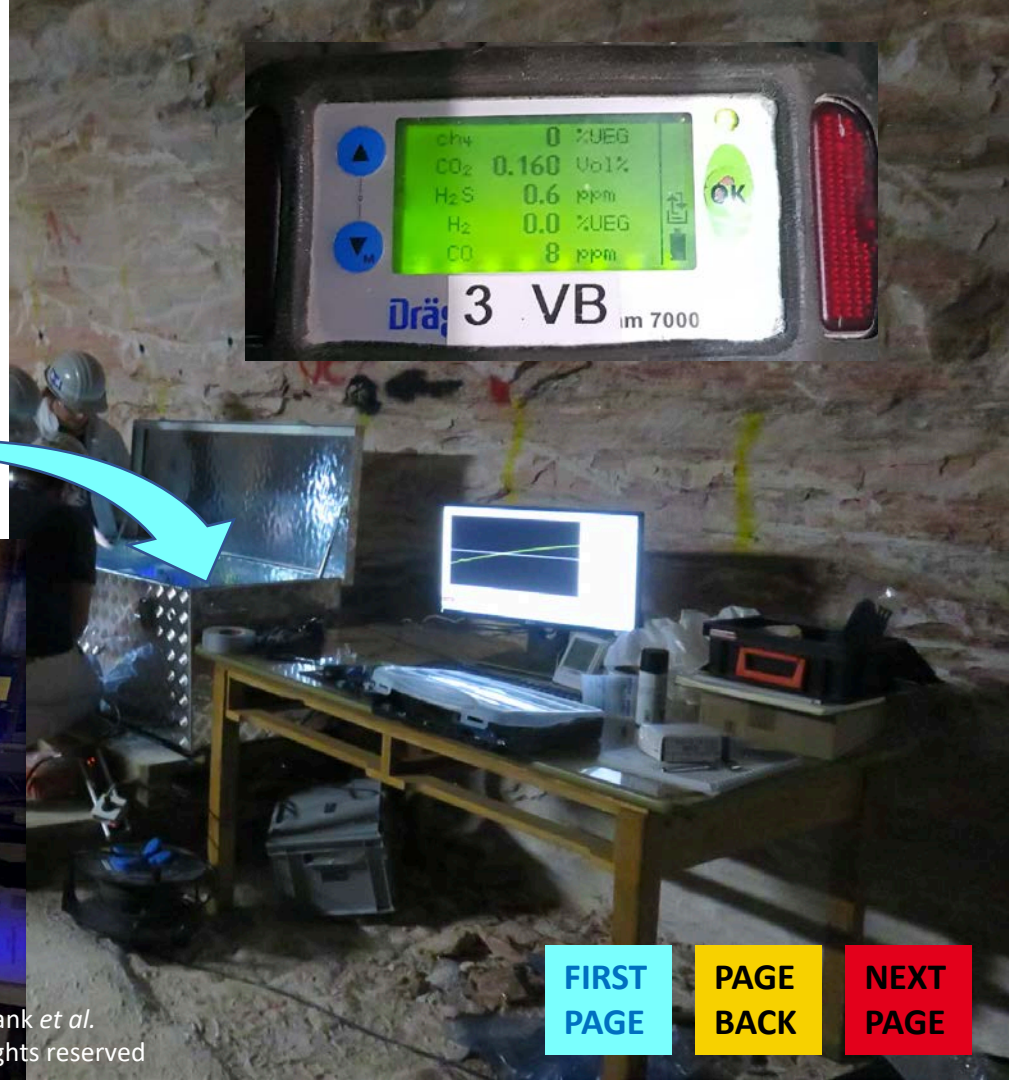
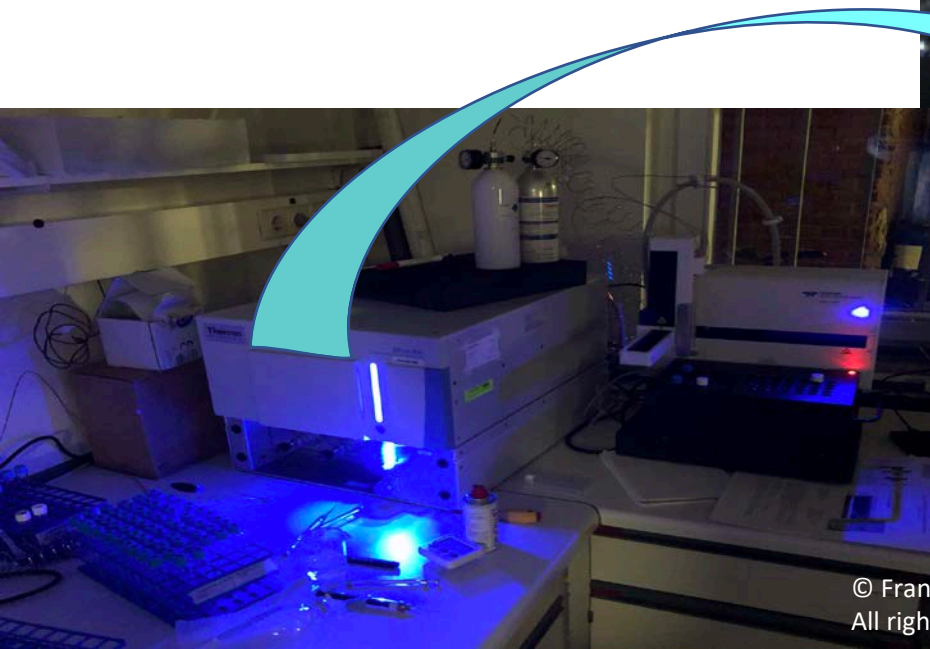


