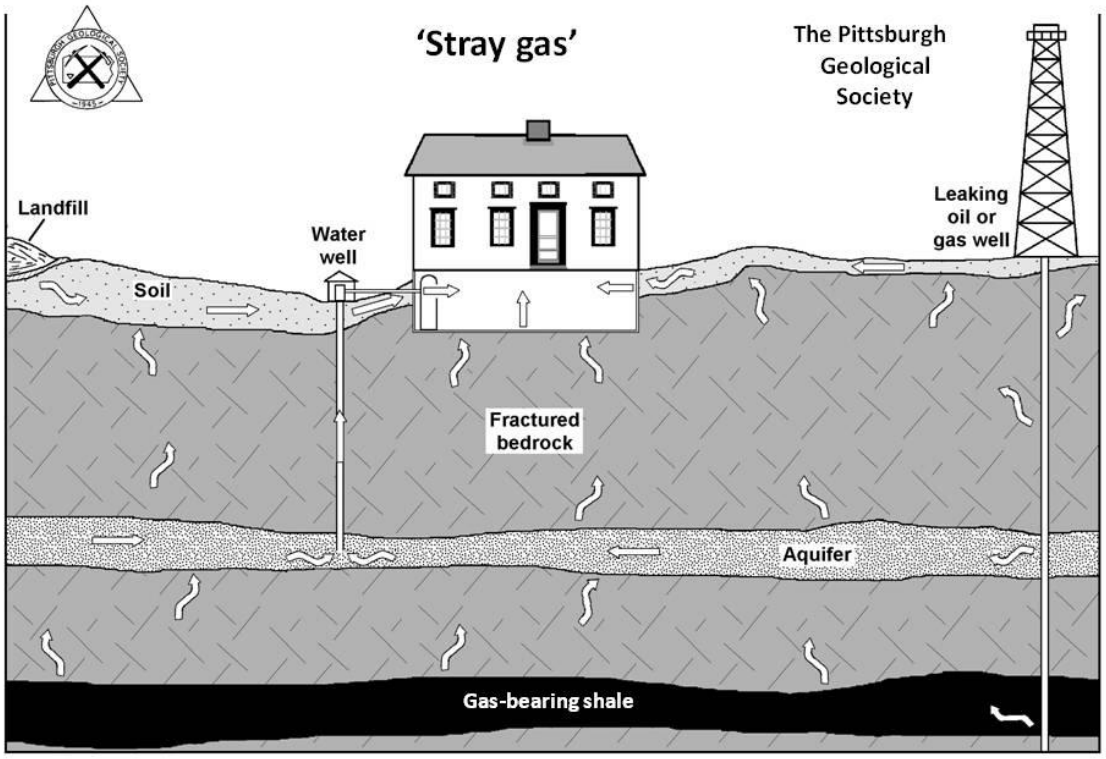
Stray Gas

Whether gas wells are being drilled in your neighborhood, or not, it is worth knowing about 'stray gas'. Stray gas in well water can occur in areas without commercial gas wells. What follows is a short description of this problem, and what steps you might take, if you have concerns about stray gas.

What is stray gas?

'Stray gas' is natural hydrocarbon gas that enters water wells as a dissolved component in groundwater, or as separate gas bubbles in household water. Less commonly, but very importantly, stray gas may enter buildings directly through foundation cracks or permeable soil beneath structures, as shown below.



note: most stray gas in water wells migrates upward from depths of 10's to 100's of feet below the ground surface

Where does stray gas come from?

Stray gas has two natural sources. Thermogenic, or 'deep gas', is formed during burial and heating of geologically ancient organic material (dead plants and animals). It is most common in areas where the bedrock is sedimentary (shale, sandstone, limestone, coal), and is the type of gas

extracted from subsurface reservoirs as commercial natural gas. Thermogenic gas consists mostly of methane (CH_4), plus some ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}). We often use a sort of shorthand, and refer to these gases just using the number of carbon atoms present, so methane is C_1, propane C_3, etc. The proportions of these hydrocarbon gas compounds vary, with higher percentages of the C_2-C_4 (ethane, propane, butane) gases found in rocks that are 'oil-prone'. We call this sort of natural gas 'wet' gas, since it is associated with petroleum liquids. 'Dry' gas has a higher percentage of methane (approaching 100%), and comes from rocks that contain little or no liquid petroleum. Since the proportions of C_1-C_4 in gas from difference sources may vary considerably, these differences can be used to fingerprint the possible sources of stray gas.

