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U.S. Government Confirms Link Between Earthquakes and Hydraulic Fracturing

By [John Daly](#) | Tue, 08 November 2011 13:49 | 31

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On 5 November an earthquake measuring 5.6 rattled Oklahoma and was felt as far away as Illinois.

Until two years ago Oklahoma typically had about 50 earthquakes a year, but in 2010, 1,047 quakes shook the state.

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Why?

In Lincoln County, where most of this past weekend's seismic incidents were centered, there are 181 injection wells, according to Matt Skinner, an official from the Oklahoma Corporation Commission, the agency which oversees oil and gas production in the state.

Cause and effect?

The practice of injecting water into deep rock formations causes earthquakes, both the U.S. Army and the U.S. Geological Survey have concluded.

The U.S. natural gas industry pumps a mixture of water and assorted chemicals deep underground to shatter sediment layers containing natural gas, a process called hydraulic fracturing, known more informally as "fracking." While environmental groups have primarily focused on fracking's capacity to pollute underground water, a more ominous byproduct emerges from U.S. government studies – that forcing fluids under high pressure deep underground produces increased regional seismic activity.

As the U.S. natural gas industry mounts an unprecedented and expensive advertising campaign to convince the public that such practices are environmentally benign, U.S. government agencies have determined otherwise.

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According to the U.S. Army's Rocky Mountain Arsenal website, the RMA drilled a deep well for disposing of the site's liquid waste after the U.S. Environmental Protection Agency "concluded that this procedure is effective and protective of the environment." According to the RMA, "The Rocky Mountain Arsenal deep injection well was constructed in 1961, and was drilled to a depth of 12,045 feet" and 165 million gallons of Basin F liquid waste, consisting of "very salty water that includes some metals, chlorides, wastewater and toxic organics" was injected into the well during 1962-1966.

Why was the process halted? "The Army discontinued use of the well in February 1966 because of the possibility that the fluid injection was "triggering earthquakes in the area," according to the RMA. In 1990, the "Earthquake Hazard Associated with Deep Well Injection--A Report to the U.S. Environmental Protection Agency" study of RMA events by Craig Nicholson, and R.I. Wesson stated simply, "Injection

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had been discontinued at the site in the previous year once the link between the fluid injection and the earlier series of earthquakes was established."

Twenty-five years later, "possibility" and "established" changed in the Environmental Protection Agency's July 2001 87 page study, "Technical Program Overview: Underground Injection Control Regulations EPA 816-r-02-025," which reported, "In 1967, the U.S. Army Corps of Engineers and the U.S. Geological Survey (USGS) determined that a deep, hazardous waste disposal well at the Rocky Mountain Arsenal was causing significant seismic events in the vicinity of Denver, Colorado."

There is a significant divergence between "possibility," "established" and "was causing," and the most recent report was a decade ago. Much hydraulic fracturing to liberate shale oil gas in the Marcellus shale has occurred since.

According to the USGS website, under the undated heading, "Can we cause earthquakes? Is there any way to prevent earthquakes?" the agency notes, "Earthquakes induced by human activity have been documented in a few locations in the United States, Japan, and Canada."

The cause was injection of fluids into deep wells for waste disposal and secondary recovery of oil, and the use of reservoirs for water supplies. Most of these earthquakes were minor. The largest and most widely known resulted from fluid injection at the Rocky Mountain Arsenal near Denver, Colorado. In 1967, an earthquake of magnitude 5.5 followed a series of smaller earthquakes. Injection had been discontinued at the site in the previous year once the link between the fluid injection and the earlier series of earthquakes was established."

Note the phrase, "Once the link between the fluid injection and the earlier series of earthquakes was established."

So both the U.S. Army and the U.S. Geological Survey over fifty years of research confirm on a federal level that that "fluid injection" introduces subterranean instability and is a contributory factor in inducing increased seismic activity." How about "causing significant seismic events?"

Fast forward to the present.

Overseas, last month Britain's Cuadrilla Resources announced that it has discovered huge underground deposits of natural gas in Lancashire, up to 200 trillion cubic feet of gas in all.

