

Chemical and Isotopic Characterization of Water and Dissolved Gases in Shallow Aquifers in the Vicinity of CBM Operations in Alberta

AUPRF project #912451

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Introduction

Coalbed methane is a vital new energy source in Alberta.

Occasionally, concerns are raised about the potential for contamination of **shallow aquifers** with CBM-derived fluids or gases.

To address such concerns in a scientifically sound manner, **reliable tracer techniques** are desirable that enable monitoring of CBM fluids and gases.

Overall Research Goal

Ensure an environmentally sustainable extraction of coalbed methane, while protecting freshwater resources in the shallow aquifers of Alberta.

- A) Thorough characterization of **produced gases and fluids** from CBM wells
- B) Thorough characterization of **shallow groundwater and its gases** prior to the commencement of CBM production (baseline)
- C) Careful monitoring of **groundwater quality** during CBM production

Objectives of this Project

Thorough characterization of **shallow groundwater and its gases** prior to the commencement of CBM production (baseline)

- determine and understand natural variability of **chemical composition** of shallow groundwater;
- determine and understand the natural occurrences of **dissolved gases** in shallow aquifers;
- determine the **sources of these gases** such as methane by analyzing their isotopic composition;

Outcome: solid background data based on which a potential impact of the CBM industry, or the lack thereof, on shallow aquifers can be tested based on scientifically sound data

Monitoring Parameters

Fluids:

- temperature, pH, electr. conduct., alkalinity, TDS
- major cations & anions (Ca, Mg, Na, K, Cl, SO₄, F etc.)
- trace elements, BTEX, PAH
- water isotope compositions ($\delta^2\text{H}$ & $\delta^{18}\text{O}$)
- isotope composition of sulfate and HCO₃⁻ ($\delta^{34}\text{S}$ & $\delta^{13}\text{C}_{\text{DIC}}$)

Gases:

- composition of **dissolved gases** (CH₄, C₂, CO₂, N₂ ...)
- carbon isotope ratios of dissolved gas (CH₄, C₂H₆, CO₂)
- carbon and hydrogen isotope ratios of methane in free gas, where available

