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More evidence for (and against) groundwater contamination by shale gas

Studies in Pennsylvania and Arkansas find that geology dictates risks.

by **Scott K. Johnson** - June 28 2013, 10:37am EDT

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Shale gas well pad in Pennsylvania.

Robert B. Jackson

Few topics in the realm of energy are as publicly charged today as fracking, the process by which natural-gas-bearing layers of shale are hydraulically fractured to create pathways for the gas to be extracted. To some, it's simply a major boon to the US economy and energy independence. To others, it's a short-sighted resource grab that will leave drinking water resources poisoned for decades. As research in areas where fracking is already prevalent has slowly plodded ahead, what we've learned hasn't fit neatly into either of the black-and-white narratives of the political debate. The realities have, unsurprisingly, been complicated.

A pair of recent papers provides an example, finding different results in areas of Pennsylvania and Arkansas where shale gas is currently being produced.

Problems in Pennsylvania

The first provides an update to an earlier study in northeastern Pennsylvania, where the Marcellus Shale has been a hot target for the natural gas industry. That study analyzed water samples from 68 private wells; methane gas was found to be more prevalent in wells close to shale gas extraction sites. The work implied that the natural gas wells were somehow enabling the migration of natural gas upwards into the drinking water aquifer.

The study was not without its critics, and the researchers returned to the area to collect more data in the hopes of answering the question more clearly. While methane is the primary component of natural gas, it can also be generated by bacteria. To help differentiate such "biogenic" methane from natural gas, they also tested for ethane and propane, longer chain hydrocarbons not produced by bacteria, and carbon isotopes in the gases. They also sampled 81 new water wells for additional compounds and isotopes.

Pulling all their data together, the correlation between methane concentration and proximity to a shale gas well held. Though ethane and propane were less commonly detected (concentrations are typically much lower than methane), the same correlation appeared there. The carbon isotopes in all the high methane samples also indicated a natural gas source, though a few of the low methane samples appeared to be biogenic.

By looking at the carbon isotopes in methane, ethane, and propane, as well as helium-4 in the samples, they were even able to characterize whether it looked like natural gas from the deeper Marcellus Shale or from slightly shallower layers (which also contain some natural gas). They found some of both, which could indicate that both shallower and deeper natural gas is making its way toward the surface due to imperfections in the seals around the gas wells.

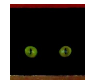
It's not impossible that some of that gas could be naturally present. Natural gas has long been bubbling up with the briney water at a nearby salt spring (an interesting feature at the center of a separate study we covered). But this can't explain all the findings. The gas at the spring fell in with the group resembling shallower sources. And the correlation with proximity to natural gas wells would not be expected for naturally occurring gas in this region.

All clear in Arkansas

While those results strengthen the case for natural gas migrating into groundwater as a result of the shale gas activities, a similar study in northern Arkansas tells a different story. The same group of researchers, working together with the United States Geological Survey, looked at 127 private wells in an area where the Fayetteville Shale is being tapped for natural gas.

There, methane was not a significant issue, with only one sample coming in high (of the 51 tested for methane). What little methane was detected showed no correlation with proximity to shale gas wells. The carbon-isotope signature of that methane also looked more like bacteria-generated methane than

renewal



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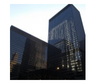

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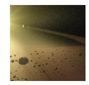

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natural gas. Nothing else about the sampled wells indicated any sort of contamination by deep fluids. They were even able to look at data from 43 wells sampled long before fracking started, finding no differences in the things that were tested for.

So why the difference? Were the shale gas wells in Arkansas constructed more carefully? It's possible, but it's more likely that the geology is responsible.

There's a relatively thick barrier separating the drinking water aquifer there from the Fayetteville Shale below. In Pennsylvania, the barrier rocks have been fractured somewhat by tectonic stresses, but the Arkansas rocks have not experienced that level of deformation. That makes fewer potential pathways for natural gas to flow through, decreasing the chances that any will migrate far enough to intercept imperfections in the well seals and hitch a ride up the borehole.

Pennsylvania also has a history of traditional oil and gas extraction that northern Arkansas does not, which means that many deep wells have been drilled in the past. Any wells that were not completely filled after they were shut down could create additional shortcuts for fluids moving through the rock.

The question "Does fracking contaminate groundwater?" does not have a yes or no answer. It depends on the specifics of the geology in the area and the specifics of the shale gas operation—which involves both the work underground as well as the handling of fracking fluid at the surface. Though some wells in Pennsylvania appear to be impacted by "stray gas", none of the potentially harmful chemicals used in the actual fracking fluid have shown up (though they have been seen in deeper groundwater elsewhere). And in Arkansas, no groundwater impacts of any kind have been found. Each situation is a little different.

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