geoconvention
Calgary • Canada • May 15-17 2023

Why do energy wells' fail? Insights of sourcing from Surface Casing Vent gas carbon isotope geochemistry

Gabriela González Arismendi[1,2] and Karlis Muehlenbachs[1]
[1]University of Alberta, Earth and Atmospheric Sciences, Edmonton, Canada
[1]University of Calgary, Geoscience, Calgary, Canada

Defective wells may account for 10 to 50% of Canada's methane emissions. New government regulations in Canada and elsewhere aimed at preventing leaks from faulty wells may be a practical strategy to cut greenhouse gas (GHG) emissions. The mechanisms and causes of wells' failure may be elucidated by geochemical variables and engineering records which may answer— "Why do energy wells' leak?". We suggest a workflow to identify the source of the leaks by first carbon isotope fingerprinting of the unwanted surface casing gas emissions. Then (i) locating the wells with high flux rates, (ii) determining the geological source of the leaks, and (iii) and examining well records for engineering and cementing information that would point to the leak's cause. In addition to isotopic data per well, the workflow utilizes public data on casing pressures, flux measurements of surface casing vent flows, and engineering data on specific wells. Our analysis of two sub-regions, Lloydminster and SE Alberta, showed that, as opposed to the deeper targeted strata, around 75% of the leaks originate from shallower and intermediate formations. The source depth of leaks from both horizontal and vertical wells is typically the same regardless of the age of the well. The majority of the leaks are caused by specific gas-charged intermediate formations. Smaller leaks originate in both the shallower, intermediate, and target zones. Surprisingly, higher shut-in pressures and larger surface casing flows tend to originate at shallower depths. In these cases, operators used significantly less cement. Thousands of faulty wells exist in the WCSB, not to mention millions elsewhere in the world. Our findings and further insights from the engineering perspective may assist both in prioritizing remediation to achieve an effective and economically viable solution to reduce GHG emissions and improve future well planning and development.