UK Shale Gas: Gamechanger or Sideshow?

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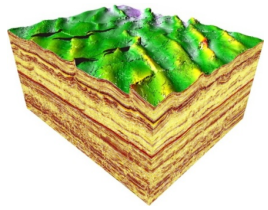

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Outline

- Geological background- what makes for a good shale gas prospect? What are the risks?
- Exemplified by US Shale Gas Plays
- Do these conditions apply in the UK? Elsewhere?
- Is it safe?

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Shale gas is very hard to find in economic quantities

- To find conventional oil and gas we need to have four components in place, but for shale gas it's a ten component problem

- Uncertainty in each component or failure of just one component compromises the whole play

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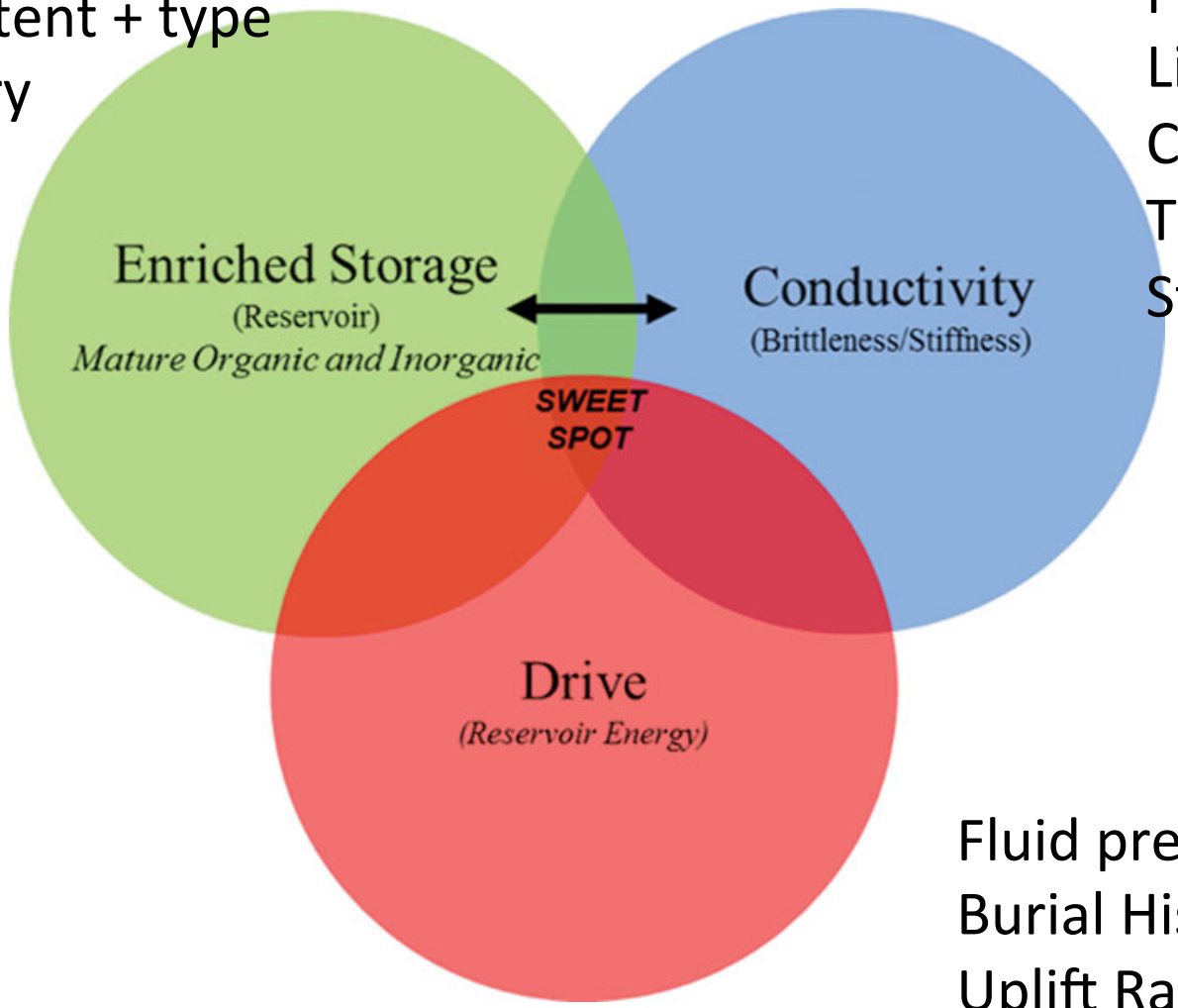
Shale Gas Plays: the Magic Three (Ten)

