Tracing Fugitive Gas in Shallow Groundwater in Areas of Unconventional Energy Resource Development

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To assess potential future impacts on shallow aquifers by leakage of fugitive gas from unconventional energy resource development, it is essential to establish a reliable baseline for shallow groundwater, but also to fingerprint gases in the intermediate and production zones. We used novel approaches of in-situ concentration and isotope measurements for methane during drilling of energy wells characterizing natural gas occurrences in the intermediate zone and in production zones of Western Canada. In addition, occurrence of methane in shallow groundwater was also investigated and methane was found to be ubiquitous in aquifers. Comparison with mudgas profile $\delta^{13}C$ values revealed that methane in the investigated shallow groundwater in Alberta is isotopically similar to hydrocarbon gases found in 100-250 meter depths in the Western Canadian Sedimentary Basin and is currently not sourced from deep thermogenic hydrocarbon occurrences. The data provide evidence that potential stray gas contamination by isotopically distinct deeper thermogenic gases from the intermediate or from production zones can be effectively detected by suitable monitoring programs.