

Shale gas and the subsurface environment

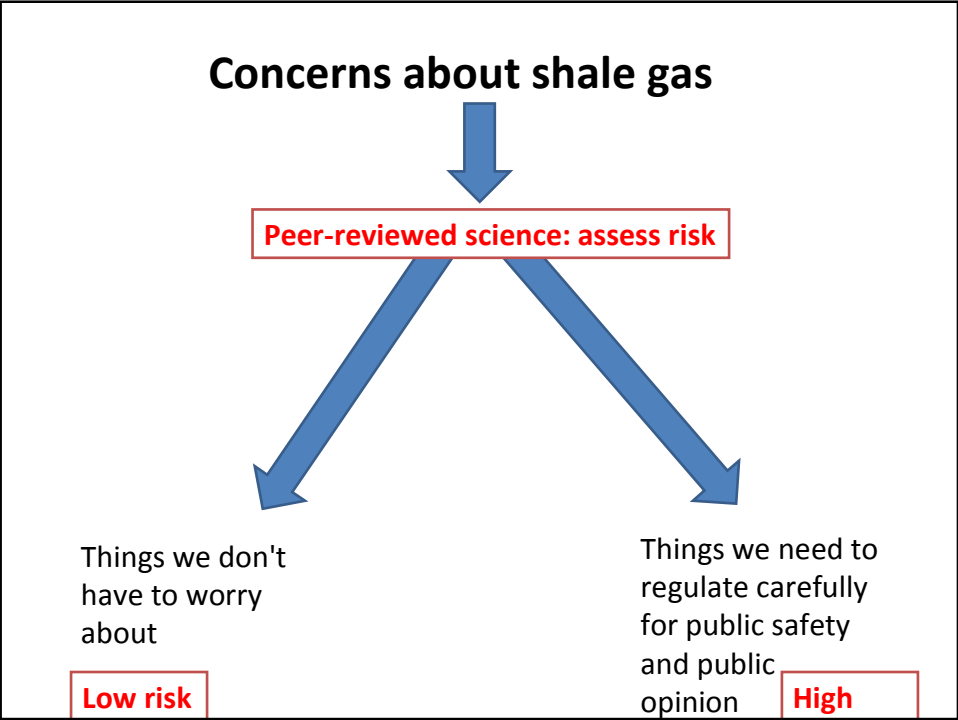
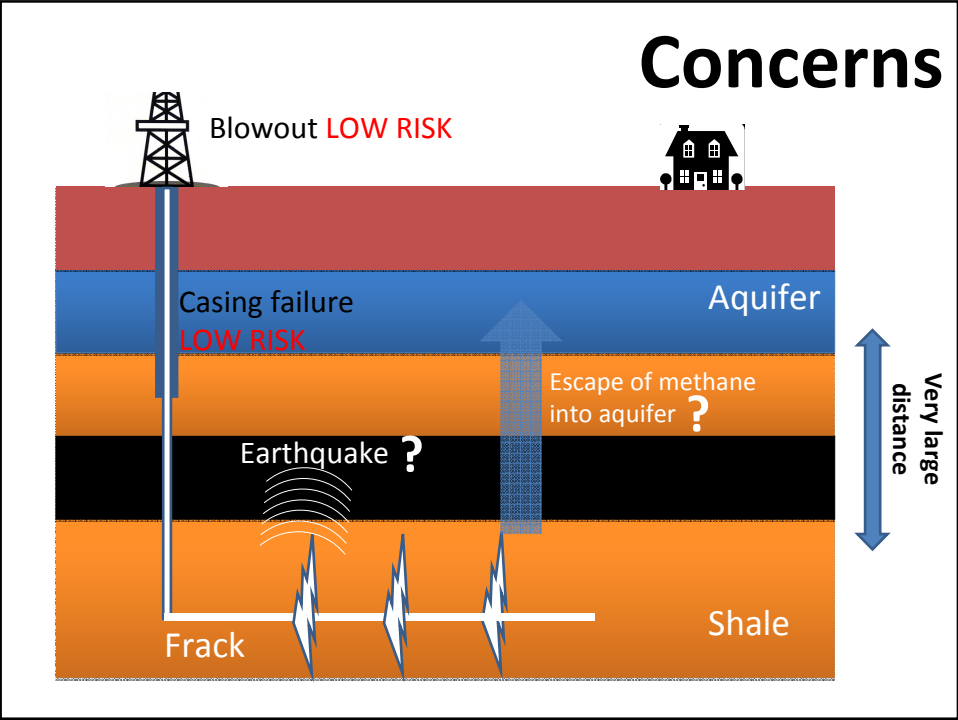