Organic content + type
Burial History
Porosity
Thermal History
Thickness
Structure
Seal



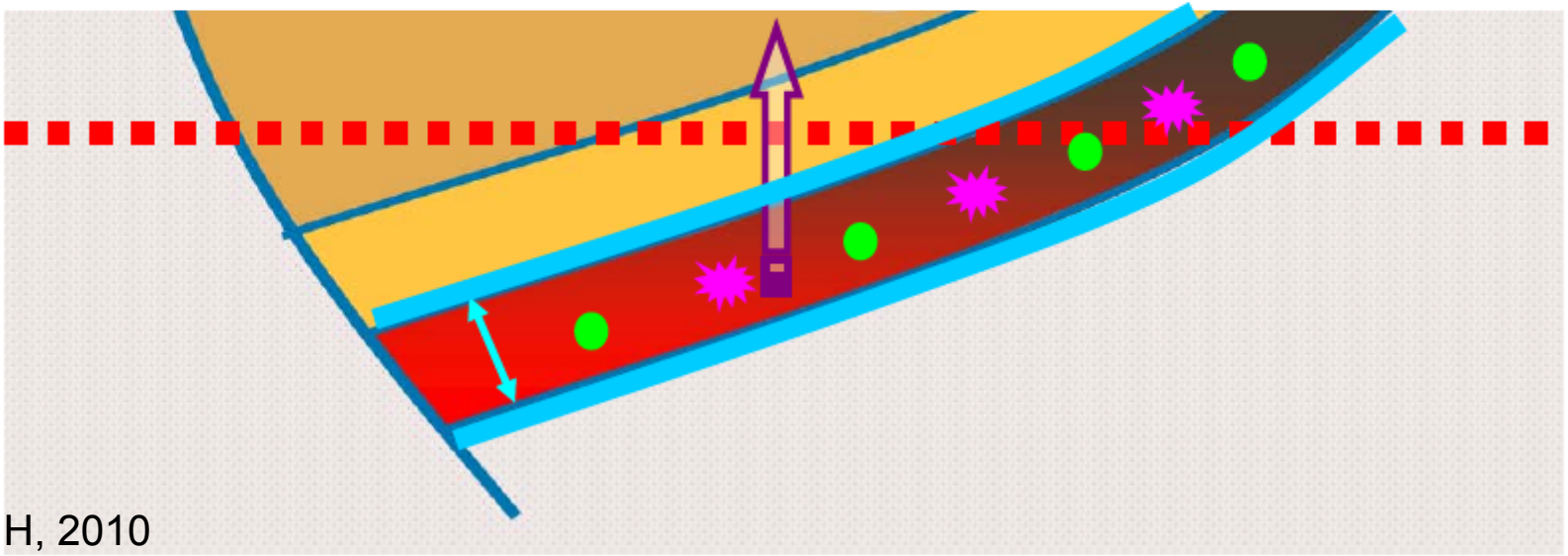
Fluid pressure
Lithology
Chemistry
Thickness
Structure