Biogenic, or 'shallow gas', is a product of natural microbial fermentation of organic matter. Biogenic gas may come from marshes and swamps, landfills, poorly vented septic tanks, manure piles, and sediments that accumulated in lakes, ponds and lagoons. Biogenic gas may also be produced by microbial breakdown of petroleum hydrocarbons or coal in near-surface settings. Like thermogenic gas, biogenic gas may enter water wells or travel through permeable surface material to enter basements of buildings. Biogenic gas consists almost entirely of methane, with very little of the higher hydrocarbon gas components (ethane, propane, butane).

Distinguishing between deep, thermogenic gas and shallow, biogenic gas requires analysis of the gas to determine the relative proportions of C_1, C_2, and C_3 using gas chromatography (the shorthand is 'GC analysis'). In addition, the stable isotope ratios of hydrogen and carbon in th gas can also be determined (using mass spectrometry). The proportions of C_1/C_2+C_3 and stable isotope ratios are plotted on graphs as shown below.

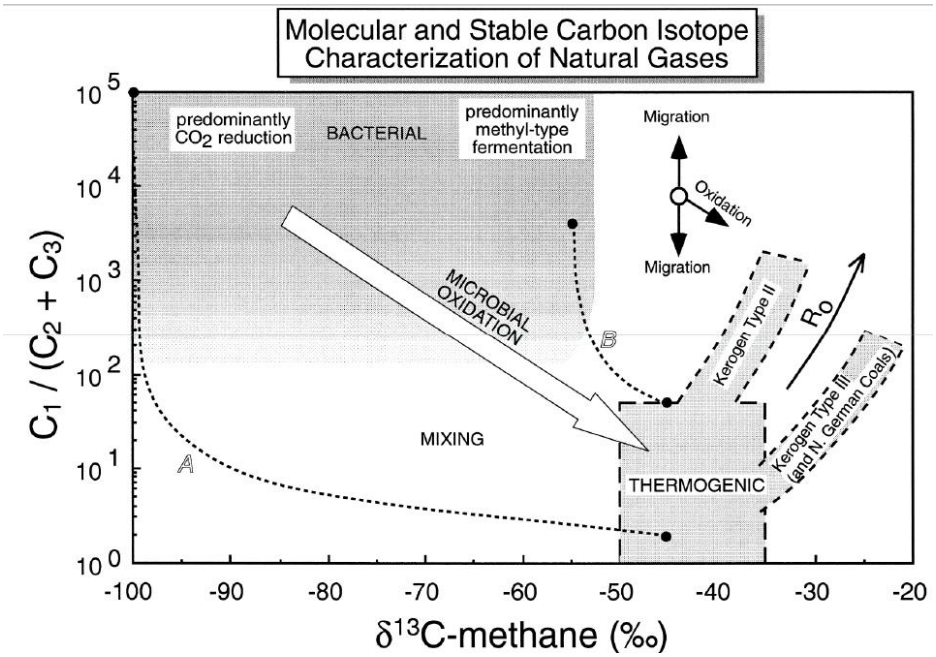


Diagram from a presentation by Fred J. Baldassare, P.G.

Ideally, deep, thermogenic gas will have higher 'wetness' (more of the C_2-C_3 gases and thus 'wetter') and less negative carbon isotope ratios than shallow, biogenic gas. However, in some areas both gas sources may be present, and mixing of gas from different sources may make it difficult to absolutely determine the source of the gas. Some thermogenic gas that formed at higher temperatures well beyond the oil window may consist almost entirely of methane, so it is 'dry'. Also, oxidation of gas as it travels upward through an aquifer will change the proportions of C_1-C_4 and may also change the stable isotope ratios of carbon and hydrogen, as shown below.