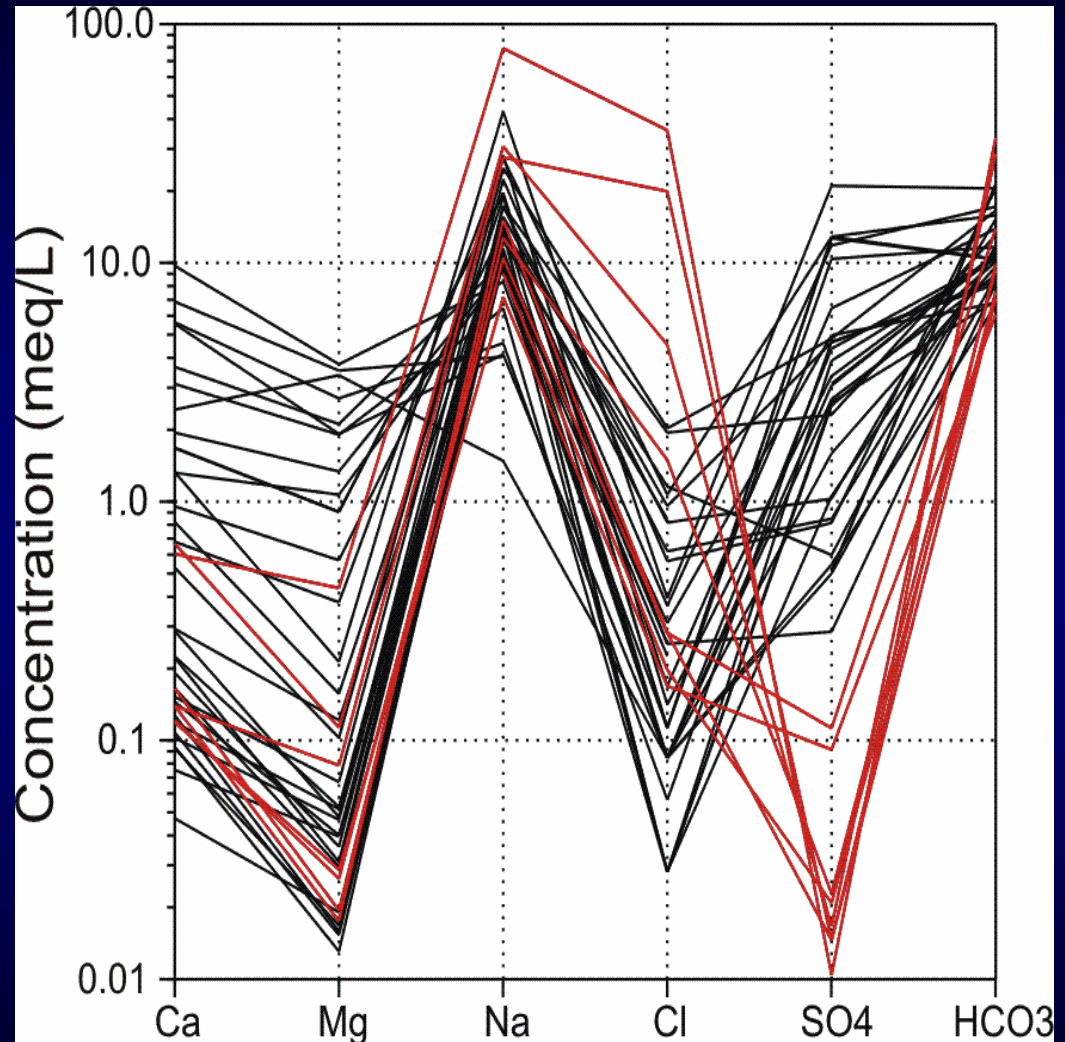
Preliminary Results: Chemistry

Total Dissolved Solids (TDS):
360 to 2630 mg/L

Water Type:
Na-HCO₃-SO₄
waters

Sulfate abundant
in most samples;

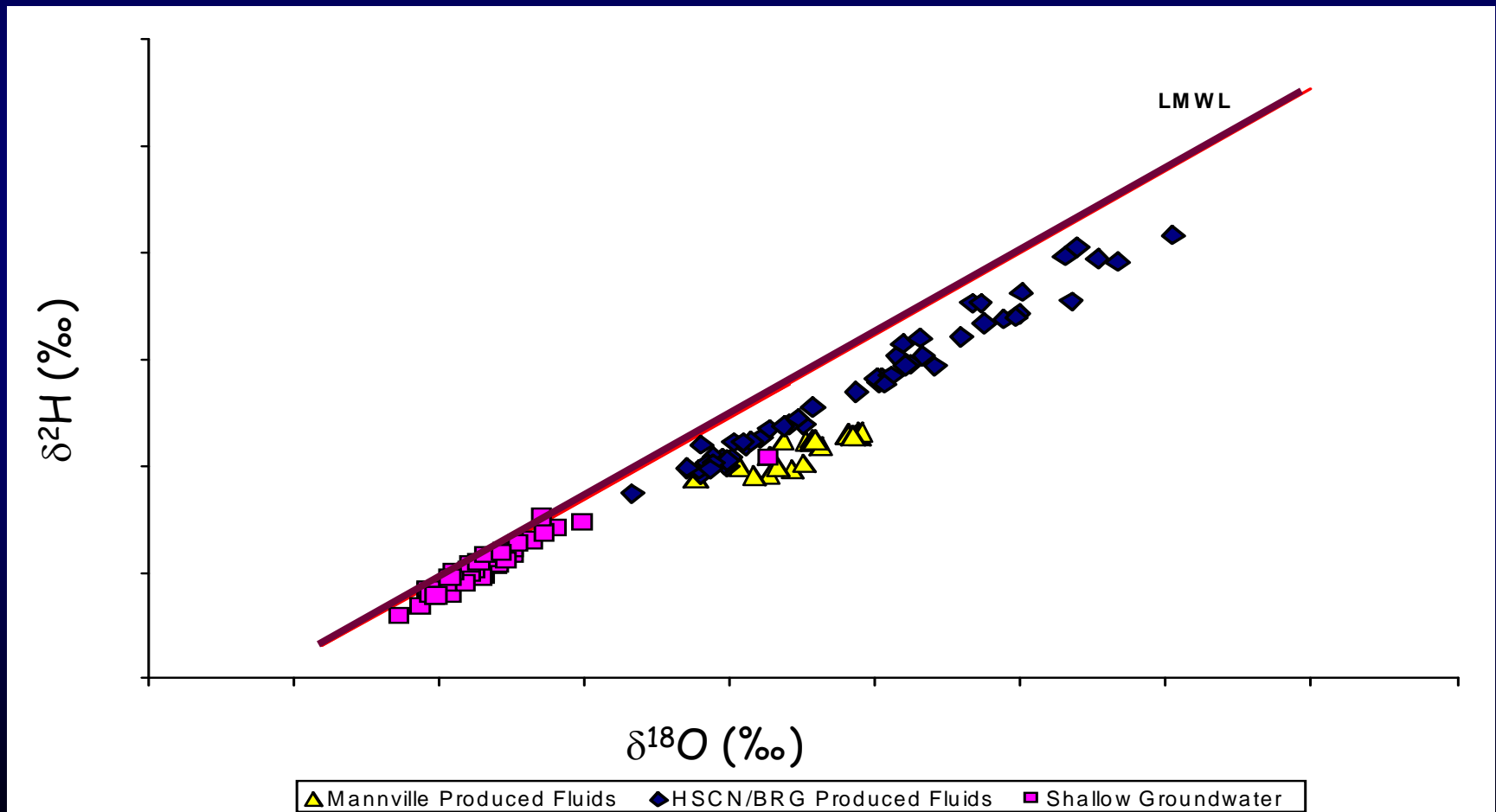
only few with low
sulfate concentrations



