

Lessons from the Isotopic Analyses of Surface Vent Flow Gas, Western Canada Basin

Karlis Muehlenbachs

Department of Earth and Atmospheric Sciences

University of Alberta

Edmonton, Alberta T6G2E3

Karlis.Muehlenbachs@ualberta.ca

A significant environmental challenge accompanying oil and gas development is to prevent and remediate the migration of gas into soil and surface casings from the 400,000 wells in the Western Canada Sedimentary Basin. Also, the high frequency (up to 45% in the heavy oil region near Lloydminster) of gas migration from wells should influence the selection of depleted oil and gas fields for possible CO₂ sequestration. Carbon isotope fingerprinting of migrating gas has proven to be an effective tool to identify its geological origin, greatly facilitating industry's efforts to plug the leaks at their source as is required by regulations for well abandonment. Many thousands of surface casing vent flow gases (SCVF) across the basin (Fig. 1) have now been analyzed at the University of Alberta for their carbon isotope ratios.

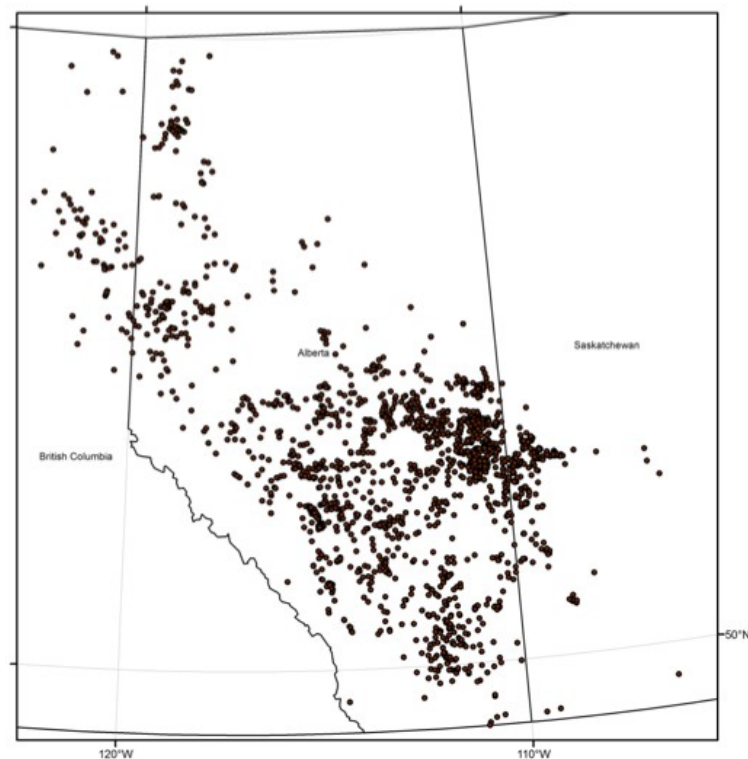


Figure 1, Location of surface casing vent flow gases in this study

Interestingly, most but not all, migrating gases from wells are not from the target pay zone but are from shallower intervening formations. Certain formations are found to be much more prone to leakage than others (e.g., Second White Speckled Shale in E. Alberta and W Saskatchewan) warning regulators and drillers of a need for more refined cementing techniques through those formations.

Proposed deep geological disposal of CO₂ requires the assured sealing off of the injection target whereas perhaps shallower leaks may be tolerable. The gas isotope database on SCVF can be queried as to what fraction of gases now migrating to surface do come from the deep reservoirs themselves. For 267 individual wells across the basin (Fig. 2), analyses are available for both the production and enclosing SCV gases.

