ENERGYINDEPTH

ISSUE ALERT

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Let's Talk About Cleavage

Or why the foliation perpendicular to stress in the context of subsurface ductile deformation matters in the debate over shale and hydraulic fracturing

We've spent some time over the past couple months taking a critical look at some of the key assertions made in the HBO documentary GasLand, putting forth in that time two separate rebuttal documents that we believe address in a substantive way a number of the misconceptions upon which the film, and its broader political message, is based.

But one of the issues we haven't tackled yet is the suggestion that fissures made in the process of fracturing a shale formation are so long, and so upwardly vertical, that they have the potential to create conduits (or cleavages) through which fracturing-related fluids can travel to water-bearing formations thousands of feet above – including the water table. In his brief explanation of what the fracturing process is all about, GasLand director Josh Fox includes

Screen grab from GasLand (5:55)

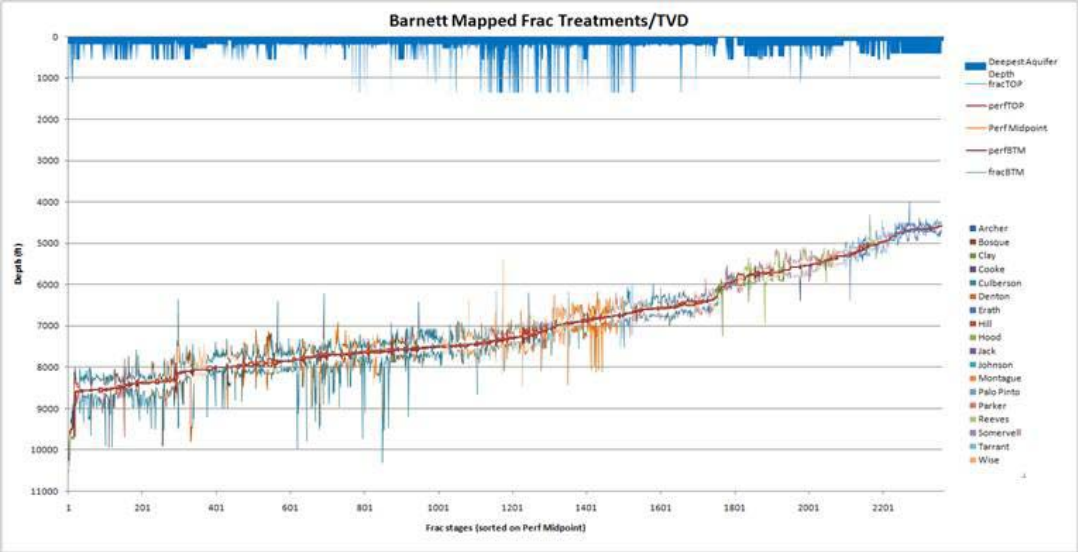
According to Fox, the fracturing process "is like a mini-earthquake," and "blasts a mix of water and chemicals 8,000 feet into the ground." At least he gets the depth right. But according to New York Department of Environmental Conservation (page 127 of this document), "**No blast or explosion is created by the hydraulic fracturing process. The proppant holds the fractures open, allowing hydrocarbons to flow into the wellbore after injected fluids are recovered.**" Guess there's no need to call in the bomb squad after all.

But basic mechanics aside, the message the director is attempting to channel through the image above is simple: Hydraulic fracturing completely decimates the shale formation, creates massive gaps in the underlying rock, and produces vertical chasms that travel all the way up to the surface. Within that context, it becomes a lot easier to understand how the technology could lead to drinking water contamination – as long as pathways and pressure exist, who can say for sure what's actually happening down there, or up here?