Schöller diagram summarizing the distribution of major ions in groundwater (in meq/L)

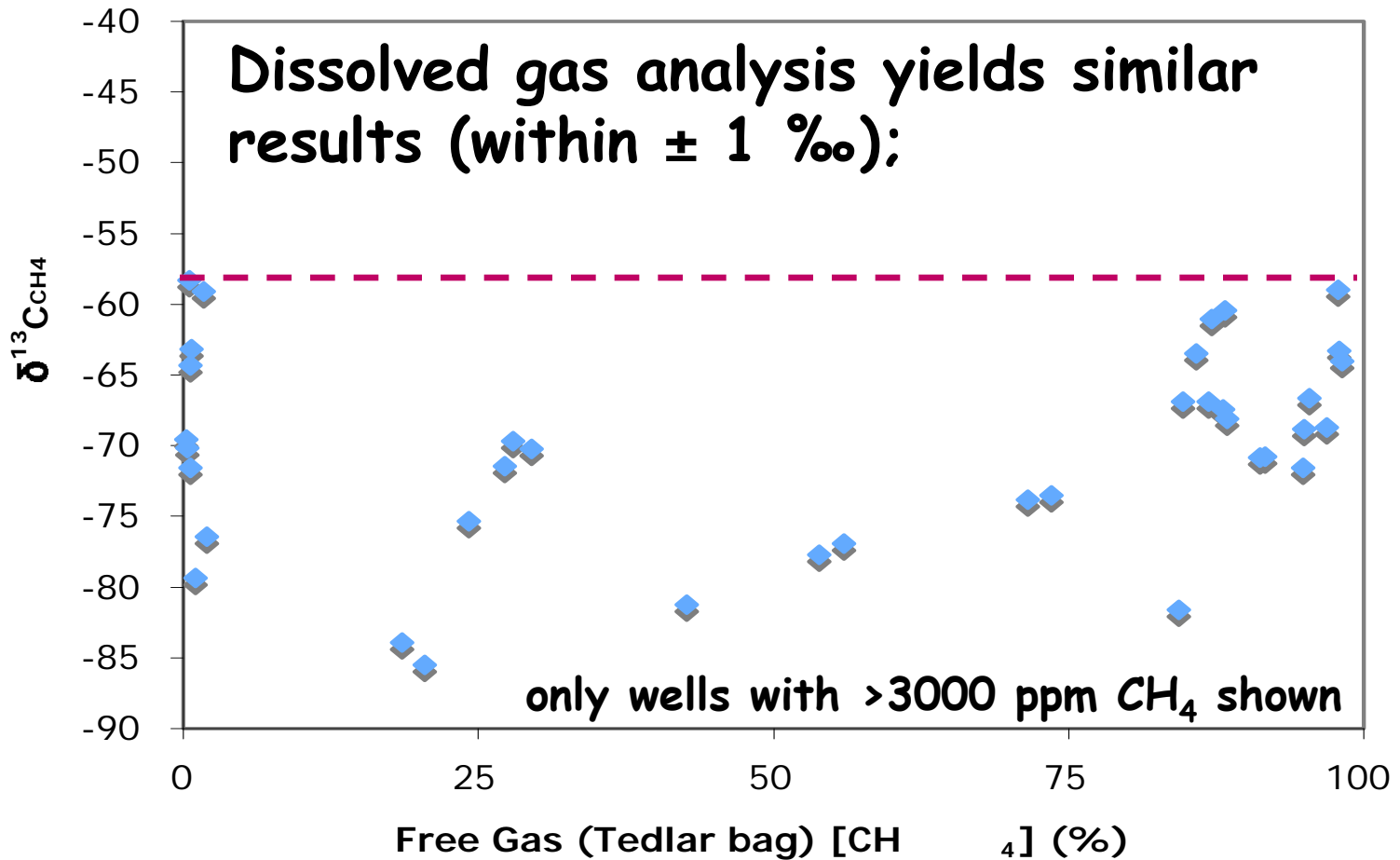
Preliminary Results: Water Isotopes

Isotopic compositions of produced fluids from the Horseshoe Canyon Formation are distinct from those of shallow groundwater



$\delta^{13}\text{C}$ of CH_4 in shallow groundwater

Independent of CH_4 concentration, $\delta^{13}\text{C}$ values are generally below -58 ‰ (biogenic CH_4)



Conclusions

Thorough analysis and knowledge of the chemical and isotopic composition of

- produced fluids & gases from CBM wells,
 - water, dissolved and/or free gases in “baseline” groundwater in concert with
 - an adequate groundwater monitoring program
- appear to have the potential to make a significant contribution to an environmentally sustainable extraction of coalbed methane, while ensuring the protection of freshwater resources in the shallow aquifers of Alberta.

Acknowledgements

PTAC funding through AUPRF #912451

Financial support from Alberta Environment
(agreement 09-0280)

Previous support from the Alberta Ingenuity
Center for Water Research