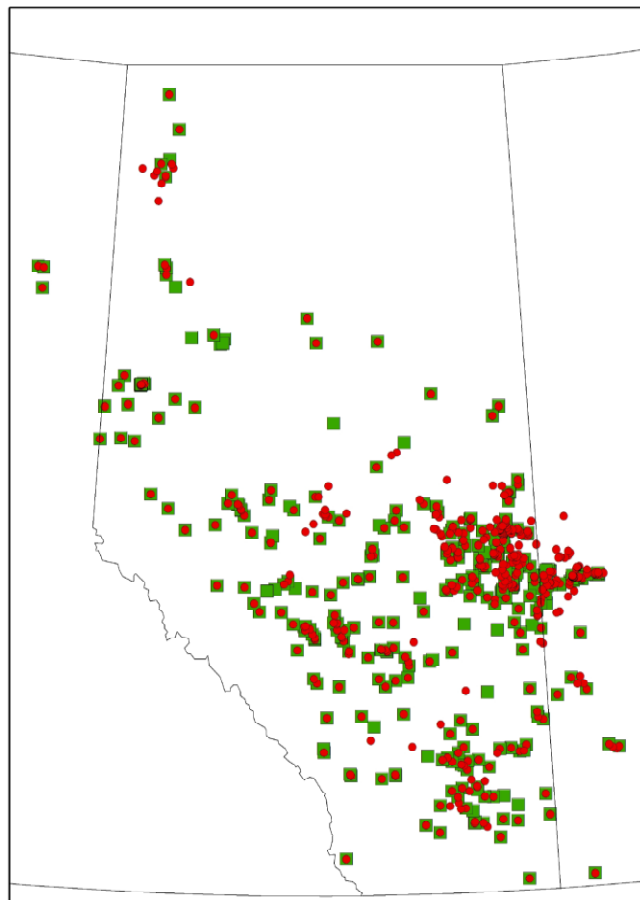


Figure 2. Location of wells for which isotopic analyses of both production and SCVF gases are available.

Gas migrating from a reservoir should have the same isotope values as the production gas. The production sourced migrating gases can be identified from the shallow SCVF as those falling on a 1 to 1 line on cross plots of the isotope delta values of both methane (Fig. 3) and ethane (Fig. 4) of production gas vs. SCVF gas.

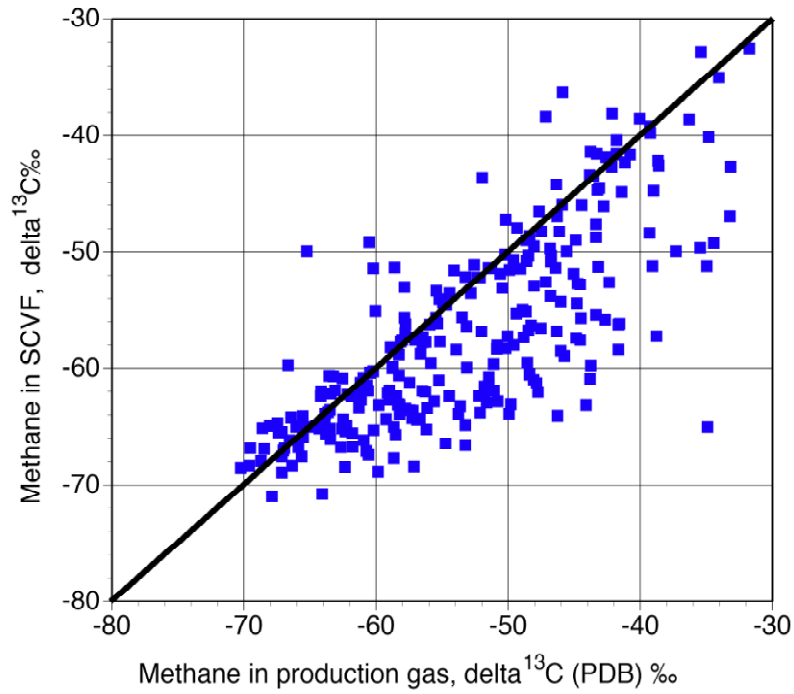


Figure 3. Comparison of methane isotope values in production gas vs. SCVF gas.