On 2 November a report commissioned by Cuadrilla Resources acknowledged that hydraulic fracturing was responsible for two tremors which hit Lancashire and possibly as many as fifty separate earth tremors overall. The British Geological Survey also linked smaller quakes in the Blackpool area to fracking. BGS Dr. Brian Baptie said, "It seems quite likely that they are related," noting, "We had a couple of instruments close to the site and they show that both events occurred near the site and at a shallow depth."

But, back to Oklahoma. Austin Holland's August 2011 report, "Examination of Possibly Induced Seismicity from Hydraulic Fracturing in the Eola Field, Garvin County, Oklahoma" Oklahoma Geological Survey OF1-2011, studied 43 earthquakes that occurred on 18 January, ranging in intensity from 1.0 to 2.8 Md (milliDarcies.) While the report's conclusions are understandably cautious, it does state, "Our analysis showed that shortly after hydraulic fracturing began small earthquakes started occurring, and more than 50 were identified, of which 43 were large enough to be located."

Sensitized to the issue, the oil and natural gas industry has been quick to dismiss the charges and deluge the public with a plethora of television advertisements about how natural gas from shale deposits is not only America's future, but provides jobs and energy companies are responsible custodians of the environment.

It seems likely that Washington will eventually be forced to address the issue, as the U.S. Army and the USGS have noted a causal link between the forced injection of liquids underground and increased seismic activity. While the Oklahoma quake caused a deal of property damage, had lives been lost, the policy would most certainly have come under increased scrutiny from the legal community.

While polluting a local community's water supply is a local tragedy barely heard inside the Beltway, an earthquake ranging from Oklahoma to Illinois, Kansas, Arkansas, Tennessee and Texas is an issue that might yet shake voters out of their torpor, and national elections are slightly less than a year away.

By. John C.K. Daly of Oilprice.com



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Leave a comment

Anonymous on November 09 2011 said:

John Daly makes a common mistake when he confuses the concept of statistical association with a "causal link." Earthquake science is still at an infantile stage, in terms of predictive power and power to prevent catastrophic events. But these findings which associate deep drilling and hydraulic injections with small earthquakes may point toward a breakthrough in earthquake science. Here is what Mr. Daly would be saying if he were believed in a causal link, and if he were concerned about preventing strong earthquakes: The release of pressure from geologic faults using geothermal drilling, deep well injection, and hydraulic fracturing, represents a valuable tool in preventing large catastrophic quakes. By facilitating multiple smaller and much less destructive quakes, this energy drilling is likely to save countless lives and trillions of dollars in property value! :eek:

Anonymous on November 09 2011 said:

As a worker in the oil industry, I hate to make this comment! Over the last 6 years I have noticed frac jobs getting bigger all the time. I have seen HUGE amounts of fluids pumped downhole in amazingly little time. A frac crew is usually waiting for us to clean up the mess left by the rig fast as possible so they can get to work. A "frac job" used to be done on old wells to restore production, now its routine for new wells. How much underground damage must happen before a huge chunk of our state slips on a cushion of mud into the gulf? Or begins to subside into a giant sinkhole? We NEED the gas, but I think we're about to learn a HARD lesson!

Anonymous on November 09 2011 said:

the author also conflates disposal injection and fracing injection. Disposal injection involves MUCH larger quantities of water - and keeps it down there. fraccing recovers most of the water.

Anonymous on November 10 2011 said:

You could also mention the recent destruction from earthquakes in Turkey, which were likely in anticipation of Israel's planned fracking of offshore shale deposits, due to take place sometime in the next few years. Anticipatory earthquakes can be the worst kind! :-*

Anonymous on November 10 2011 said:

Since when did we start measuring earthquake intensities in Darcy; the measure of permeability?

Anonymous on November 10 2011 said:

That's swell. So, Cheney pushed through legislation while in office so that his natural gas company Halliburton can bypass all laws protecting the public, our property, and our human water supply to practice fracking legally. Now after a few years of fracking, the water supply is not useable and he's creating earthquakes that even rattle New Jersey. Gotta love corporations taking over government. Somebody here deserves the death penalty.

