Detectability of fugitive emissions at an enhanced oil recovery site

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Enhanced oil recovery (EOR) is a fundamentally important technology for securing future oil production. However, this technology requires the use and transportation of fluids at high pressures above and below ground, which can lead to surface or subsurface seepage, especially as infrastructure ages. The EOR project located in Weyburn, Saskatchewan consists of more than 1000 active wells, several processing plants, and hundreds of kilometres of pipeline infrastructure over a 100 km2 area. This highly distributed operation presents challenges for gas leakage monitoring in terms of size and complexity of gas signals, and stretches conventional techniques beyond their limits. By comparing the ratios of observed atmospheric trace gases against the ratio fingerprints of known industrial, potential emission sources have been constrained. This presentation discusses the development of new large footprint techniques for identifying sources and magnitudes of fugitive emissions, and to understand targeted gas evolution across multiple land uses and through time.

To observe changes in the atmospheric composition of select gases, and to ascertain how those might be related to industrial activities, we used two Cavity Ringdown Spectroscopy (CRDS) instruments and a novel trace gas detection strategy to identify atmospheric emissions in this large domain (10×10 km). These instruments measured atmospheric concentrations of CO_2, methane and its stable carbon isotopic ratio (δ13C-CH_4), and hydrogen sulfide (H_2S). Both instruments alternated as stationary and mobile (vehicle-based and geo-located) receptors during field campaigns in 2013–2014. This presentation focuses on our mobile receptor techniques for constraining the location of potential emissions.

Anomalies in gas ratios of CO_2:CH_4 and CH_4:H_2S detected along route by the mobile receptor were compared to known ratios of likely industrial sources (e.g., pipeline, injection fluid, formation gases, etc.). This geochemical fingerprint was used to distinguish these sources from one another, and from other potential confounding sources including biological emissions, combustion engines, and atmospheric pooling. Our results identified several anomalies that were found to correspond with oilfield activities at the time of the survey, which were known to have gas emission potential. Here we give case study examples showing how potential emission events were pinpointed and investigated. This multi-gas component approach allows us to extend the utility of analyzers beyond single-mode deployments, to constrain the location and better estimate the source of potential emissions in the Weyburn field. It is a promising package for EOR, Carbon Capture and Storage (CCS), unconventional gas and hydrofracturing, and other fugitive gas monitoring programs where sensitivity and specificity are required.

Atlantic Geology, 2014, Volume 50, Number 1
Atlantic Geoscience Society Abstracts: 40th Annual Colloquium & Annual General Meeting 2014
doi: 10.4138/atlgeol.2014003