# Geochemistry of fluids from an unconventional gas field in New Brunswick, Canada: Identification of unique tracers for migration to shallow groundwater


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ABSTRACT
Natural gas has been produced commercially from hydraulically fractured wells in the McCully gas field in New Brunswick since 2001. Despite the economic potential of this resource, development of the McCully field has been met with public resistance and a provincial moratorium on hydraulic fracturing due to concerns over impacts to fresh water resources. A joint research project between Natural Resources Canada and the University of Ottawa was initiated in 2014 to characterize local shallow groundwater and deep formation fluids of the gas field to assess any potential impacts to fresh water resources.
Thirteen gas and nine formation water samples were collected from production wells drilled into Carboniferous fluvio-lacustrine shale and overlaying sandstone units of the Albert Formation (Horton group) in the McCully gas field in 2015/2016. Hydrocarbon concentrations and stable isotope ratios ($\delta^{13}C$, $\delta^{2}H$) of the natural gas were measured using gas chromatography and IRMS. Major ion and trace metal concentrations as well as isotope ratios ($\delta^{18}O$, $\delta^{2}H$, $^{87}Sr/^{86}Sr$) of the water samples were measured using ICP-MS and IRMS.
Analysis of the natural gas samples reveals a thermogenic origin and a partial isotopic inversion of the hydrocarbon gases ($\delta^{13}C\ CH_4 > \delta^{13}C\ C_2H_6 \leq \delta^{13}C\ C_3H_8$). The unusual isotopic signature of the hydrocarbons is thought to result from late-stage pyrolysis of liquid hydrocarbons under conditions of high thermal stress. The formation water samples display chemical signatures similar to seawater but with variable salinities. The marine signature of the water in the fluvio-lacustrine strata of the McCully field suggests infiltration and mixing of water from overlaying marine rocks (Windsor group) with low salinity connate water. The chemical and isotopic signatures of the formation fluids will be used as tracers to identify possible sources and pathways of deep-sourced contamination to shallow groundwater resulting from gas production activities in the McCully field.

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