Anonymous on November 10 2011 said:

This is really just the tip of the iceberg, as a number of recent studies are finding that in fact there is a strong likelihood, if not a direct causal link, between the impacts of fracking the seismic activity. As mentioned above, the recent study commissioned by Cuadrilla, which found that there was a link between fracking and low-level seismic activity (Popular Science - 11/3/2011 is worrisome, especially since they found that the fracking fluids likely caused the pre-existing division between the rocks to lubricate and slide, which gets to J's comment above about subterranean geological slippages. Reuters also had some more good coverage on this issue, and possible links with recent events in Oklahoma and surrounding states--Is Fracking Behind Oklahoma's Earthquakes.

Anonymous on November 10 2011 said:

"Sensitized to the issue, the oil and natural gas industry has been quick to dismiss the charges and deluge the public with a plethora of television advertisements..."So, Nov. 5th earthquake in Oklahoma and the industry has "deluged" the US with commercials to try and hide they are causing these earthquakes. We are still trying to figure out who killed Kennedy, Obama's Birth, etc. Please leave out emotionalism and statements that are leading in nature to your bias. Be a good journalist...we need good ones to have a healthy democracy. Also, I don't know if fracking can cause an earthquake, or the reason in OK. Opinions just don't matter much at all. Many before and after, "The magnitude 5.5 April 9, 1952, earthquake centered near El Reno affected most of Oklahoma and parts of Arkansas, Iowa, Kansas, Missouri, Nebraska, and Texas." USGS website.

 Anonymous on November 11 2011 said:

This is a technical argument where emotions should be left out of it. Unfortunately, greens are unable to leave emotions out, since nothing more would remain. Earthquakes result from a buildup of seismic forces. Earthquakes, large and small, have been occurring since time immemorial. If we were lucky enough to discover a way to release seismic forces at early stages before catastrophic forces built up, we might find a way of balancing the total seismic load so as to prevent devastating quakes. We should be excited by the possibility of a breakthrough, instead so many hide in the darkness and quake in fear. Emotions among Greens have run rampant, abandoning reason. They have become enemies of all reliable forms of energy, and advocates of all unreliable and ruinously expensive forms of energy such as big wind and big solar.

 Anonymous on November 12 2011 said:

Fracking has been used over a million times, with a ratio of fracks to quakes of about 500,000 to 1. These are small quakes, unlike the huge quakes that have devastated Japan and other quake prone lands. The anti-energy contingent of the irrational green movement has outdone itself with this particular argument. It may work on the gullible and less intelligent, however. :P

 Anonymous on November 12 2011 said:

Respectfully, if A happens, then B happens, it's interesting. If A happens twice and B happens each time, it's curious. If B happens every time A happens, there's a definite relationship. I'm not gullible, and I'm not "green". Fracking causes earthquakes which damage property. The only people denying it are those who make a profit from it and don't want to pay for the consequences and damages.

 Anonymous on November 12 2011 said:

Hydraulic fracturing should be limited to areas where the majority of voters believes that it won't cause any damage. Related legislation should be left to affected States. If people don't believe that there will be damage, they can vote accordingly. After all, we live in a free country. Those who want to have freedom must be willing to bear the consequences of their action.

 Anonymous on November 14 2011 said:

Man has a history of being egotistical. He even thinks he can change the climate i.e., "global warming" yet green house gasses were 10 times higher in the past & the earth was cooler. When a large number of planets coragate on one side of the sun it literally pulls the epicenter of the sun off center causing multiple disturbances on the suns service which has been hyped as global warming as late. Man thinks he controls nature & fails to understand nature controls his actions i.e., having heart attacks, selling stocks when a high number of electrons are in the ionospher. Man over estimates his power & even thinks mystical beings (god) guides him. Like a child thinks the world revolves around him. The gravitational angle of pull from the planets etc is more powerful than the power man can harness & will have a far larger impact on activating earth quakes than man can

 Anonymous on November 14 2011 said:

[quote name="jet"]Man has a history of being egotistical. He even thinks he can change the climate i.e., "global warming" yet green house gasses were 10 times higher in the past & the earth was cooler.[/quote]1) Sources or it didn't happen 2) Assuming you are correct, you do realize that for the earth to be warmer now it would have to accumulate heat after this unspecified cooler time, right? Perhaps through the vehicle of a greenhouse effect caused from excessively high amounts of greenhouse gasses in the atmosphere? Don't hurt your brain thinking about this one too much.