**Concentration variations cannot be directly attributed to sources, and discrete sampling is not able to resolve spatial-temporal variations.**

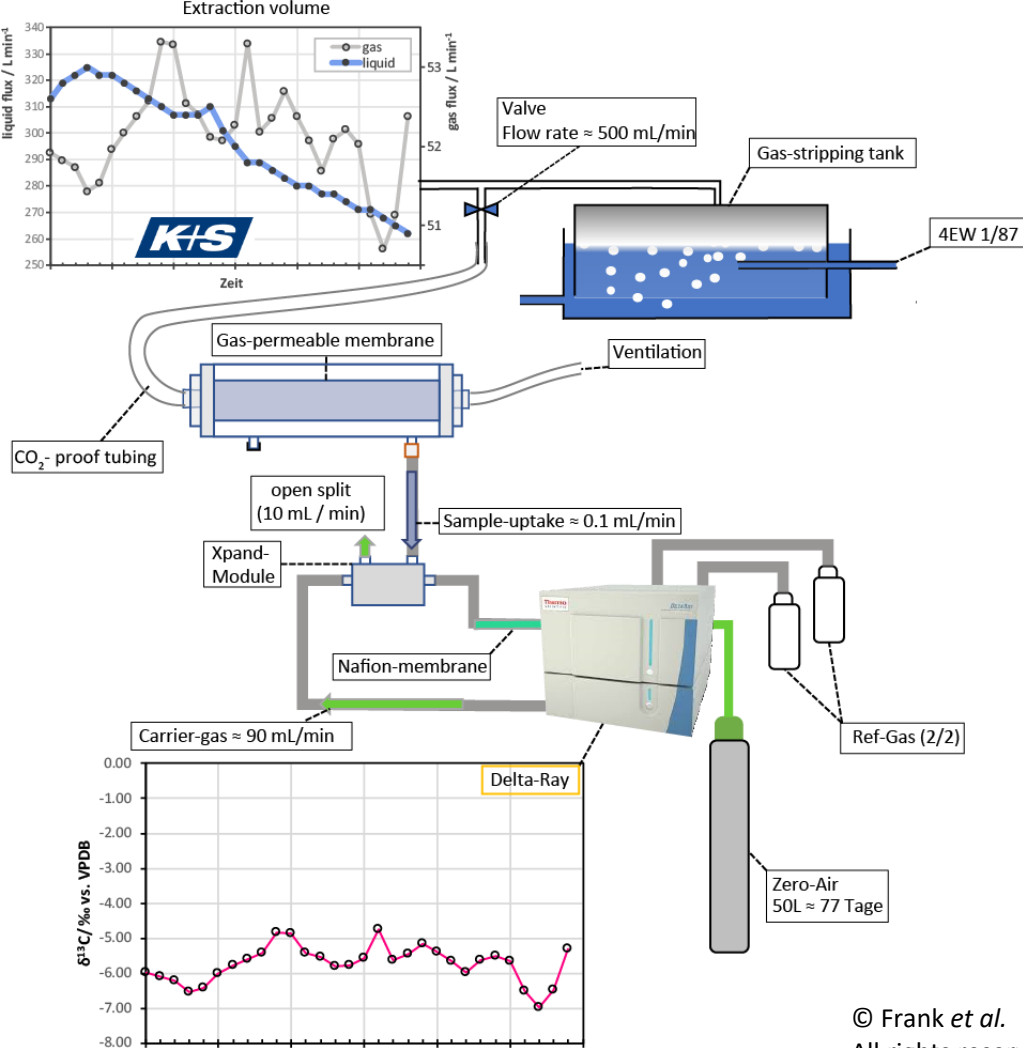
An isotope ratio mid-infrared laser spectrometer (Delta Ray, Thermo)

was set up in a salt mine for continuous measurements of:

- CO<sub>2</sub> concentration
- Isotope ratios of <sup>13</sup>C/<sup>12</sup>C & <sup>18</sup>O/<sup>16</sup>O.



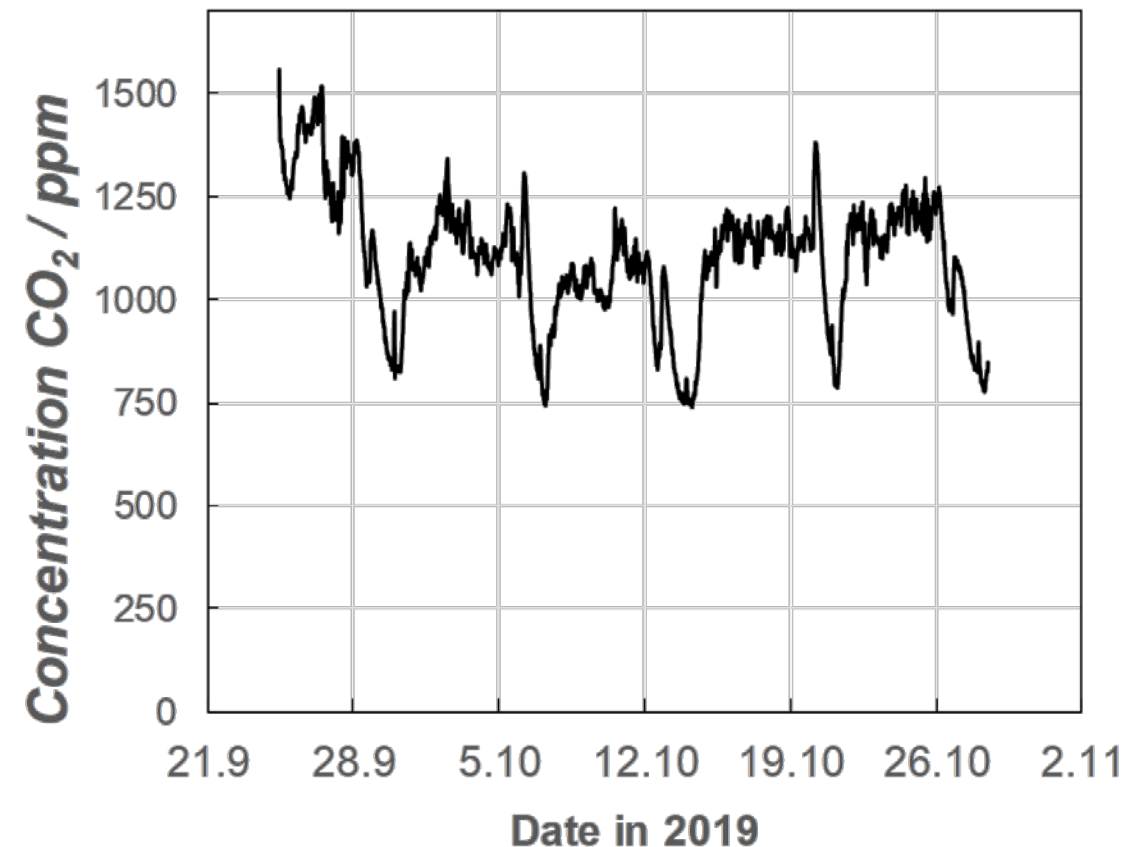




Typical setup employs a water trap and continuous supply of reference gas that is isotopically calibrated.

This allows high-frequency measurements of CO<sub>2</sub> in time intervals of every minute over time periods of over 30 days.

