

Interactive comment on “Fracking bad language: Hydraulic fracturing and earthquake risks” by Jennifer J. Roberts et al.

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General comments The paper has a good structure and examines the topic of the language of induced seismicity in good detail. The paper should be of broad interest to Earth Scientists, and those in other disciplines. The article would benefit from perhaps a glossary of terms at the start, given the variety of terms used throughout. The results section which describes the survey results could possibly be more concise, given the tables and figures which also communicate the results. The main areas for possible improvement is clarity in the use of terms used when describing the shale gas activities (mentioned in the specific comments).

Specific Comments Lines 39/40 - in the introduction the authors introduce the stake-

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holders and include ‘scientists. With specific reference to controversial geosciences, it may be useful to pick apart the different roles which scientist have in shale gas – for example, within industry, within academia, within the regulators.

The authors introduce that many geoscience concepts and technologies are unfamiliar to the public (line 49/50), but it may also be relevant to discuss here the contrast between established and ‘new’ activities. To this extent a discussion of changes in perceived acceptance – what may have been an acceptable in the past, is no longer socially perceived as acceptable (e.g. Beck et al. 1993).

Authors introduce disputes in geoscience, however, do not include here mention of the Lusi mud volcano (e.g. Tingay et al., 2018) – which is highly relevant given that it was a source of both geoscience, community and political contention.

The use of ‘geological engineering’ throughout may possibly lead to confusion, particularly given the broad appeal of the paper. It may make sense to use ‘geologist’ and ‘engineer’ separately, particularly in the case of hydraulic fracturing, where the two areas of expertise have different roles.

Line 82/83 - references ‘the language in communicating shale gas extraction’ – although this paper focuses on the language of surrounding induced seismicity, it seems likely that ‘shale gas’ more broadly is thwart with many examples of ‘bad language’. For example, even the use of the word ‘extraction’ in the UK context and to hydraulic fracturing could result in confusion. The authors could expand on what they consider the term extraction to encompass. Does this include all elements of the E&P lifecycle?

The article should consider expanding the description of hydraulic fracturing, and consider describing the range of different techniques, e.g. King (2012). The article could also differentiate between hydraulic fracturing and other well stimulation techniques. The addition of a diagram to illustrate the practice of hydraulic fracturing could also make the article more widely accessible.

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Since specific reference is made throughout to the induced seismicity in the UK, perhaps an examination of the language used in the Hydraulic Fracture Plans prepared by operators and provided to the OGA and EA could be included in the compilation of publicly available expert reports.

Line 145 - the term 'tight gas' is introduced and seems to be used to refer to shale gas. In the O&G industry, commonly the terms tight gas and shale gas are used to define different resources. tight gas commonly refers to a reservoir where the hydrocarbons are within a conventional scale pore space (e.g microns) but are not connected. Whereas in shale gas resources the pores are often nanometres scale, and, for example may include pore space within organic components of the shale,

Line 154/155 – “not all seismic events have any detectable effect in terms of being felt, or recorded” – this statement could be expanded to include references, and to mention what the detection limits are for seismic events.

Lines 156-167 – covers a discussion on quantifying seismicity. However, it would perhaps be appropriate here to discuss or make mention of other industries, such as quarrying, which have their limits set/defined by ground motion.

Lines 173/174 – should the ‘UK network’ be defined? Are you referring to the BGS seismometer network? What is the detection limit of the dedicated surface arrays installed at the shale gas sites?

Line 181/182 – Could you clarify if the induced seismicity is associated with HF or with the production, or both?

Line 182/183 – “However, the largest recorded induced seismic events associated with shale gas extraction activities” – as previous, it might be worthwhile clarifying earlier in the paper where hydraulic fracturing sits within the context of shale gas extraction activities.

Line 213/214 – the technical expertise listed again includes ‘disciplines’ that might

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cause confusion. Geological Engineering – not a field or role common in O&G sector, Oil Field Services – would seem to be a catch all category, and could include petroleum engineer.

Line 384/385 – “since hydraulic fracturing, by definition, will induce (albeit small) seismic events, it could be argued that assertions such as “shale gas development is associated with earthquakes” are factual” - are all seismic events earthquakes? what is the definition of the earthquakes? a section addressing individual scientific questions/issues

Line 619 – 622 – perhaps it would be worthwhile providing definitions of these terms in a glossary of terms. Providing definitions of the terms you use.

Line 656 – “much more decided on the topic than the UK general public” – referring back to the statement in the introduction that experts have a greater appreciation of uncertainty, this is an interesting finding, perhaps warrants discussion.

Line 689 – It might be beneficial to introduce the concept of ‘what constitutes an earthquake?’ much earlier in the paper.

Technical Corrections Line 52 – ‘such uncertainty’ – previous sentence does not specifically which uncertainty you are referring to. Line 70 - typo ‘we explore the perception of and terminology’ Lines 84/85 – examples of other causes of induced seismicity need references. Line 133/134 - Should include reference for moratorium/ suspension on fracking. Lines 145 – examples of applications of hydraulic fracturing should include references. Are there examples of HF for water production? Line 148 – Davies & Cartwright, 2007 paper is not an appropriate reference here. Line 168/169 – perhaps it should be clarified ‘hydraulic fracturing’ is one step in the extraction process. HF doesn’t result in extraction, that still requires a pressure drawdown to create a differential. Line 345 – missing close bracket - (micro-seismic events, seismicity, and earthquakes) Line 698/699 – as Fig 1, TLS is OGA not UK Government. Line 191 – should make it clear whether the ‘6 months following’ is a 6 month moratorium, or 6 months

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after the induced seismicity. Figure 1 caption– in the figure caption, it states that the traffic light system is from UK Government. The TLS is from the Oil and Gas Authority (OGA) and the OGA is a government owned company Figure 2 caption – “...shale gas with earthquakes decreases, while the number of participants that...” should add in ‘2012-2014’ to make it clear over what years.

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