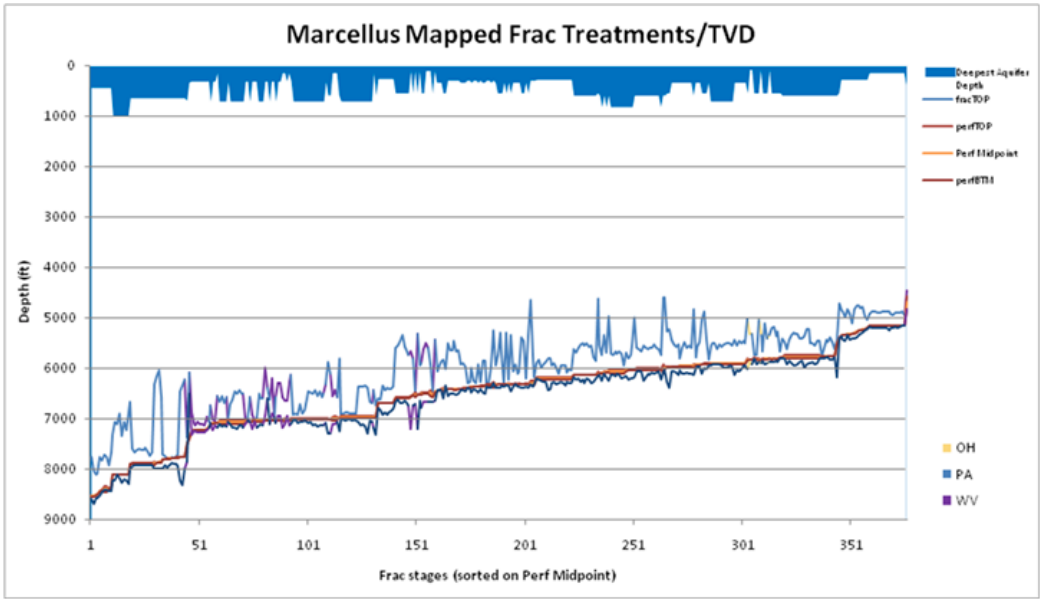
Serious geologists have known since time immemorial that such a phenomenon is a virtual impossibility – and so has the EPA, which wrote in 1995 that "given the horizontal and vertical distance between the drinking water well and the closest methane production wells, the possibility of contamination of endangerment of USDWs [underground sources of drinking water] in the area **is extremely remote**." And

that letter, keep in mind, was in reference to a coalbed methane well – which reside thousands of feet closer to the water table than shale wells.

But thanks to the good folks over at Pinnacle Technologies, we now have some solid data to express this separation in quantitative terms. As reported by Pinnacle general manager Kevin Fisher in July's edition of the American Oil & Gas Reporter, the following graphs plot actual field data from tens of thousands of fracturing operations conducted over the past decade – this first one, in the Barnett Shale, which shows quite clearly that even the most shallow fissures created through the hydraulic fracturing process remain separated from the water table by more than 3,500 feet:



But that's just the Barnett, right? Everyone knows there's no problem out there. Isn't the real area of concern the Mighty Marcellus – where activists continue to claim that gas, chemicals, salt, metals, and Lord knows what else regularly get dredged up from the depths and beamed into every well, sink and stream in sight? Well, Pinnacle ran the numbers on the Marcellus as well, and although the data set isn't quite as robust as what you'd find in the Barnett (remember: we've been developing that one a bit longer), the story in Pennsylvania, West Virginia and Ohio is remarkably similar. To wit:



Here we see an even greater separation between fractures in the underlying rock and sources of potable water above – with the closest the two shall ever meet clocking in at roughly 4,300 feet.

In other words, the deepest formations holding drinking water and the most shallow depth at which you'll find a fracture in the Marcellus Shale are still separated by the equivalent of three-and-a-half Empire State Buildings – or three Petronas Towers, for our Malaysian friends. And by the way: they're not exactly separated by air either. Between the two, you'll find millions of tons of solid, impermeable rock – rock that has for literally hundreds of millions of years acted as an immutable barrier preventing salty water below from communicating with fresh water above.

But just to be sure we got this right, we sent these graphs and data up to Williamsville, N.Y. so that Ph.D. geologist Michael P. Joy might give them a gander and share some technical insights into what makes the phenomenon possible. Below is a (small) excerpt from the email he sent us in reply:

> The hydraulic fracturing process creates fractures that are very small, usually an 1/8th inch or less in width. There is not enough pressure that could be exerted on the column of water to create a fracture matrix long enough to reach anywhere close to near surface aquifers… The gas and water in these deep shale formations exist in hydrostatic equilibrium; the pressure acting down on the formation fluid is equal to the pressure being exerted from the bottom upward and the formation fluids act under the immutable laws of physics and stay in place.

Right. Exactly what he said.

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Additional resources available at Energy in Depth:

- **Debunking Gasland**: Long-Version Rebuttal // Short-Version Fact Sheet
- **Issue Alert:** No Place Like Dome?
- **Graphic**: What's In Frac Fluids?
- **Browner Memo**: Letter of Support for Hydraulic Fracturing from Carol Browner, Fmr. EPA Administrator
- **EPA Report on HF:** "No credible evidence" that hydraulic fracturing endangers groundwater

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