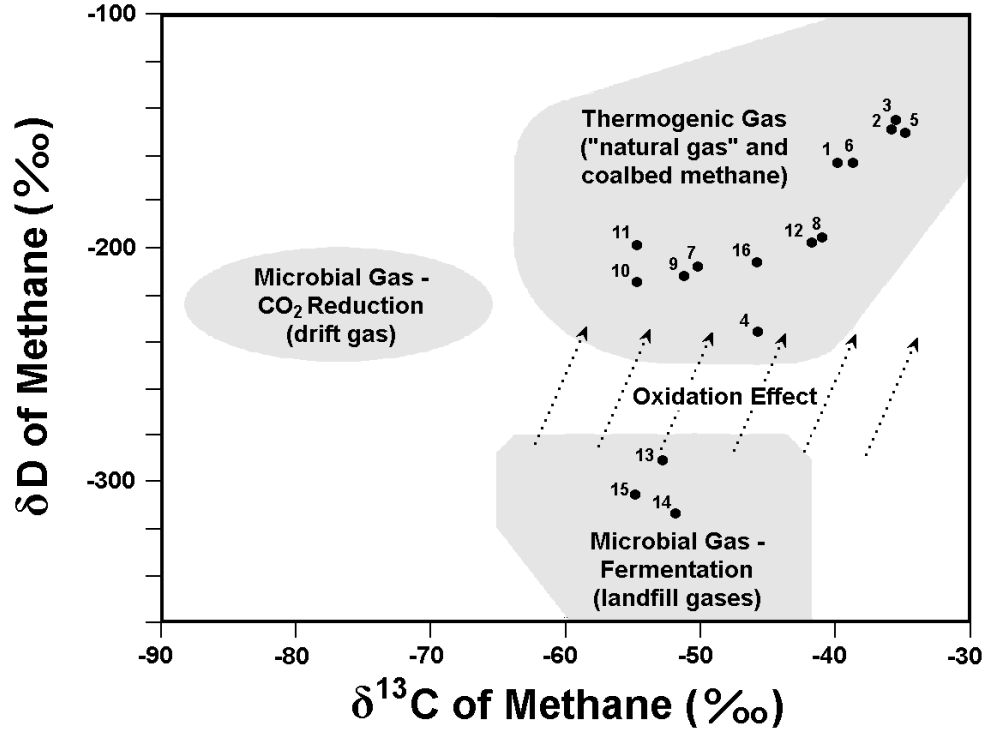


Diagram from a presentation by Fred J. Baldassare, P.G.

How do I know if I have 'stray gas' in my well water?

Stray gas in well water is often suspected when the first water drawn from a faucet is accompanied by obvious gas bubbling or hissing. This may be especially noticeable after a period of time when the water system has been unused (say after a few days away from the house). The gas may have very little or no odor. Periods of inactivity allow dissolved gas in the well water to separate and accumulate in the upper parts of the plumbing system near faucets. In some cases, the gas that comes out of the faucet can be ignited and will burn for a number of seconds. When water is drawn into a clear container, gas bubbles will form and give the water a milky appearance. This can also be caused by dissolved air. Many household water systems that

contain stray gas require treatment of water prior to use. This may be as simple as allowing water to rest in a tank prior to use. The water is held at atmospheric pressure, which allows the gas bubbles to form and escape. The gas must be vented to outside air to prevent explosion hazard.

Gas is more soluble in water under increased pressure, so stray gas is more often a problem in deeper wells that are drilled into bedrock in areas underlain by shale. However, shallow wells may also contain produce water containing dissolved gas, and natural gas seeps and 'bubbling' springs are not uncommon.

What should I do? Sampling and testing:

If stray gas is suspected in a water system, sampling and testing of water is highly recommended. As noted above, stray gas may be present in areas where no commercial development of natural gas has occurred, so sampling and testing prior to any new development is a really good idea. Sampling of well water should be done following the established procedures that are outlined in the website listed below. The sample needs to be taken from the well itself, at depth, where the dissolved gas is representative of the inflow into the well. Water sampled at the tap may have passed through filters, water softeners or heaters that could alter the gas chemistry.

Analysis of water and contained gas is generally done by a commercial lab (e.g. Isotech), or in labs at some major research universities. Sample, containment and shipment procedures are really important with dissolved gas samples. Users are advised to contact the lab directly for advice on sampling, containment and shipment.

Link to website at Isotech Labs that provides information on sampling:

http://www.isotechlabs.com/customersupport/samplingprocedures/DGbottle.pdf

A great source of information on stray gas in the Appalachian Basin:

http://pa.water.usgs.gov/projects/energy/stray_gas/presentations.php

If you have questions or concerns, please contact:

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