CONSTRAINING THE SOURCE AND MIGRATION OF NATURAL GAS IN RESERVOIRS AND SHALLOW AQUIFERS USING NOBLE GAS AND HYDROCARBON ISOTOPE GEOCHEMISTRY

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Advances in horizontal drilling and hydraulic fracturing technologies have substantially increased the potential for the recovery of natural gas and oil from unconventional energy resources (e.g. organic-rich black shales). Nonetheless, public and political enthusiasm and consent is tempered by various concerns regarding the environmental risks associated with shale gas development, specifically drinking-water quality (e.g. contamination from hydraulic fracturing fluids, production/flow back waters, and/or stray combustible gases).

The significance of elevated levels of combustible gas in shallow aquifers have been at the forefront of these concerns. Previously, Osborn et al 2011 identified 17-times higher concentrations of thermally mature methane (CH₄) and aliphatic hydrocarbons (e.g. ethane (C₂H₆)) in drinking water wells within 1km of shale gas development sites producing from the Marcellus Shale in northeastern Pennsylvania. While these findings suggest a correlation between areas of shale gas development and elevated methane concentrations in shallow aquifers, others suggest that the presence of methane in shallow groundwater aquifers is common, natural, and unrelated to shale gas development (e.g. Molofsky et al, 2011). The potential for elevated methane concentrations from both natural geological migration and anthropogenic activities highlights the need to develop and validate advanced geochemical systematics (e.g. integrated noble gas and hydrocarbon molecular and isotope geochemistry) capable of evaluating the source, timing, and migration history of hydrocarbon gases currently present within shallow aquifers. I will discuss an initial assessment of the noble gas and hydrocarbon molecular and isotope geochemistry of production gases and shallow aquifers in the Appalachian Basin.

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