Mike Stephenson
BGS

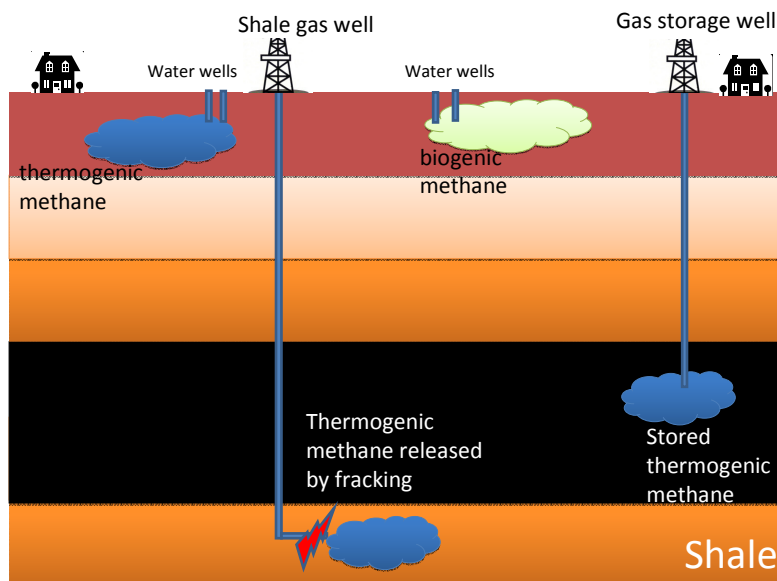
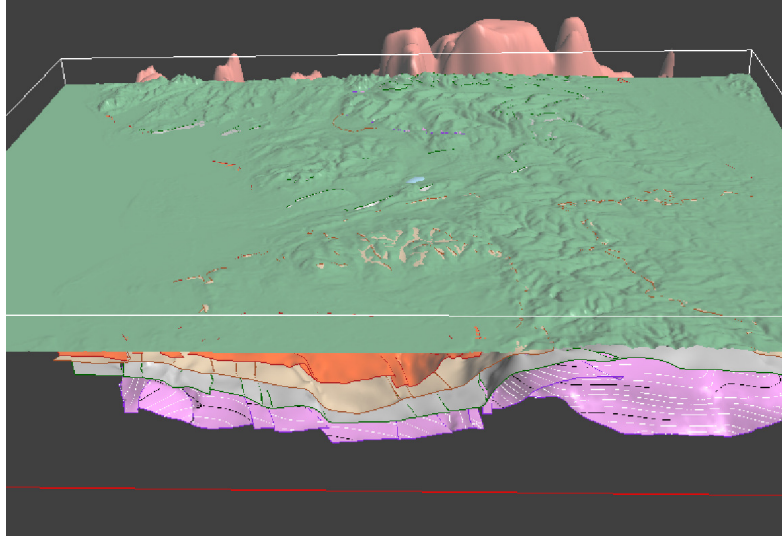


Cracks in a bridge on Lytham Road, Blackpool

Claim and counterclaim



Methane contamination of groundwater



Can we tell them apart?

Sometimes we can....

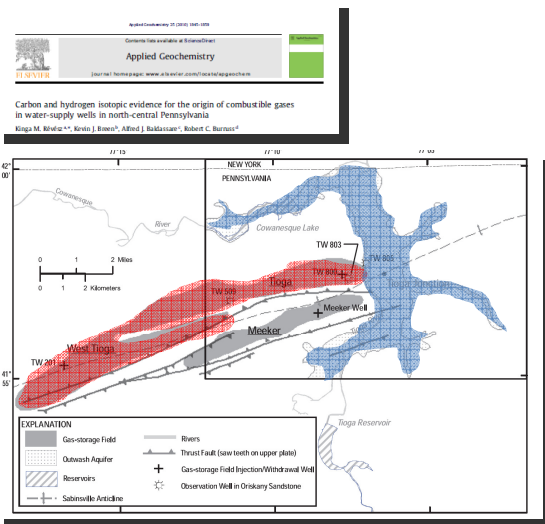
- $\delta^{13}\text{C}$ CH_4
- Gas mixture
- ^{14}C

Two peer-reviewed
papers

very few of them!

Contamination from gas storage?:

Révész et al. 2010



- Water wells contained
 - biogenic methane
 - thermogenic gases probably from storage field
 - Also mixtures of thermogenic and biogenic
- Not sure how storage field was leaking

Contamination from fracking?

