

## Clare McMullan

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**From:** Robert Westaway  
**Sent:** 10 November 2014 13:54  
**To:** [REDACTED]  
**Cc:** Paul Younger; Ross Barker  
**Subject:** RE: University of Glasgow energy engineers call for new regulatory framework for fracking

[REDACTED]

The logic is not simply to propose a less stringent magnitude threshold. It is that nuisance ground vibrations from induced earthquakes should be regulated on a par with other sources of nuisance ground vibrations, the natural comparison being with ground vibrations caused by quarrying, which have been regulated in the UK for many years. If the comparison were to be made with a different source of nuisance ground vibrations that is also regulated, say with pile driving, the conclusions would be very similar.

Yes the two largest microearthquakes at Preese Hall were indeed of magnitudes 1.5 and 2.3. They caused damage to the borehole but not to any property at the Earth's surface, which is what one would expect from earthquakes of this size.

Fracking in the UK is likely to occur at depths of circa 2.5 km, which was the depth of the induced earthquakes at Preese Hall. So, whatever strength of seismic waves is radiated by the earthquakes, these waves spread out after travelling over at least that distance, which limits their strength at any particular point and hence limits the potential for damage. For a well-maintained property the strength of vibration at that distance from a magnitude 3.6 earthquake will do no more than crack some plaster or maybe break a pane of glass - the consequences would be similar to slamming a door really hard. If a property is poorly maintained then other things might happen, such as chimney pots falling down, but that would only be because they weren't properly cemented on in the first place. I repeat, however, that effects at this level would not happen intentionally and would only be at this level very infrequently if ever; they are a hypothetical worst-case scenario.

Yours, Rob

Dr Rob Westaway  
Senior Research Fellow

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**From:** [REDACTED] [REDACTED]@thetimes.co.uk]  
**Sent:** 10 November 2014 13:07  
**To:** Robert Westaway  
**Cc:** Paul Younger; Ross Barker  
**Subject:** Re: University of Glasgow energy engineers call for new regulatory framework for fracking

Thanks Rob. What are the benefits of raising the earthquake threshold as you suggest? is it simply that it reduces the risk of shutdowns, such as happened at Preese Hall in 2011?  
Also, I think the two minor quakes then were much smaller than the maximum you propose: 2.3 and 1.5. Was there any damage caused by those quakes?  
And are the possible impacts of a 3.6 quake limited to minor plaster cracking or are there other possible, if highly unlikely, consequences?  
many thanks  
[REDACTED]

[REDACTED]

Twitter: @ [REDACTED]

On 10 November 2014 12:50, Robert Westaway <[Robert.Westaway@glasgow.ac.uk](mailto:Robert.Westaway@glasgow.ac.uk)> wrote:

Yes, that's right.

RW

Dr Rob Westaway  
Senior Research Fellow

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**From:** [REDACTED] [REDACTED]@thetimes.co.uk]  
**Sent:** 10 November 2014 12:48  
**To:** Robert Westaway  
**Cc:** Paul Younger; Ross Barker  
**Subject:** Re: University of Glasgow energy engineers call for new regulatory framework for fracking

Thanks Rob. When you refer to "induced earthquakes of this size", presumably you mean 3.6?

[REDACTED]  
Twitter: @ [REDACTED]

On 10 November 2014 11:33, Robert Westaway <[Robert.Westaway@glasgow.ac.uk](mailto:Robert.Westaway@glasgow.ac.uk)> wrote:  
Dear all

What we are saying is that, first, we are noting that current 'fracking' technology utilizes a sufficient volume of water at a sufficient pressure to produce fracture networks that may be up to ~600 m long. Second, if such a large fracture were to develop in a single fracturing event it would be equivalent to an earthquake of magnitude ~3.6. However, it is extremely unlikely that such a large fracture will develop in a single event, since the fracture networks tend to develop incrementally, but the possibility should nonetheless be considered. One possible solution would be to impose regulatory limits on, say, the volume of water that can be used in a single 'frack', to reduce the upper bound to the fracture network that might develop, and thus reduce the size of the maximum possible induced earthquake that might result. However, we suggest, instead, that an alternative approach would be to accept that there is a chance that induced earthquakes of this size might occur very occasionally but to compensate people in the area if any damage results to their property and/or if the strength of the ground vibrations exceeds the appropriate threshold that we are setting out. Combined with monitoring of the induced seismicity, the technique that we have developed, and which is capable of future refinement, will enable the strength of the ground vibrations to be estimated at any point on the Earth's surface to facilitate such assessments.

