Attribution of natural gas in shallow groundwater using dissolved nitrogen and alkane chemistry in Parker County, Texas

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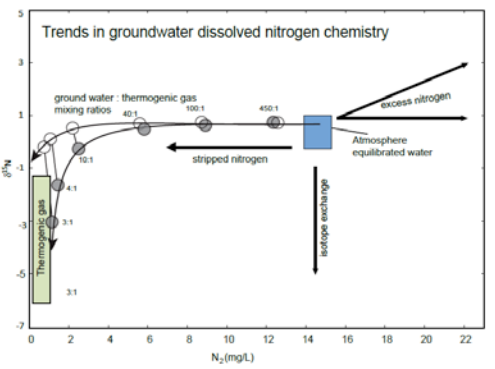
Public debate centers on understanding if hydraulic fracturing and natural gas production threaten groundwater quality. We report dissolved alkane and nitrogen concentrations and corresponding $\delta^{13}C$ and $\delta^{15}N$ values from 208 groundwater wells in the Barnett Shale footprint of Texas to: (1) differentiate 'stray' thermogenic gas from microbial methane, and (2) estimate water:stray gas ratios in affected wells. Whereas dissolved alkane chemistry effectively distinguishes thermogenic and microbial gas, dissolved nitrogen and its $\delta^{15}N$ value is more useful to estimate volume ratios of stray gas to groundwater. We observe an inverse correlation between dissolved methane and nitrogen concentration and $\delta^{15}N$ value; wells affected by large volumes of stray gas have the lowest dissolved nitrogen concentrations and $\delta^{15}N$ values due to stripping and exchange with reservoir gas (Figure 1).



Most sampled wells have trace to non-detect methane. A cluster of wells near the Parker and Hood county line have >10 mg/L dissolved methane concentrations with alkane chemistries similar to natural gas from the Barnett Shale and/or Strawn Formation. Many samples, even those with >10 mg/L methane, have dissolved nitrogen chemistry typical of atmosphere equilibrated groundwater. Dissolved nitrogen in the two most affected wells is consistent with infiltration of stray gas from the Strawn Formation, rather than from the Barnett Shale. Collectively, these data suggest that local geology will have more effect on stray gas content inshallow groundwater rather than nearby hydraulic fracturing operations.