Fluid pressure
Burial History
Uplift Rate

Ottmann and Bohacs, Exxon, 2013 AAPG

Shale Gas: Geological Criteria for a Successful Play

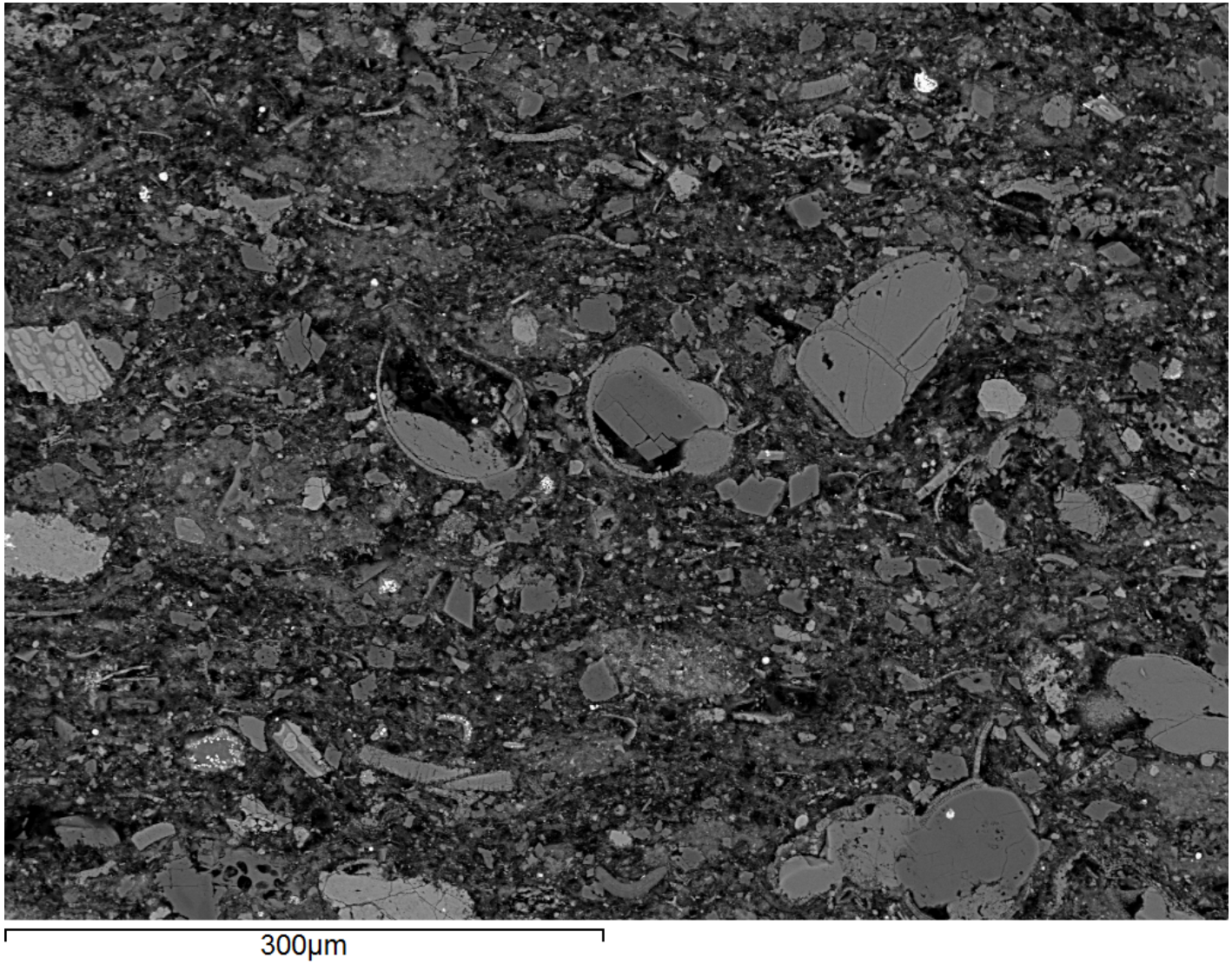
- Gas mature shaly source rock
- High richness preferred - 2-3% TOC seems sufficient
- Fracability – possibility to fracture the shale
- Minimum thickness – 20m
- Confining elements
- Uplift



