Quantifying Relative Contribution of Natural Gas Fugitive Emissions to Total Methane Emissions in CO, UT, and TX Using Mobile Isotopic Methane Analysis Based on Cavity RingDown Spectroscopy (CRDS)

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Fugitive emissions of methane into the atmosphere are a major concern facing the natural gas production industry. Because methane is more energy-rich than coal per kg of carbon dioxide emitted into the atmosphere, it represents an attractive alternative to coal for electricity generation, provided that the fugitive emissions of methane are kept under control. A key step in assessing these emissions in a given region is partitioning the observed methane emissions between natural gas fugitive emissions and other sources of methane, such as from landfills or agricultural activities. One effective method for assessing the contribution of these different sources is stable isotope analysis, using the isotopic carbon signature to distinguish between natural gas and landfills or ruminants. We present measurements of methane using a mobile spectroscopic stable isotope analyzer based on cavity ringdown spectroscopy, in three intense natural gas producing regions of the United States: the Denver-Julesburg Basin in Colorado, the Uintah Basin in Utah, and the Barnett Shale in Texas. Performance of the CRDS isotope analyzer is presented, including precision, calibration, stability, and the potential for measurement bias due to other atmospheric constituents. Mobile isotope measurements of individual sources and in the nocturnal boundary layer have been combined to establish the fraction of the observed methane emissions that can be attributed to natural gas activities. The fraction of total methane emissions in the Denver-Julesburg Basin attributed to natural gas emissions is 78 +/- 13%. In the Uinta Basin, which has no other significant sources of methane, the fraction is 96% +/- 15%. In addition, results from the Barnett Shale are presented, which includes a major urban center (Dallas / Ft. Worth). Methane emissions in this region are spatially highly heterogeneous. Spatially-resolved isotope and concentration measurements are interpreted using a simple emissions model to arrive at an overall isotope ratio for the region.

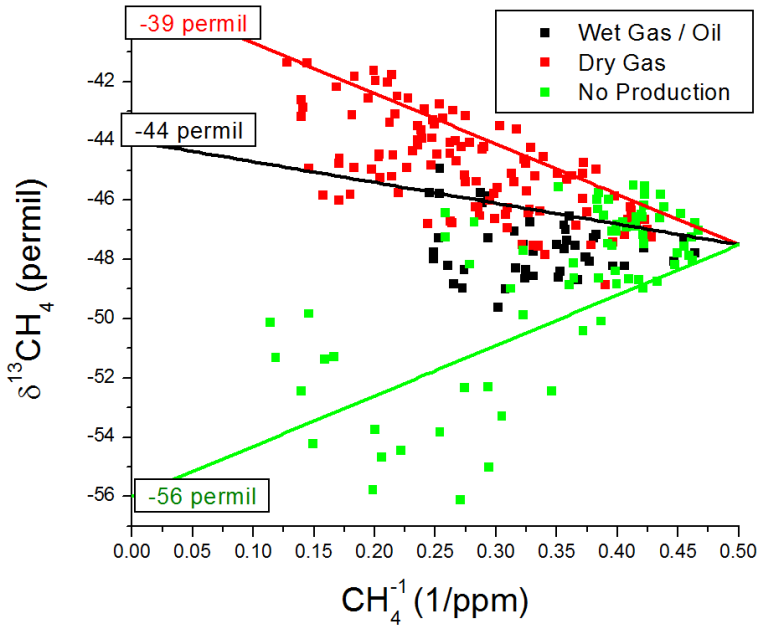

Figure 1. Keeling Plot of mobile isotope data in the Barnett Shale region, in dry gas production areas (red), wet gas production areas (black), and areas with little or no production (green).