Baseline monitoring of CO_2 and methane for risk assessment of a future pilot CCS site LBr-1: relationship to the residual oil and gas field saturation

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Keywords: CO_2, methane, soil gas, well design, integrity, temperature, atmospheric pressure

ABSTRACT

Baseline survey of the soil gas is an important part of the preparation of the LBr-1 pilot project for CO_2-EOR and CO_2-storage in the northern Vienna Basin. The primary objective is to characterize the quantity and seasonal variability in CO_2 and methane in soil gas above and away from the earlier oil and gas field LBr-1. The results provide basis for determination of baseline values prior to the planned CO_2 storage. The area of interest is presently covered by woods and fields. It is specific by annual flooding in early spring from the Morava river. 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 oil and gas production from the LBr-1 field ended in the late 1990s and all the wells were abandoned, some of them even re-abandoned. In this study, a 3D model of the reservoir, seal and the overburden was constructed in Petrel and the well design was carefully documented with casing types, earlier perforations and cementation status and the risk of leak is evaluated (Fig. 1). Two automatic soil gas stations (IGS) are 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 a great number of data are measured underwater. Data are collected every hour from March 2016 to January 2017 with a break in from mid-September to early November (Fig. 1 right). Additional measurements of instantaneous CO_2 and methane concentrations are made using Ecoprobe 5. Daily, monthly and seasonal variations of the CO_2 and methane are investigated in respect to the probe position, climatic, hydrological and lithological data. Significant increase in CO_2 in soil gas is observed from April to late May. Then the values fluctuate from 4 to 7% above the oil and gas field and from 1 to 2% outside the field. From late August to mid-September, the CO_2 decreases to 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 those of CO_2. High methane in soil gas occurs after drops in the atmospheric pressure.

The risk assessment identified the well design status as the major reason of the potential leaks. Similarly to 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. Our observations suggest that, at least partly, higher CO_2 in soil gas does not necessarily indicate a

leak from the CO_2 storage but rather a higher microbial oxidation of both biogenic and thermogenic methane.

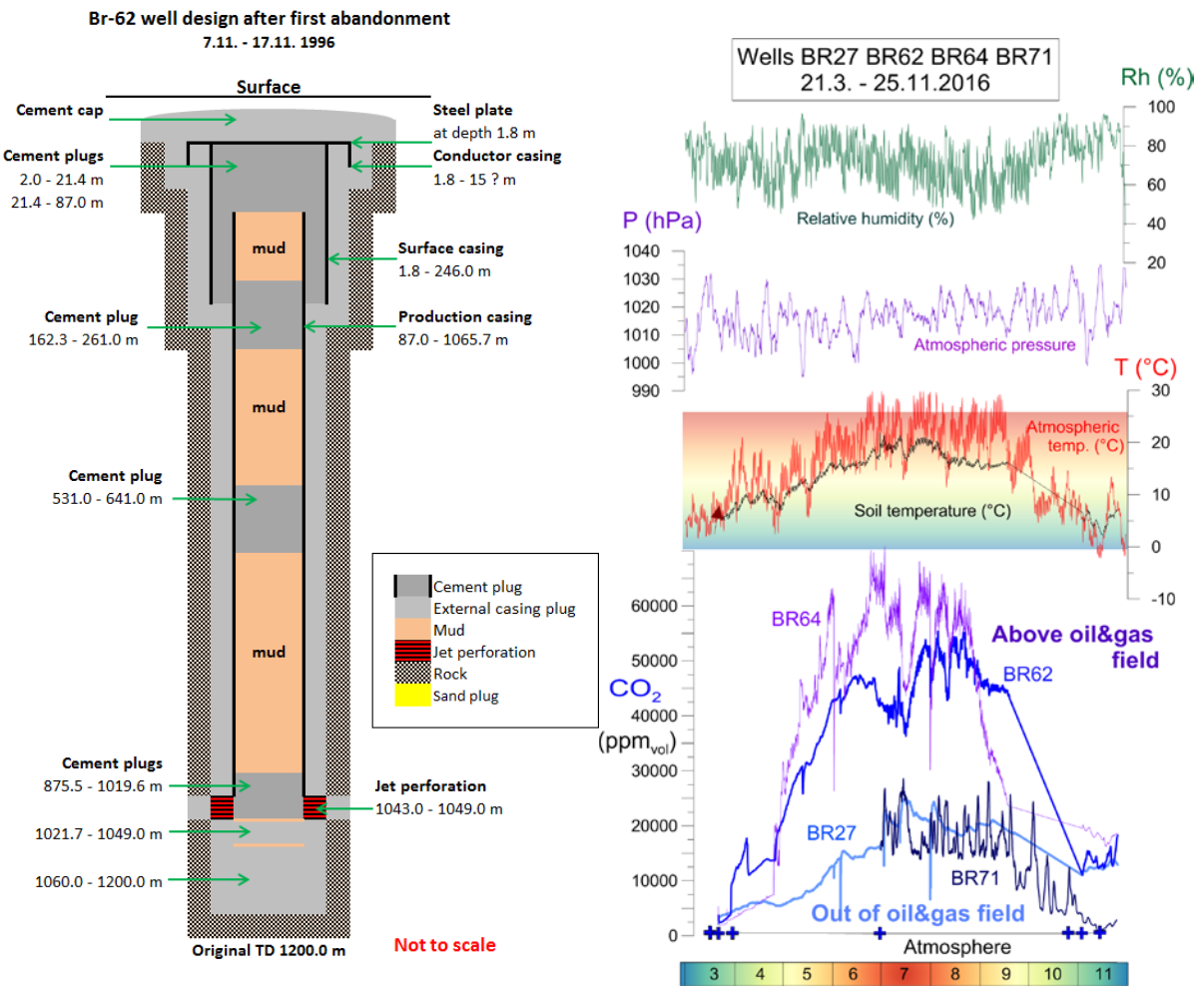

Fig. 1 Well design of the Br-62 well on the final day of abandonment - Nov 17, 1996. Soil gas composition from Mar to Nov 2016 above and out of the LBr-1 oil and gas field.

Acknowledgements

The REPP-CO_2 project is supported by a grant from Norway within the CZ-08 programme of Norway Grants 2009-2014. Special thanks are given to the MND, a.s. for providing the LBr-1 archive site data and to Schlumberger for providing the academic license of Petrel.

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