Best wishes, Rob

Dr Rob Westaway  
Senior Research Fellow

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Begin forwarded message:

**From:** [REDACTED]@thetimes.co.uk>  
**Date:** 10 November 2014 10:16:40 GMT  
**To:** Paul Younger <[Paul.Younger@glasgow.ac.uk](mailto:Paul.Younger@glasgow.ac.uk)>  
**Subject:** Fwd: University of Glasgow energy engineers call for new regulatory framework for fracking

Hi Paul, is this suggesting that earthquakes up to magnitude 3.6 could be permitted, with compensation for any minor damage?

Thanks

Sent from my iPad

Begin forwarded message:

**From:** Ross Barker <[Ross.Barker@glasgow.ac.uk](mailto:Ross.Barker@glasgow.ac.uk)>  
**Date:** 10 November 2014 09:26:43 GMT  
**Subject:** University of Glasgow energy engineers call for new regulatory framework for fracking

**STRICTLY EMBARGOED UNTIL  
0001hrs TUESDAY 11 NOVEMBER 2014**

## News Release

Tuesday 11 November 2014

### **Energy engineers call for new regulatory framework for fracking**

Leading energy engineers are suggesting that UK regulations on the surface vibrations caused by shale gas fracking are unnecessarily restrictive.

University of Glasgow academics state in a new paper that widely applying restrictions similar to those currently in force on fracking would require a ban on heavy vehicles from passing houses or walking on wooden floors.

They also state that the threat of serious earthquakes caused by fracking activity is considerably lower than commonly feared.

The report, written by Dr Rob Westaway and Professor Paul Younger of the University of Glasgow's School of Engineering, is published today (Tuesday 11 November) in the Quarterly Journal of Engineering Geology and Hydrogeology.

They suggest that adopting a new fracking regulatory framework closer to the rules which govern activities such as quarry blasting would be a clear improvement on the current guidelines.

Dr Westaway said: "Currently, the Department of Energy and Climate Change's regulation is that any fracking operation which induces surface vibrations greater than magnitude 0.5 on the Richter scale should be shut down immediately.

"That level of vibration is extremely low. To put it in perspective, if regulations for other vibration-causing activities were similarly

restrictive you'd have to prevent buses from driving in built-up areas or outlaw slamming wooden doors.

“By analysing the seismic waves which travel through the earth as a result of fracking activity, we've been able to determine a scale of activity which will create surface vibrations within those already allowed for by quarry blasting regulations. For example, induced earthquakes of magnitude 3 from fracking activities 2.5km below the earth's surface will create surface vibrations similar to the limits allowable from quarry blasting.

“Conversely, induced earthquakes at the current UK regulatory limit of magnitude 0.5 would be expected to produce vibrations in a person's home that are smaller than those typically caused by the movement of buses or lorries past the end of their garden and comparable to many other widely-accepted forms of 'nuisance' vibration”.

The authors state that the largest possible fracture which could conceivably be created by current drilling processes on properly-surveyed land would be 600 metres long. The maximum length of fractures is determined by the amount of fracking fluid used in the process, which would be used up before any fracture could reach more than 600m.

Professor Younger said: “We've determined that a fracture of that length created in a single rupture, which is very unlikely, would likely correspond to a maximum quake of magnitude 3.6. That might be sufficient to cause minor damage on the surface such as cracked plaster. Again, however, there is already regulation in place for compensation for similar incidents caused by RAF fly-bys or mining operations and we'd suggest it would make sense for similar schemes to be put into place for fracking.

“From the knowledge we've gained from tens of thousands of fracking operations elsewhere in the world that by far the biggest cause of serious seismic incidents isn't the drilling or the fracking process itself. Instead, it's the practice of disposing of waste water back into the borehole once the process is finished. This washes away particles of sand holding open the fractures created during the process, which can cause earthquakes.

“In Britain, we've adopted longstanding EU groundwater regulations which bar subsurface disposal of wastewater completely, meaning there is no danger of this sort of event happening here. Instead, the water would be treated and disposed of safely elsewhere.”

Dr Westaway and Professor Younger's paper, titled 'Quantification of potential macroseismic effects of the induced seismicity that might result from hydraulic fracturing for shale gas exploitation in the UK', is published in the Quarterly Journal of Engineering Geology and Hydrogeology.

**ENDS**

**For more information contact Ross Barker in the University of Glasgow Media Relations Office on 0141 330 3535 or email [ross.barker@glasgow.ac.uk](mailto:ross.barker@glasgow.ac.uk)**

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