Osborn et al. 2011

Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

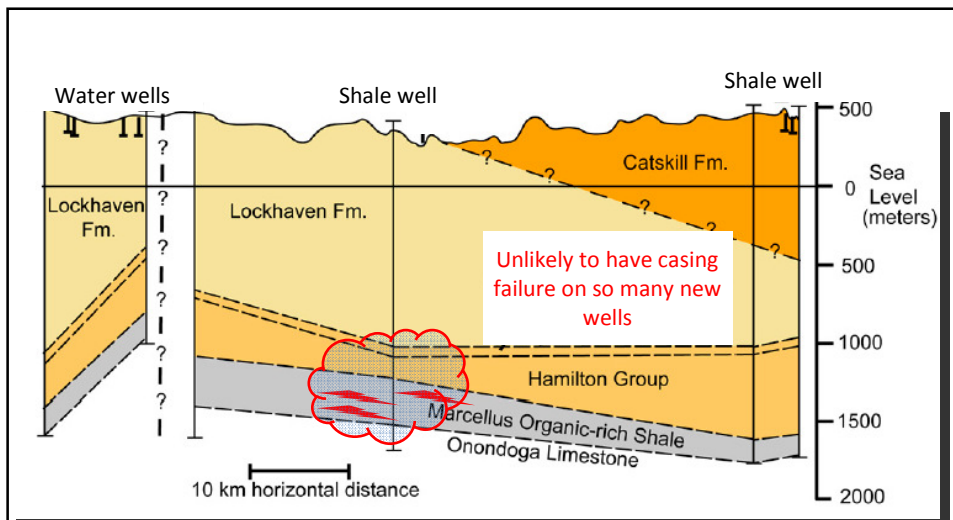
Stephen G. Osborn¹, Avner Vengosh², Nathaniel R. Warner³, and Robert B. Jackson^{1,2,4}



- Studied:
 - Methane in shallow water wells in shale gas areas
 - measured methane content and $\delta^{13}C$

What did they find?

- Higher methane concentrations in water wells close to shale gas wells
- $\delta^{13}\text{C}$ suggests thermogenic
- Authors then say '*likely to be shale gas from the fracking*'
- No evidence of contamination with fracking fluids



Maybe thermogenic methane but **not** from fracking?
Difficult to tell without baseline values ...
Baseline should feed into regulation

Earthquakes at Blackpool

- Largest on 1 April
- magnitude 2.3
- felt >50 people

The screenshot shows the British Geological Survey website page for a Blackpool earthquake on 27 May 2011. The page includes a navigation menu, a list of research themes, and a table of earthquake details. A map on the right shows the location of the earthquake near Poulton-Le-Fylde, with a red star indicating the epicentre and a blue pin for the Preese Hall drill site. Below the map is a WMS layer toggle and a seismic waveform plot.

Blackpool earthquake Magnitude 1.5 27 May 2011	
Date	27 May 2011
Origin time	00:48:46.5 UTC
Lat/Lon	53.821° North / 2.956° West
Grid ref	337.1 kmE / 436.5 kmN
Depth	2.0 km
Magnitude	1.5 ML
Locality	Poulton-Le-Fylde
Intensity	3 EMS

We have recently recorded magnitude 1.5 (27 May) and magnitude 2.3 (1 April) earthquakes in the Blackpool area near to the Preese Hall shale gas drilling site operated by Cuadrilla Resources.

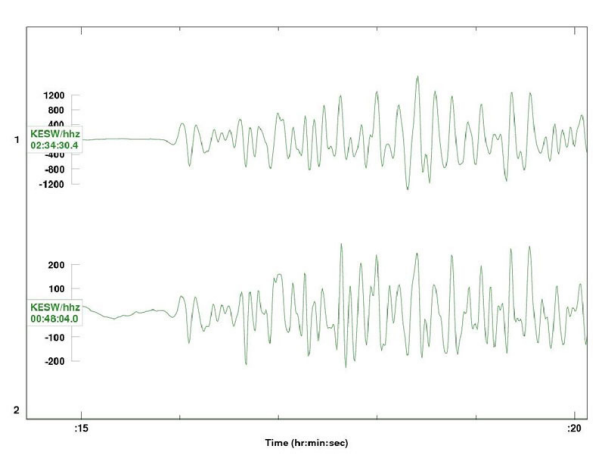
The 27 May earthquake was felt by at least one person in Poulton-Le-Fylde.

Analysis of data from two temporary instruments close to the drill site, installed by BGS after the magnitude 2.3 earthquake on 1 April, places the epicentre of this event within 500 metres of the Preese Hall site and gives a depth of approximately 2 km.

The recorded waveforms are very similar to those from the magnitude 2.3 event on 1 April, which suggests that the two events share a similar location and mechanism (see Figure 2).

Comparison of signals

- Comparison of signals from the 1 April and 27 May
- Waveforms very similar, so similar origin



We conclude that the earthquakes were a **direct consequence** of the fluid injection during fracking

Damage

- Damage **very unlikely** to have been caused by earthquake
- **BUT**
 - We need to know how to monitor
 - Monitoring will improve public confidence



Conclusions

- Almost all the risk is known, understood and manageable (e.g. oil and gas industry)
- For newer risks
 - Distinguish between what matters and what doesn't
 - Learn how to monitor
- Peer reviewed science important