 Anonymous on November 14 2011 said:

Respectfully, Izzy, if small earthquakes occur 1 time out of 500,000 times fracking is used, that is not a significant correlation. Earthquakes are more closely associated with deep injection for geothermal power. But as long as the quakes are small, and theoretically preventing much larger quakes in the future, geothermal drilling might just be okay! 8)

 Anonymous on November 16 2011 said:

Come on 'Shleeples'- !! WAKE-UP !! Try to remember what your COMMON-SENSE and critical-thinking felt like before the Skinnarian-training: If someone drills deep-holes in a quake-zone, repeatedly fills them full of toxic chemical-explosives, then detonates them to collapse the bedrock: IS IT THE CAUSE OF THE FOLLOWING EARTHQUAKES SHOWING THE EPICENTERS AT THE DRILLED-HOLES!?! (If you answer "Yes", you will get a 'happy face, delightful music, and more points to play a game!')

 Anonymous on November 16 2011 said:

Money means nothing when you are responsible for the pollution of water and the beauty of our earth. These oil companies that have no compassion of the pain they inflict on others are responsible for the sickness that goes with their actions. With all due respect to the need, I would think that solar power is safest and that is what they ought to dwell on. They are committing a crime against mother nature and they don't even see the damage they are doing to themselves and others. I know what it is like to have lived here before. The Spirit is the seed and they will revolve back to this earth after they have left. They have no control of where they will be born so it would not surprise me in the least to see them suffer many times over from the harm they have caused. In truth they are already suffering from the effect of the poisons this government has allowed into our food system. They must be brain cell dead to allow this to happen. Counselor Counselor.

 Anonymous on November 17 2011 said:

"According to the U.S. Army's Rocky Mountain Arsenal website, the RMA drilled a deep well for disposing of the site's liquid waste after the U.S. Environmental Protection Agency 'concluded that this procedure is effective and protective of the environment.'""That statement is incorrect. The well was drilled in 1961. The EPA was created nine years later in 1970.

 Amanda on December 01 2011 said:

Here's an additional thought from an Oklahoman that grew up in Lincoln County, Oklahoma. The earthquakes are not the only major issue. I grew up in Southwestern Lincoln County and have frequented the epicenter areas years before this happened. In the town of Prague, OK (one of the many epicenters)the city water has a higher level of minerals and chemicals in it than the average tap water. Also, my own well water from my prior residence (about 15 miles away from the epicenters) also had a higher content these minerals and chemicals. I do not know the exact chemicals, however I do know that the water in both Prague and my former residence tastes disgusting and has a yellow coloring. Coincidence?!? I think that this needs to be looked at further b the correct professionals.

 Brian Fahey on December 05 2011 said:

Any who are in doubt of the relationship of HydroFracking and recent earthquake activity have to go no farther than the USGS to ascertain the location of quakes occurring in US Fracking fields. Indeed, if you get the locations Latitude and Longitude numbers from USGS and put them into Google Earth, you will find them very close to recent fracking operations, usually within a mile or two. There is a YouTube member who daily posts on Weather Modification and on Earthquakes. He draws the same conclusion. His Youtube name is Dutchsinse.

 Emily on December 28 2011 said:

I'm sure the author tried to write NEPA, but his computer autocorrected it to EPA. NEPA was a precursor to the larger more encompassing EPA, as there were several agencies that we rolled into the makeup of today's EPA.

 Wayne Christensen on January 02 2012 said:

How many and how often and how big have any earth quakes have happened since they stopped pumping fluids and chemicals at Rocky Mountain Arsenal?In other words, have the earth quakes returned to pre pumping numbers?

