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Application of faulty energy wells' gas carbon isotope data to allocate and reduce methane emissions in the WCSB

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The transition to a clean future requires not only the development of renewable energy sources, but also the mitigation of unwanted greenhouse gas emissions from old and new petroleum fields. To do so effectively requires the ability to allocate emissions to each segment of the industry. Isotopic ratios of carbon in fugitive natural gases are effective in fingerprinting and identifying their source. We have compiled and mapped thousands of isotopic fingerprints of oil-associated and production gases, surface casing vent flows, and migrating gases in soils in the Western Canada Sedimentary Basin (WCSB). The cumulative data was generated to plug individual faulty wells, but when compiled and mapped, it reveals regional isotopic trends, which are potentially useful in the campaign to reduce GHG emissions by identifying their sources, followed by remediation. The following are the key findings from our previous research: (1) the isotope ratios of these gases change across the WCSB, reflecting the shape and depth/maturity of the fields. Thus, atmospheric monitoring of GHG at different locations in the WCSB may reveal what fraction of GHG at that location comes from emissions from industry. Also, (2) we have observed that about 75% of the faulty wells emit GHG with a different isotope fingerprint than the target formations, reflecting that most leaks are shallower than the target. This isotopic difference between producing and migrating gases can be used to allocate downstream emissions from local, well-related emissions. (3) Our preliminary data indicate that among the faulty wells, in specific fields, the most voluminous emissions come from shallower formations. Leaks from the target horizons, on the other hand, are typically smaller. This observation should guide prioritizing remediation strategies. (4) In the south east section of the WCSB, the isotopic composition of fugitive methane reflects a biogenic origin. Thus, it may no longer be a unique identifier. However, it should be noted that even when the isotopic fingerprint has an ambiguous methane value, the composition of ethane, propane, and butanes from oil and gas field emissions clearly separates them from the emissions from cattle, landfills, and wetlands, which lack the higher hydrocarbons.