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Investigating resource wells for combustible gas levels and types using intrusive and non-intrusive methodologies – will one standardized method provide an accurate assessment of combustible gas contents found in soils outside casing in all environments?

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In western Canada and globally, many oil and natural gas wells are leaking gas into surface casing vents and soils outside casing near the well-head. This undesired leakage, or migration of natural gases from deep thermogenic reservoirs may pose significant operational, safety and environmental concerns. Fugitive gases may move from hydrocarbon reservoirs at depth, upward into shallow porous strata and influence shallow aquifers, soils and, ultimately, may be released to atmosphere contributing to greenhouse gas emissions (GHG). Light hydrocarbon gases may enter a well bore at points of poor cement bonding with wall rock, in small, and possibly gas induced channels within the cement itself, or in micro-annuli at the contact between well casing and cement. When gas is found in the surface casing vent, it is termed surface casing vent flow (SCVF) and when found in soils outside or near well casing, it is termed active gas migration (AGM). In addition to thermogenic gases associated with anthropogenic activities such as drilling resource wells to exploit hydrocarbon reserves, combustible gases may be present in soils as a result of biological activity and soil respiration processes, hydrocarbon contamination related to spills or chemical releases, or natural background processes. Correct identification of the levels, types and origin(s) of combustible gases found at or near resource wells is essential for designing cost effective methods and successful execution of leaking gas intervention operations to retain zonal isolation at depth.

Government regulators overseeing the resource industry have provided direction and guidelines outlining methodologies to access or identify stray or combustible gas contents found in soils outside casing (i.e. Alberta AER Directive-20 March 15, 2016, British Colombia, BC-OGC, OGOM Ch.9 Sec. 9.7.3 to 9.7.6 October 2017 and Saskatchewan, SK-ME PNG 026 November 2015 & PNG 015 November 2015). GCHEM Ltd.'s extensive internal research has shown that some techniques may provide 'false positives' or 'false negatives' at identifying the types and levels of combustible gas contents found in soils rendering the assessment invalid. 'False negatives' may cost operators significantly more capital in intervention operations as after the resource well is cut, capped, abandoned and the lease is reclaimed additional operations are required to re-enter the well bore to eliminate undesired fugitive gas emissions.

In this presentation, field methodologies are provided that compare intrusive and non-intrusive leaking gas detection techniques and soil vapor flux measurements complimented with field case studies obtained from resource wells located in Western Canada and the Canadian Arctic. In addition, gases found in soils at resource wells can be classified, characterized, the geological origin(s) of combustible gas contents can be identified using molecular and stable carbon (□13C) and hydrogen (□D) isotopic compositions of light alkane/ene gases (Energy-Forensics).