Methane in drinking water unrelated to Pa. fracking, study suggests

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Fracking doesn't appear to be allowing methane to seriously contaminate drinking water in Pennsylvania, a new study finds—contrary to some earlier, much publicized research that suggested a stronger link. But the lead authors of the two bodies of research are sparring over the validity of the new results.

The new study of 11,309 drinking water wells in northeastern Pennsylvania concludes that background levels of methane in the water are unrelated to the location of hundreds of oil and gas wells that tap hydraulically fractured, or fracked, rock formations. The finding suggests that fracking operations are not significantly contributing to the leakage of methane from deep rock formations, where oil and gas are extracted, up to the shallower aquifers where well water is drawn.

The result also calls into question prominent studies in 2011 and 2013 that did find a correlation in a nearby part of Pennsylvania. There, wells closer to fracking sites had higher levels of methane. Those studies, however, were based on just 60 and 141 domestic well samples, respectively.

"I would argue that [more than] 10,000 data points really tell a better story," says hydrogeologist Donald Siegel of Syracuse University in New York, whose team published the new study online this month in *Environmental Science & Technology*. Chesapeake Energy Corp., which has large oil and gas stakes in Pennsylvania, supplied the researchers with the database, the largest of its kind, and also funded the work.

Fracking relies on the high-pressure injection of water, sand, and other chemicals to create microfractures in rock formations, thereby making it easier to draw out oil and gas. The term is also used more generally to describe a host of unconventional extraction techniques, such as horizontal drilling, which have helped make the United States the top producer of crude oil in the world. The Marcellus Shale formation, an organic-rich mudstone running from West Virginia to New York, was one of the first to be exploited by fracking. But the process has been dogged by concerns over its environmental impact and also its impacts on the climate, because any leaking methane acts as a powerful greenhouse gas.

Some of those fears were stoked after the 2011 and 2013 well water studies, which appeared in the *Proceedings of the National Academy of Sciences* (*PNAS*). The two papers seemed to show that fracking was leading to increased concentrations of methane in drinking water. Dissolved methane is not toxic, and drinking water often contains significant background levels of the gas from natural sources. But that was cold comfort to residents of Dimock, Pennsylvania, who were shown in the documentary *Gasland* igniting the flammable gas that came out along with water from their household faucets. A December 2014 New York State health department study cited the 2011 *PNAS* study in its review of the impacts of fracking, which found that there were potential water quality hazards. Governor Andrew Cuomo then banned fracking in the state.

But Siegel says that all of these fears are overblown. His study found natural backgrounds of methane in well water, but no trend related to the proximity of 661 oil and gas wells. "We found plenty of methane—and that's the whole point," he says, referring to natural sources of the gas.

Siegel doesn't deny that there have been problems with a few wells with poorly engineered steel casings or cracked and degraded cement walls designed to keep the boreholes from leaking. Such defective

borehole walls can provide a conduit for the methane to move from the shale formation, more than a kilometer underground, to water wells just a hundred meters or so below the surface. But he says his study shows that it is an exceedingly rare issue. “We haven’t seen any evidence [of methane migration] other than the occasional local issue,” he says. “I think our paper, in my view, pretty much seals the deal.”

Siegel believes the *PNAS* studies, led by Robert Jackson, a hydrogeologist at Stanford University in Palo Alto, California, painted a more worrisome picture because their small sample set was skewed toward locations with known well-casing issues. “I’ve always felt that the Jackson group studies have been highly flawed,” Siegel says.

Jackson, however, contests that characterization and argues that Siegel’s larger sample size doesn’t necessarily make for a better study. He says it is unclear whether the Chesapeake samples were measured at the water well itself, or inside houses, after the water may have had time to release its methane fumes, or after it has passed through purification systems. He also points out that the water samples were collected using the “inverted bottle” technique, a method avoided by many academic labs because it can lead to lower measured values of methane in samples with the highest levels of the gas, because it allows the methane to percolate out of solution. “They’ve introduced a whole series of methods that introduced noise into the data set,” Jackson says. He adds that, in a trip to Chesapeake headquarters in Oklahoma in 2011, he offered to collaborate with the company using the large data set but was rebuffed.

Bert Smith, a co-author on the new study and a former employee of Chesapeake who now works as a consultant, says he initially approached the U.S. Geological Survey with the company’s data set, but the agency declined. He then asked Siegel to collaborate on the study.

For all their disagreements, scientists on both sides of the fracking debate agree that it is very unlikely that microfracturing of rock formation itself contributes to the vertical migration of gases. The problem, they say, is with a minority of badly cased or cemented wells—they just disagree on how often this occurs. Siegel cites a 2014 study that found that just 0.24% of the thousands of wells in northeast Pennsylvania were ever given violation notices related to the migration of methane into groundwater. But Anthony Ingraffea, a civil engineer at Cornell University who is alarmed by the risks of fracking, says those violation notices are just the tip of the iceberg. He points to a study he led, published in *PNAS* in 2014, which found that 9% of unconventional wells drilled in northeast Pennsylvania since 2009 already have structural integrity issues. That problem will grow, he says, as wells age, and as tens of thousands of new wells are bored. “We’re just at the beginning,” Ingraffea says.

Siegel says he plans to publish three more studies using the Chesapeake data. One will examine the connections between background methane and the hydrogeological setting, and another will look at other chemical constituents in ground water. A third will take a focused look at how methane levels vary over time in 12 homes in which water wells were instrumented and monitored around the clock for 1 to 2 years.

Terry Engelder, a geologist at Pennsylvania State University, University Park, who was among the first to recognize the economic potential of the Marcellus Shale formation, says that large data sets like the one Siegel is working with is, at least, one benefit of the whole fracking controversy. “We’ve learned more about groundwater chemistry in northeast Pennsylvania than any other place in the world,” he says. “The intensity of sampling, not only of methane, but other chemicals, will be immensely valuable.”