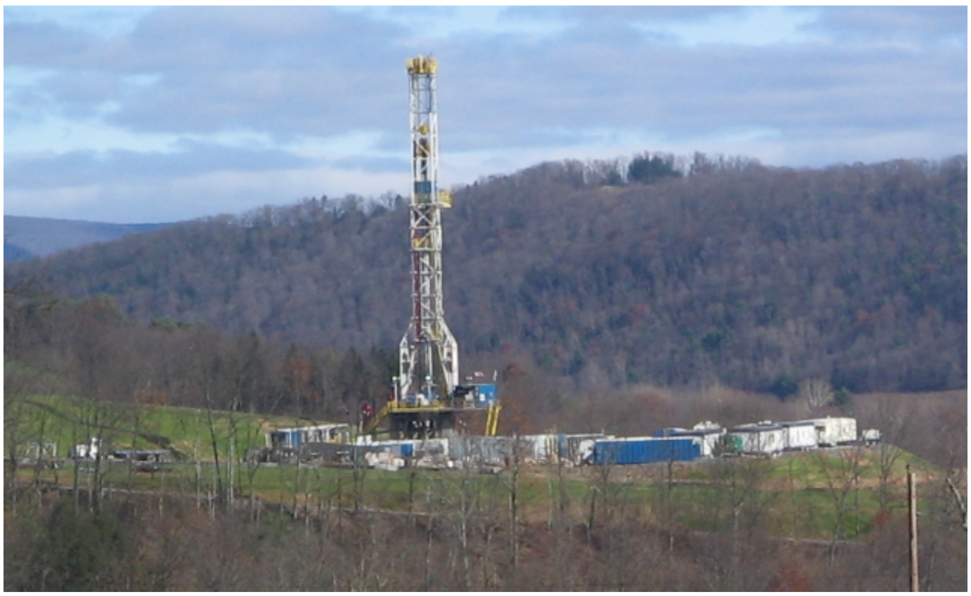
Fracked Pennsylvania shale could be naturally leaky

Drinking water aquifers contained some Marcellus-like salty water pre-fracking.

by **Scott K. Johnson** - July 16 2012, 12:30pm EDT

EARTH SCIENCE ENERGY 32



A fracking rig targets the Marcellus Shale.

Wikimedia Commons

Hydraulic fracturing—fracking—for natural gas has revolutionized the energy industry in many places, including the United States. The pushback over contamination concerns has been a prevailing storyline in the public eye. This possibility has been viewed as unlikely, though, as the shale gas layers being fracked are typically several thousand feet deeper than any aquifers used for drinking water. Fractures would have to propagate tremendous distances, through a number of confining layers, to create a pathway for contamination.

The physics required to make something like that happen just aren't there. In nature, however, it's usually true that to consider something to be impossible is to be disappointed. And so the nagging question remained: *what if there are already some pathways present through those confining layers?*

In 2011, researchers from Duke University published results (open access) showing a correlation between methane concentrations in private water wells and proximity to local natural gas production wells in parts of Pennsylvania and New York. While that suggested the water well contamination could be related to recent fracking, it was not at all a sure thing. The work was controversial, too—triggering a string of comments and replies in the journal that published it.

To learn more, the research group returned to northeast Pennsylvania with a different question—would they find evidence of *water* from the Marcellus Shale in drinking water wells? If the Marcellus, which is a couple thousand feet down, is really perfectly isolated from shallower groundwater, the answer should be no.

However, there were good reasons to think it might not. Any visitor to Pennsylvania's Salt Springs State Park, if they understood what they were looking at, could tell you that. As you might guess from its name, natural springs of salty water bubble to the surface in that park. That might come as a surprise to those geographically in tune with Pennsylvania's safe distance from the ocean. In the deep history of the Keystone State's rocks, however, one can read maritime stories.