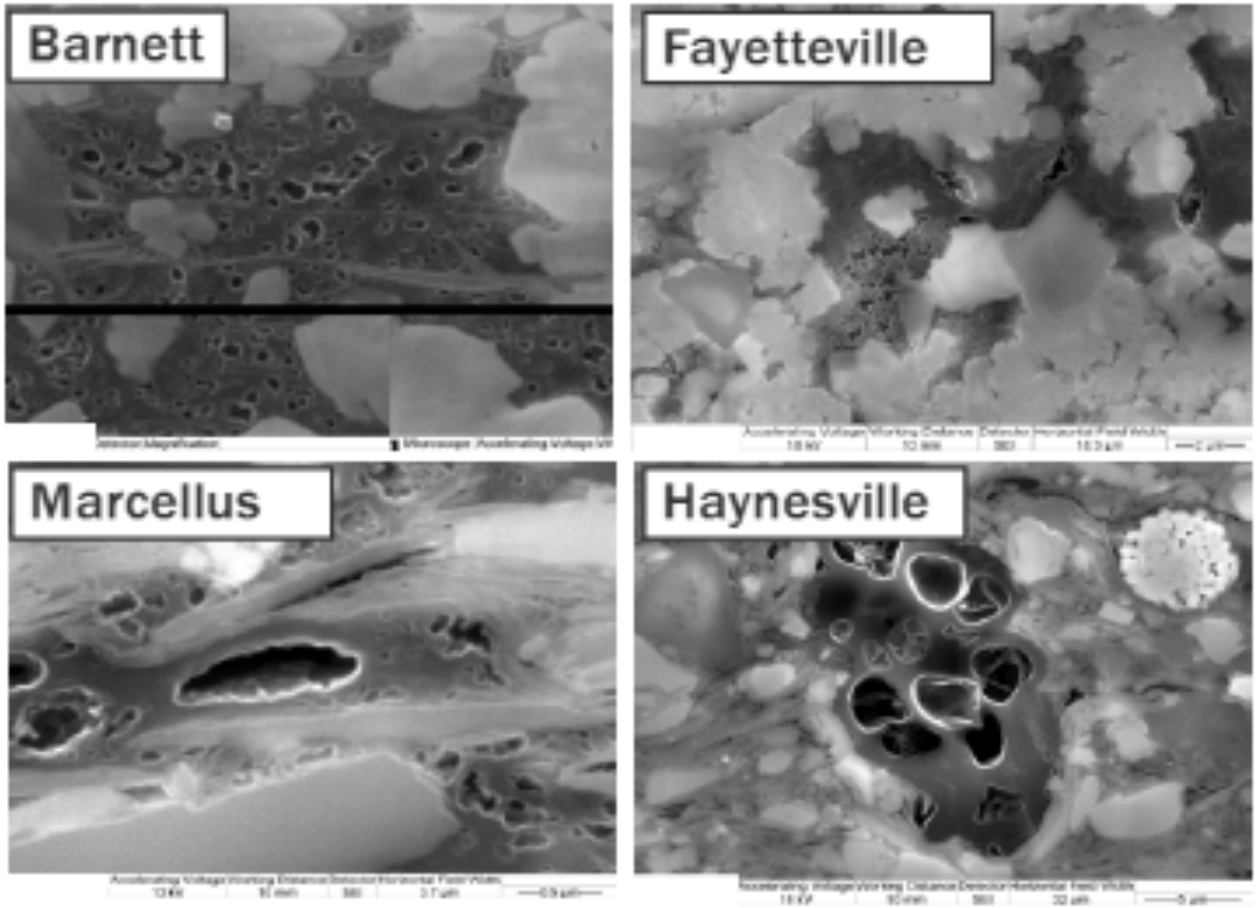
Loseth, H, 2010


Kimmeridge Bay

Shales under the SEM

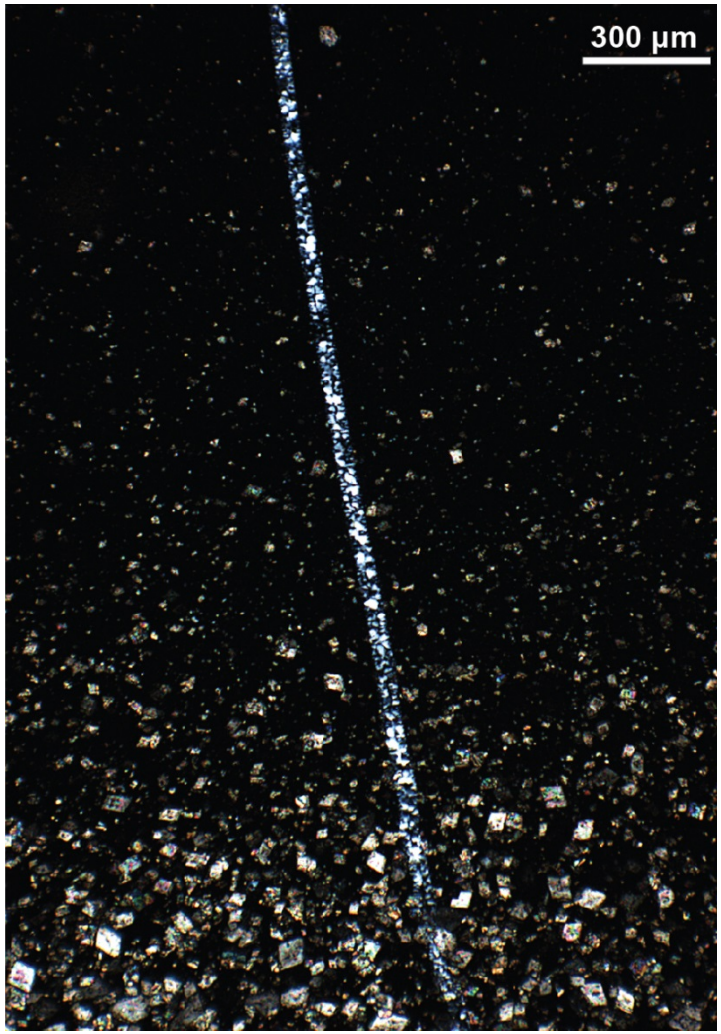


Small is beautiful: Nannoporosity

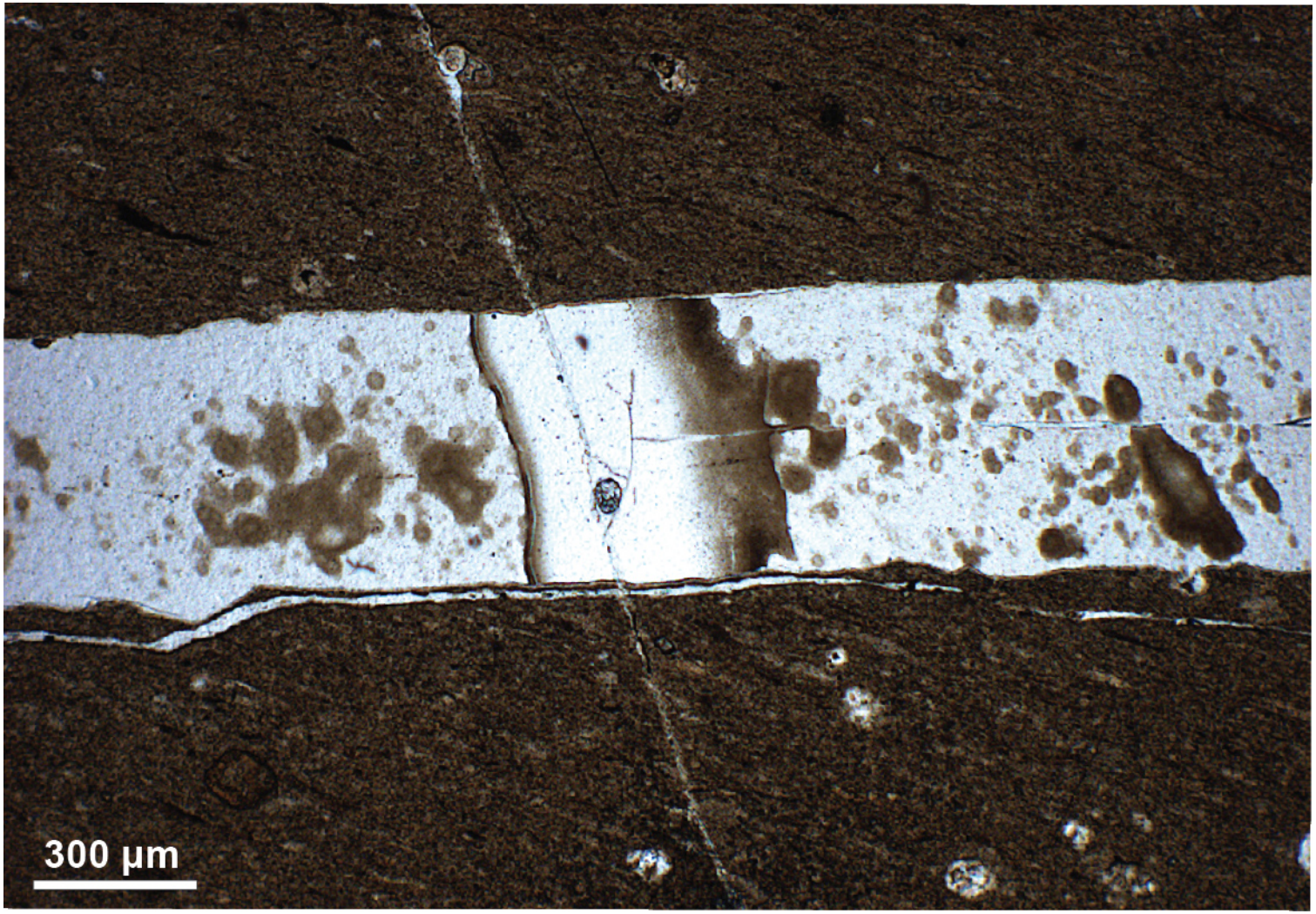


< 0.01 micrometres

