LETTER

Methane contamination of drinking water caused by hydraulic fracturing remains unproven

Shale gas extraction involves the drilling of organic-rich, low-permeability shale and then stimulation of hydraulic fractures that allows gas to be produced. Methane in aquifers located above the shale strata, for instance, in Pennsylvania, United States, has been attributed by some to be the result of contamination caused by the hydraulic fracturing process. The work by Osborn et al. (1) described geochemical data from 68 drinking water wells in northeastern Pennsylvania and upstate New York and evaluated whether the aquifers that the water wells penetrated were contaminated with thermogenic methane sourced from the underlying Marcellus and Utica shale formations. The work by Osborn et al. (1) concluded that contamination had occurred and that the contamination accompanied gas well drilling and hydraulic fracturing. The inference from the text and title of the paper is clear—hydraulic fracturing had a role. However, the evidential basis for implicating this specific process is not sound and needs to be closely scrutinized.

The water well dataset is small, nonrandom, and covers a geologically diverse area that is up to ~200 km wide. Several of the contaminated water wells come from around Dimock in Pennsylvania. At Dimock in 2009 and 2010, it was reported that aquifer contamination was caused by recent casing leaks in at least three wells rather than hydraulic fracturing (2). It is also important to note that ~184,000 wells were drilled in Pennsylvania before records were kept (3), and there are ~8,000 orphaned wells that have been located but still need to be properly plugged (3). Methane leakage as a result of inadequate cementing of gas wells has been extensively reported elsewhere (4) as well as in their study area and therefore, could account for the contamination that they reported (1). Furthermore, natural seepage of methane in Pennsylvania is common and led to the locating of the first oil and gas wells. Unfortunately, the analysis by Osborn et al. (1) did not include critical measurements of CH_4 levels in the aquifers before hydraulic fracturing; therefore, some of the contamination could be historical, predating hydraulic fracturing operations.

By their own admission, "there are at least three possible mechanisms" (1) for the contamination. Of these mechanisms, natural methane migration and casing leaks are relatively well-understood (4). Any new process of methane leak as a result of the hydraulic fracturing should incorporate the findings of other studies. For instance, the strong evidence from microseismic and tiltmeter data (5) that shows that the hydraulic fractures generated in the Marcellus formation are located >1 km below the aquifers (and not connected) is not described or cited. There are no new data reported by the work of Osborn et al. (1) that specifically point to hydraulic fracturing as a mechanism that should be implicated; instead, ref. 5 shows that it is highly unlikely.

Their data showed that contamination may have occurred (1), but the association with hydraulic fractures remains unproven. To test whether hydraulic fracturing could cause aquifer contamination requires baseline measurements of levels of CH_4 in aquifers before and after hydraulic fracturing, preferably elsewhere in the world where there has been less historical drilling and natural seepage.

Richard J. Davies[1]

Durham Energy Institute, Department of Earth Sciences, Durham University, Durham DH1 3LE, United Kingdom

1. Osborn SG, Vengosh A, Warner NR, Jackson RB (2011) Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. *Proc Natl Acad Sci USA* 108:8172–8176.
2. Pennsylvania Department of Environmental Protection *Pennsylvania's Plan for Addressing Problem Abandoned Wells and Orphaned Wells.* Available at http://www.portal.state.pa.us/portal/server.pt Accessed August, 2011.
3. Pennsylvania Department of Environmental Protection *Testimony of J. Scott Roberts Deputy Secretary for Mineral Resources Management Department of Environmental Protection Before the House Republican Policy Committee.* Available at http://www.portal.state.pa.us/portal/server.pt'test_CabotDimock_052010FINAL.pdf'. Accessed August, 2011.
4. Dyck W, Dunn CE (1986) Helium and methane anomalies in domestic well waters in southwestern Saskatchewan, Canada, and their relationship to other dissolved constituents, oil and gas fields, and tectonic patterns. *J Geophys Res* 91:12343–12353.
5. Fisher K (2010) *The American Oil and Gas Reporter* 53:30–33.

Author contributions: R.J.D. wrote the paper.

The author declares no conflict of interest.

[1]E-mail: richard.davies@dur.ac.uk.