CO_2 IN SOIL GAS IN RELATIONSHIP TO METHANE OXIDATION ABOVE AND AWAY FROM AN OIL AND GAS FIELD IN THE NORTHERN VIENNA BASIN

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Introduction

The preparation of the LBr-1 pilot project for CO_2-EOR and storage in the northern Vienna Basin includes CO_2 and methane measurements in soil gas in order to determine baseline values prior to the planned CO_2 storage. Here the daily, monthly and seasonal variations of the CO_2 and methane are discussed more in detail in respect to the probe position, climatic, hydrological and lithological data.

The LBr-1 site is an earlier oil and gas field in the northern Vienna Basin. The hydrocarbon accumulation formed in a Middle Badenian reservoir known as Lab horizon sealed by a 30 m thick shale of the same age. About 50 wells were drilled into the LBr-1, two of them entered an overpressured gas zone and blowed out. The field was closed and all the wells were abandoned. Some of them required second abandonment. The strategy of the current soil gas monitoring is focussed on possible communication of the abandoned wells with the surface. Two automatic soil gas stations were installed above the earlier blow-outs and additional ones outside the oil and gas field for comparison. The IGS instruments are based on diffusion of gases through a membrane (Beaubien et al. 2014) and are ground water resistant, a great number of data were measured underwater. Data were collected every two hours from March to November with a break in from mid September to early November. Additional measurements of instantaneous CO_2 and methane concentrations were made using Ecoprobe 5. Gas flux was measured by chamber method (Schlömer et al. 2013).

Results

Significant increase in CO_2 in soil gas is observed from April to late May (Fig. 1). Then the values fluctuate from 4 to 7% above the oil and gas field and from 1 to 2% outside the field. Every 14 days a clear decrease in CO_2 occurs. From late August to mid September, the CO_2 decreases to the "April" value (ca. 2%).

Methane shows similar concentrations to CO_2 in late April but in May to August decreases below 2%. In August to September, methane increases up to 5.8%. In November, Methane concentrations surpass CO_2. High methane in soil gas occurs after drops in the atmospheric pressure.

Conclusions

The presented results confirm and complement the earlier observations by Schlömer et al. (2013) and Beaubien et al. (2014). Higher amounts of CO_2 were found above the abandoned oil and gas field and lower outside. The quantity of CO_2 and methane do not show always clear relationship with one another. Yet, the isotopic $\delta^{13}C$ of methane and CO_2 suggest, that in cases where long term methane flux exists from deeper horizons, methanotrophic archaea

probably convert part of the methane to CO_2. This may have a serious implication for CO_2-EOR or CO_2-storage monitoring and base line interpretation. Of special interest is the fact that higher CO_2 in soil gas does not necessarily indicate a leak from the CO_2 storage. Further study of this phenomenon is urgently needed.

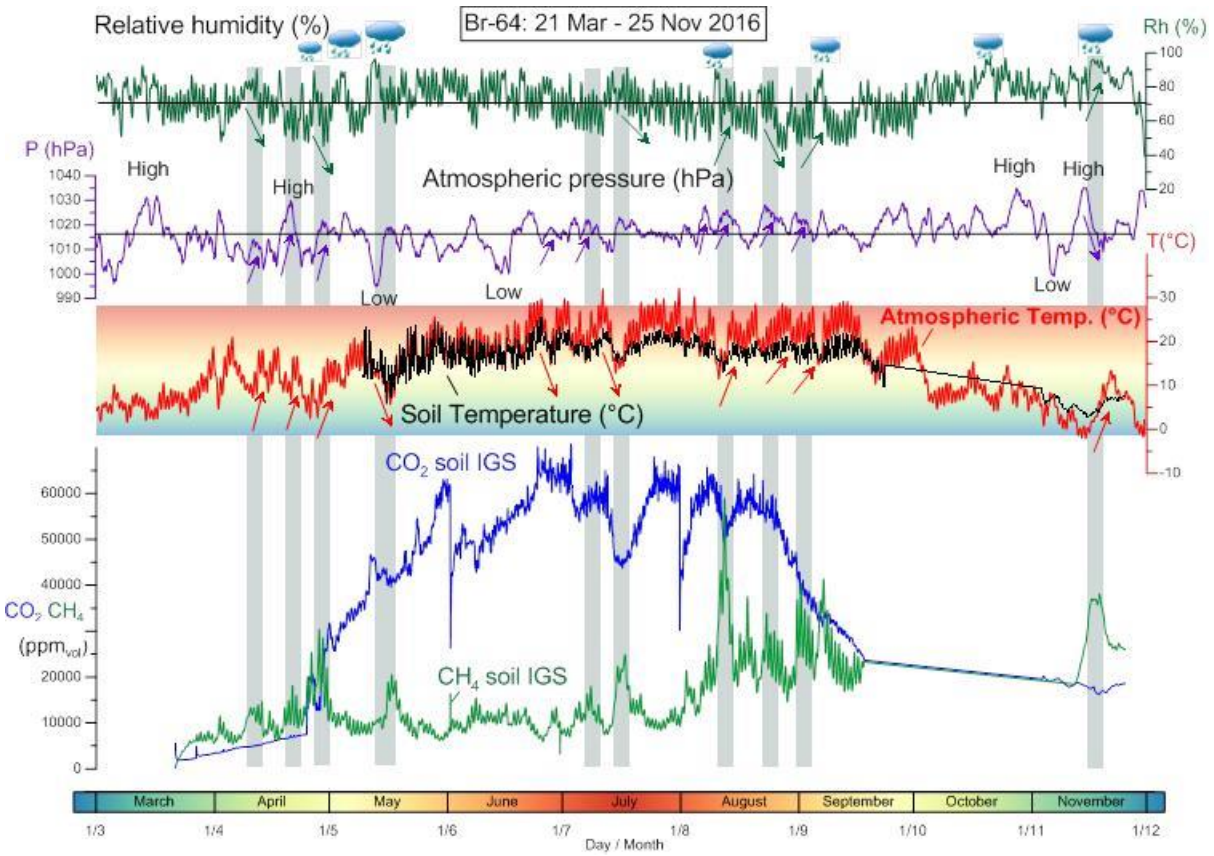

Figure 1 *Variation of CO_2 and CH_4 in soil gas from March to November 2016 above the exploited oil and gas field LBr-1. Meteorological data include relative humidity, atmospheric pressure, soil and air temperature. The episodic highs in methane are highlighted by pale blue stripes.*

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