 Mikal on January 06 2012 said:

The release of pressure from geologic faults using geothermal drilling, deep well injection, and hydraulic fracturing, represents a valuable tool in preventing large catastrophic quakes. By facilitating multiple smaller and much less destructive quakes, this energy drilling is likely to save countless lives and trillions of dollars in property value!

 Sy000 on January 28 2012 said:

When plates shift which they most always invariably do...these little seismic fluctuations will look like a cakewalk compared to what is really coming down the pike. These little tremors are actually putting off the big one...so enjoy the time frackin is giving you..

 JAYNOMES on March 19 2012 said:

The Author is a BIOFUELS guy and for obvious reasons has made classic leftist-environmentalist arguments and converted limited antedotal evidence into "fact". Without a doubt, this is a political hit piece disguised as a "Confirmation".

Mark Novak on April 19 2012 said:

We need to switch to more reliable technologies like terra slicing technology, not using destructive perforation fracturing techniques. Terra slicing is one of the only environmentally friendly and ecologically safe technologies for oil extraction, but no one hears about it!

Paul on May 01 2012 said:

Mikal (and others) suggested "By facilitating multiple smaller and much less destructive quakes, this energy drilling is likely to save countless lives and trillions of dollars in property value!" What happens if we use hydraulic fracturing in an area where the stress is already built up? This could result in a much larger earthquake - 7 or 8 in mangnitude - which otherwise may not have happened for several centuries, if at all. Could be something to consider.

AOK on July 16 2012 said:

To Emily. NEPA is the acronym for the National Environmental Policy Act of 1969. It was not an agency of the the U.S. government; not a precursor organization to the EPA.

Janie Sue Shepherd on July 19 2012 said:

Because I live in Lincoln County, OK, I emailed Austin Holland at USGS asking him about the connection between locations of the disposal injection wells close to the Wilzetta Fault (which runs along Robinson Creek between Prague and Meeker and Sparks,OK), and the locations of the recent earthquakes in that area.

He replied that it was being looked into and not to worry.

Now, the USGS website, Recent Earthquakes, has been edited to show ONLY ones greater than 3.0. and the Lincoln County information has been generalized (buried) into the world wide info. Now, I cannot even check to see if "that shaking I felt" was yet another earthquake nearby.

What the Hell? I thought USGS was not a sell out to the Oklahoma Corp. Commission???

Meanwhile I am still repairing multiple cracks in my house walls, running from the ceilings to the floors.

bruce on July 12 2013 said:

I don't believe anything that comes out of this administration of liars and traitors.

Conrad E Maher on December 23 2013 said:

This is an article by someone who does not have a good grasp of the science involved. It is clear from the Rocky Mountain Arsenal Well that injection into this well can induce seismic activity. I remember when this was being discussed and before the data was available. A geologist had predicted that injection of waste water in the well was the cause of the earthquakes being felt in the area. Good geologist are good observers and when the data was eventually released and plotted against earthquake activity, the correlation was good enough to convince the geologic community. The amount of seismic activity that might be expected will be dependent on the zone in which the fluids are being injected. In the Rocky Mountain Arsenal Well, from memory, I remember that the fluids were injected into fractured granite. The area is in the very complex geology of the Front Range of the Rocky Mountains. We now know enough to identify the area and the disposal zone as being at risk for triggering earthquakes following injection of fluids under high pressure. When the well was drilled, a careful analysis of the formations at depth should have warned a good geologist that the potential for slippage of the rocks in the zone of injection was a distinct possibility.

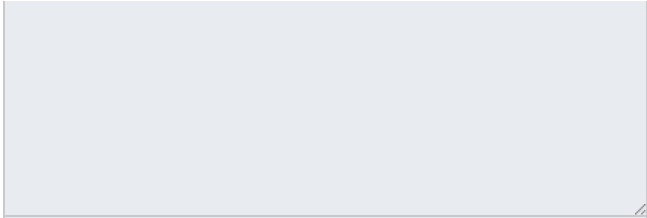
There have been many comments that injection of fluids into fractures and fault zones can trigger ss

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