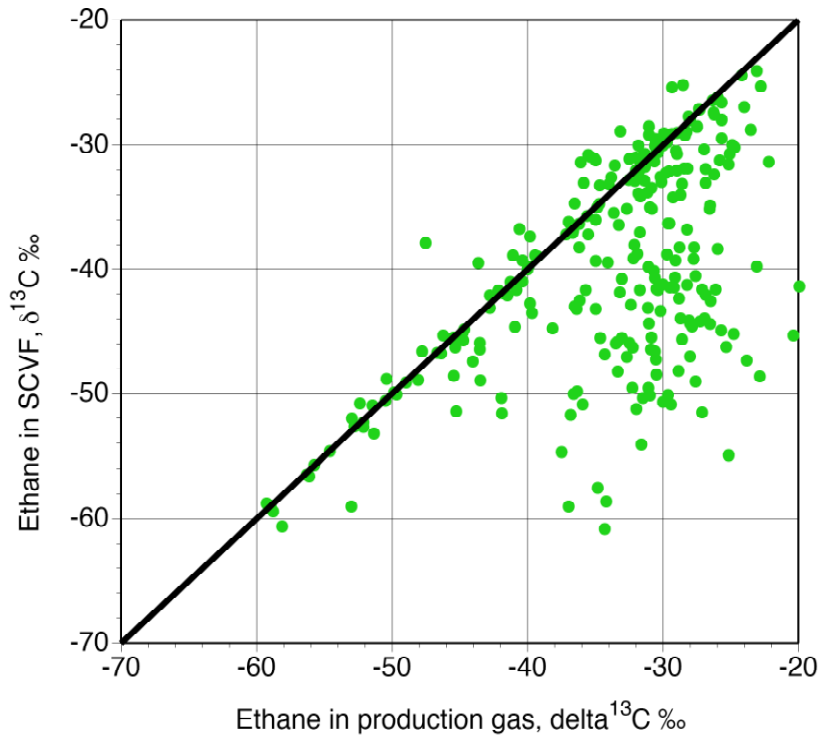


Figure 4. Comparison of ethane isotope values in production gas vs. SCVF gas.

In the above subset, 68 (about 25%) SCV gases are identified as coming from the deep production horizons. There appears to be no bias in their geographic distribution (Fig. 5). Also, the spans of isotope values of methane and ethane in Figs. 3 & 4 are huge, 40 per mille, implying no obvious selectivity with respect to depth for gas leaking along faulty well bores.

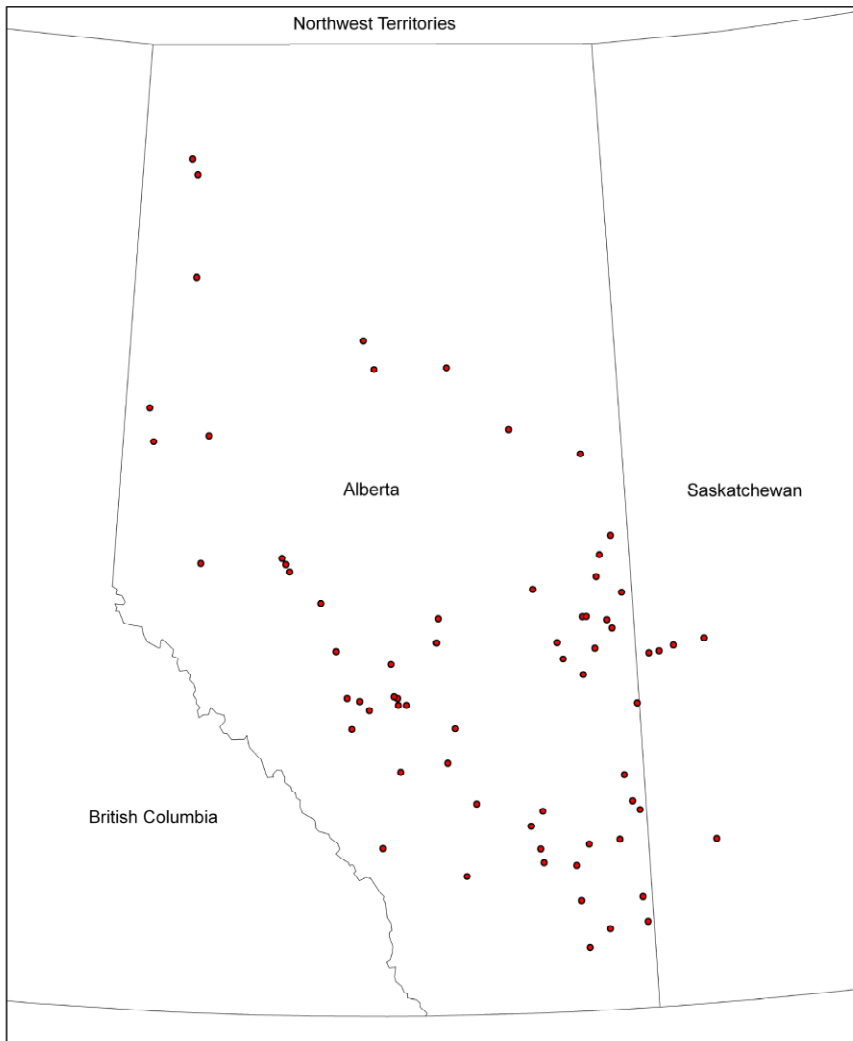


Figure 5. Location of oil and gas wells where the SCVF gas comes from the deeper production zone.