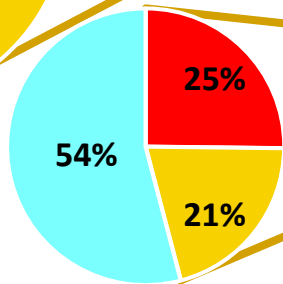
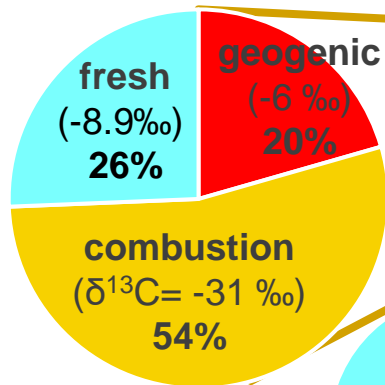
# Weekly patterns in concentration and isotope value.



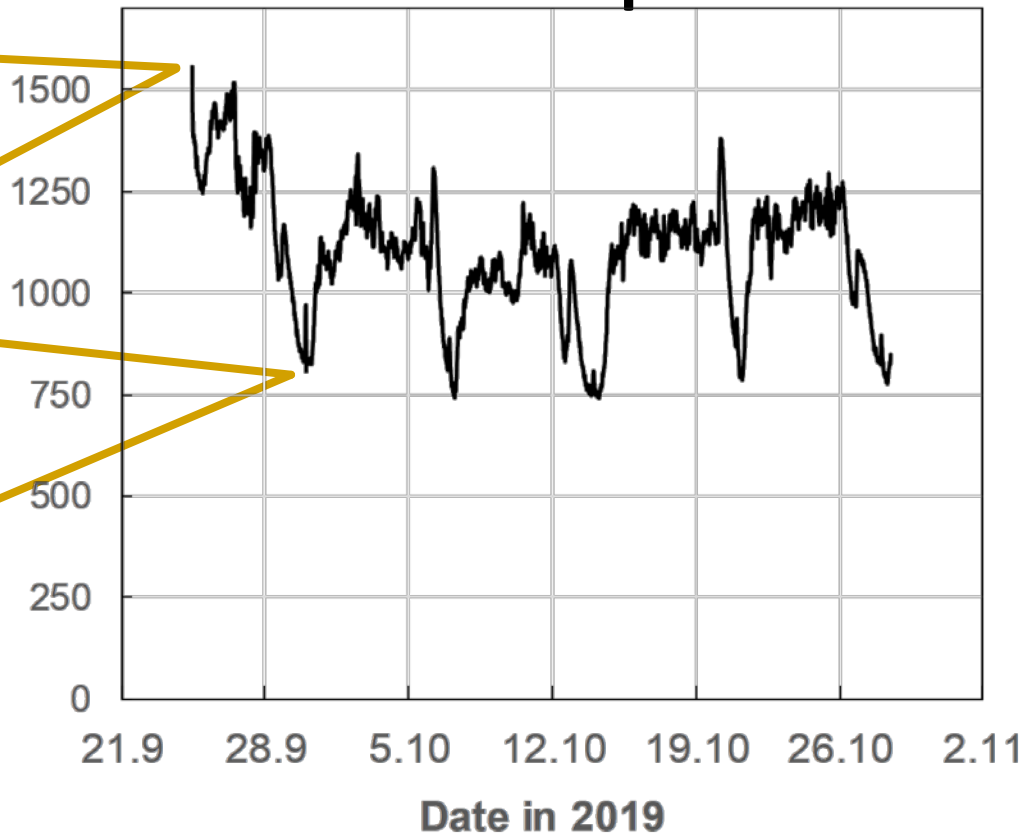
**Weekly patterns in CO<sub>2</sub> concentration and isotope value.**

**Concentrations and isotope ratios were correlated, indicating a variable contribution of geological CO<sub>2</sub> and CO<sub>2</sub> from machinery (data not shown).**

# Weekly patterns in concentration and isotope value.



Concentration  $\text{CO}_2$  / ppm



Size of pie and slice represent the 3 endmembers of the mixing model.

- HIGH-FREQUENCY TIME SERIES of CO<sub>2</sub> CONCENTRATIONS and STABLE ISOTOPE RATIOS  $^{13}\text{C}/^{12}\text{C}$  and  $^{18}\text{O}/^{16}\text{O}$  in a SALTMINE
- GEOGENIC CO<sub>2</sub> QUANTIFIED via MASS BALANCE WITH 3 END-MEMBERS
- CONCENTRATION GRADIENTS PRESENT DRIVE GEOGENIC CO<sub>2</sub> DIFFUSION RATES

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