Geochemical characterization of West Virginia groundwater in an area impacted by hydraulic fracturing

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West Virginia is experiencing a rapid increase in exploration of the methane-rich Marcellus Shale. One of the risks associated with shale gas development is stray gas contamination. [1] Yet studies in other areas of the Appalachian Basin have shown evidence for both naturally occuring methane from upflow of deep saline groundwater [2] [3] and stray gas contamination from leaking shale gas wells. [1] In order to evaluate the impact of hydraulic fracturing on the water quality of shallow aquifers in northwestern West Virginia, the chemistry of drinking water wells were investigated in 110 private drinking water wells sampled between May 2012 and August 2014. Geochemical and isotope variations ($\delta^{13}C$-CH_4, $\delta^{18}O$, $^{87}Sr/^{86}Sr$, $\delta^{11}B$ and $\delta^{7}Li$) in drinking water wells located <1km and >1km from active shale gas wells were analyzed to determine the source of methane and dissolved constituents in the groundwater in the study area. Chloride concentrations ragned from <1 ppm to 2,200 mg/L. A subset of the study wells had elevated salinity (chloride > 50 mg/L) and Br/Cl ratios (>0.0015) that resemble the composition of Ca-rich brines. The $^{87}Sr/^{86}Sr$, $\delta^{11}B$ and $\delta^{7}Li$ variations suggest that the saline groundwater originated from naturally occurring processes, such as upflow of deep-seated saline groundwater, similar to what observed in northeastern PA. [1] [2]

[1] Darrah, Vengosh, Jackson, Warner and Poreda (2014), *PNAS* **111**, 14076-14081. [2] Warner, Jackson, Darrah, Osborn, Down, Zhao, White and Vengosh (2012), *PNAS* **109**, 11961-11966. [3] Wunsch (1993), *Thesis Series 5: Kentucky Geological Survey*.