

Assessing Potential Impacts from Unconventional Gas Development on Groundwater Resources in Alberta, Canada

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With the rapid expansion of natural gas exploitation from unconventional reservoirs including coalbed methane and shale gas plays, there is significant public concern about potential future contamination of shallow groundwater with stray gases, formation waters or chemicals used during hydraulic fracturing. In order to enable a scientifically sound assessment of potential future deterioration of freshwater resources in shallow aquifers, it is essential to first establish a baseline of groundwater quality including its dissolved or free gases. This is especially important in areas where prior conventional oil and gas extraction has occurred.

Since 2006, we have conducted monitoring programs determining the chemical and isotopic compositions of water, its dissolved constituents, and of gases obtained from shallow groundwater and formation fluids collected from coalbed methane and shale gas plays in Western Canada. We found that total dissolved solids, chloride concentrations and in some cases $\delta^{18}\text{O}$ values of water, are effective indicators for monitoring for potential impact of formation waters on shallow groundwater. Analyses revealed that methane and often also ethane occur in baseline groundwater samples. Joint evaluation of gas compositions, wetness parameters, and isotopic compositions of methane indicated that the majority of the baseline samples contained methane of biogenic origin. Analyses of chemical and isotopic compositions of methane and higher n-alkanes from mud gases and producing formations revealed that stray gas intrusion from deeper formations into shallow aquifers can be effectively monitored by determining the $\delta^{13}\text{C}$ values of methane and ethane in dissolved or free gas. Provided that baseline data for shallow groundwater have been determined, and that chemical and isotopic data for mudlog gases and production gases are available, it appears possible to identify the formation from which potential gas leakage occurs. This presentation details an approach used in Alberta for monitoring for potential negative impacts on shallow groundwater from stray gases or formation waters during development of unconventional natural gas resources.