geoconvention
Calgary • Canada • May 13-17 2019

Application of Chemical and Stable Carbon ($\delta^{13}C$) and Hydrogen (δD) Isotopic Compositions to aid Operators in Determining the Source of Leaking Thermogenic Natural Gas in Surface Casing Vents (SCVF) or Soils Outside Casing (AGM) in Area Base Closures.

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Repairing leaking thermogenic natural gas found in surface casing vent (SCVF) or soils outside casing (AGM) at resource wells has proven to be a difficult and challenging task where first attempt intervention success rates using conventional 'leaking gas source technology and tools' are only 15 to 20%. Each unsuccessful or failed attempt costs resource companies' significant capital and collectively, with the volume of impacted wells scheduled for abandonment and reclamation including orphan wells, it is estimated at a several billion-dollar liability in Western Canada alone.

Chemical and stable carbon and hydrogen isotopic compositions of natural gases (Energy Forensics) is an emerging science that is being used to identify the geologic source(s) of leaking thermogenic natural found in SCVFs and AGM at resource wells. Identifying the geological origin of leaking natural gas is critical for designing successful intervention strategies.

Specific areas on a local and regional scale leak natural gas to surface from common geological intervals. Once these leaking geological intervals have been identified, operators can focus their intervention efforts to eliminate undesired gas leakage to surface. A common 'intervention methodology' maybe developed and by applying 'what works' for that interval or well location could be applied to other offset wells leaking from that specific source interval.

By incorporating a multi-disciplinary approach using geochemistry, geology, engineering and area history and applying this approach to an 'Area-Based Closure' philosophy where a high number of wells are scheduled for abandonment, operators will realize increased success and benefit on economics of scale for well abandonment services to repair resource wells impacted with undesired thermogenic natural gas leakage to surface.

In this presentation, we will demonstrate 'Energy-Forensics Techniques' to identify the geological origin(s) of leaking thermogenic natural gas sources and areas that are leaking from common natural gas intervals in the subsurface to apply to 'Area Based Closure' scenarios.