

Distribution and origin of groundwater methane in Lower Saxony, Germany – a regional inventory

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More than 90% of Germany's domestic gas production and reserves are located in Lower Saxony, North Germany. Recently, research has been intensified with respect to unconventional shale gas, revealing a large additional resource potential in northern Germany. However, many concerns arise within the general public and government/political institutions over potential groundwater contamination (fracking fluids and/or methane stray gas) from additional gas wells through fracking operations.

In order to determine the naturally occurring background methane concentrations, ~950 groundwater wells have been sampled covering ~48,000 km² and subsequently analysed for dissolved methane, ethane and propane. The isotopic composition of methane ($\delta^{13}\text{C}$) is a very sensitive parameter to any additional methane input to the groundwater, in particular at initially very low CH₄ concentrations. Hence, special emphasis has been devoted to develop a sample preparation line for routine GC-irMS analysis at low dissolved gas concentrations (lower limit for $\delta^{13}\text{C}$ ~0.7 $\mu\text{l/l}$).

Dissolved methane concentrations cover a range of ~ 7 orders of magnitude between the limit of quantification at ~20nl/l and the maximum values. Similar to other studies we observed a maximum concentration of ~30ml/l, which can be attributed to partial degassing during the sampling process. However, more than 95% of the samples are not affected by this phenomenon. A first interpretation indicates a bimodal distribution of the dissolved gas, which might mirror a regional trend. The ¹³C isotopic composition of methane is normally distributed (mean ~ -70‰ vs PDB), but shows a large variation between -110‰ and +20‰, clearly indicating both the occurrence of methanogenic and methanotrophic biogenic processes.

The ongoing project will include a second complete sampling of the wells, seasonal observations of selected bore holes, and the correlation of these data with hydrogeologic units and hydro-chemistry. Hydrogen isotopes of methane and ¹³C of CO₂ will also be included in selected subsets of samples acquired during the next phase.