Nearly 400 million years ago, the sediment and organic matter that would become the Marcellus Shale and its natural gas was collecting on the seafloor just offshore from the Acadian Mountains, one of the mighty predecessors to the Appalachians. As those sediments sank deep into the Earth under the ever-increasing weight of new material deposited above, they took the seawater that permeated them along for the ride. In addition, older salt layers (formed by evaporating seawater) provided plenty of brine to this deep sedimentary basin.

In the course of those nearly 400 million years, the Marcellus Shale suffered the usual geologic torture of life near a plate boundary. At one point, the collision of the North American plate with Africa drove up the Appalachians (since subdued by erosion), warping the surrounding rocks and creating regularly spaced cracks. It's those little cracks that are exploited by hydraulic fracturing techniques, which extend them and prop them open with sand grains. In places, the characteristics of the rock and the cracks running through it can conspire to create continuous pathways—little fluid highways through otherwise impenetrable layers of rock.

So, drill down deep enough in this area, and the clean groundwater will turn to brine. If you find salty water near the surface, however, you're probably looking at a leak from the deeper layers. If that deeper layer is the Marcellus, it raises the possibility that fluids injected during fracking could potentially find their way into drinking water aquifers.

Over 400 samples from drinking water wells were analyzed, some recent and some from before the time when energy companies began lining up to frack Pennsylvanian rocks. For comparison, over 80 samples of deep sedimentary brine were analyzed as well. The water samples were chemically fingerprinted, using bromine, chloride, sodium, barium, strontium, lithium, calcium, magnesium, sulfate, carbonate, and isotopes of hydrogen, oxygen, strontium, and radium.

The researchers found that more than 10 percent of the drinking water samples contained the fingerprint of diluted brine. And the isotopic strontium and radium signatures matched Marcellus brines more closely than brines found in other deep layers.

So is that evidence for fracking contamination? Probably not. There was no significant difference between the pre- and post-fracking water sampling, meaning that there are likely natural areas of mixing—subdued versions of Salt Springs State Park. There was no correlation with proximity to natural gas production wells, either.

However, when the researchers compared this data to their methane sampling, they found that almost all the methane detections that came more than one kilometer away from natural gas wells occurred in water wells with a brine signature. That hints that the methane in those wells is very likely natural.

Near natural gas wells, however, methane detections were not tied to any one water type, leaving open the possibility of a connection to natural gas production.

Regardless, the researchers believe that what they've learned is important. They write, "the coincidence of elevated salinity in shallow groundwater with a geochemical signature similar to produced water from the Marcellus Formation suggests that these areas could be at greater risk of contamination from shale gas development because of a preexisting network of cross-formational pathways that has enhanced hydraulic connectivity to deeper geological formations."

The effect could be minor—figuring that out will take a lot more work. However, the Las Vegas assumption that what gets injected in the Marcellus stays in the Marcellus—at least in northeast Pennsylvania—appears not entirely valid.

PNAS, 2012. DOI: 10.1073/pnas.1121181109 (About DOIs).

LATEST NEWS

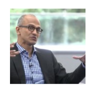

Back to the future: Dusting off Bill Gates' *The Road Ahead*

STOP IN THE NAME OF THE LAW
Patriot Act author: Absent reform, we'll halt bulk metadata program renewal


Facebook releases "Conceal," a lightweight tool to make Android apps safer


Judge slams Prenda for "sophistry" in defamation suit sanction


Planets' chaotic orbits shook up asteroids like a snow globe


Satya Nadella brings technical skill and enterprise strength, but what's the consumer story?

READER COMMENTS 32

Scott K. Johnson / Scott is a hydrogeologist and educator. He joined the Ars science crew in 2011.

Follow @SJvatn

← OLDER STORY

NEWER STORY →

YOU MAY ALSO LIKE

SITE LINKS

About Us
Advertise with us
Contact Us
Reprints

SUBSCRIPTIONS

Subscribe to Ars

MORE READING

RSS Feeds
Newsletters

CONDE NAST SITES

Reddit
Wired
Vanity Fair
Style
Details

Visit our sister sites
Subscribe to a magazine

VIEW MOBILE SITE