Most shales are full of natural fractures



Jurassic, Western Canada

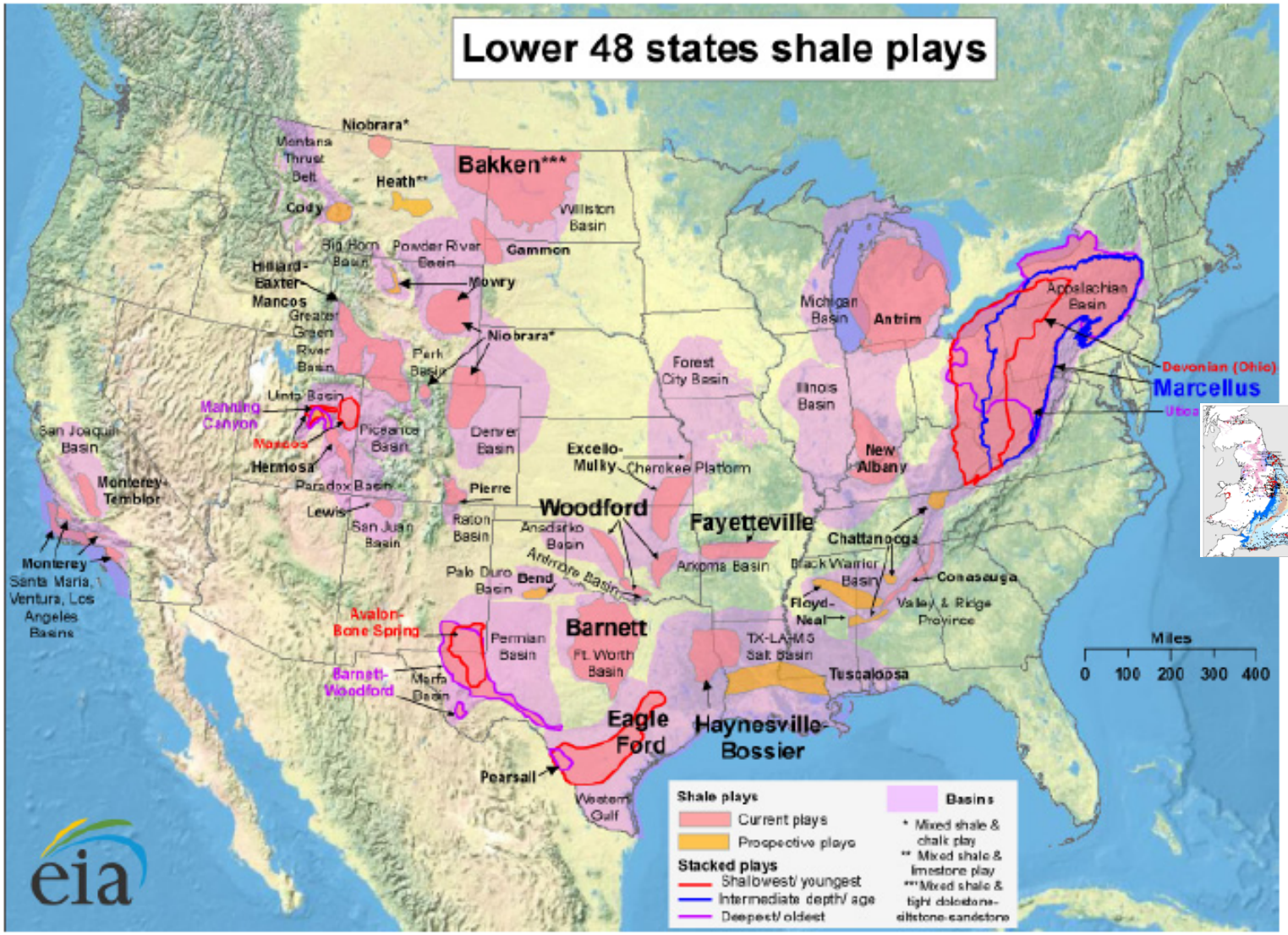


Fracture in Oil Shale, with bitumen cemented in the fracture

Image courtesy of John Hooker

Scale of US >> UK

Figure 1. Map of U.S. shale gas and shale oil plays (as of May 9, 2011)



Source U.S. Energy Information Administration based on data from various published studies.
Upeate: May 9, 2011

US Shale Gas 'Play Areas'

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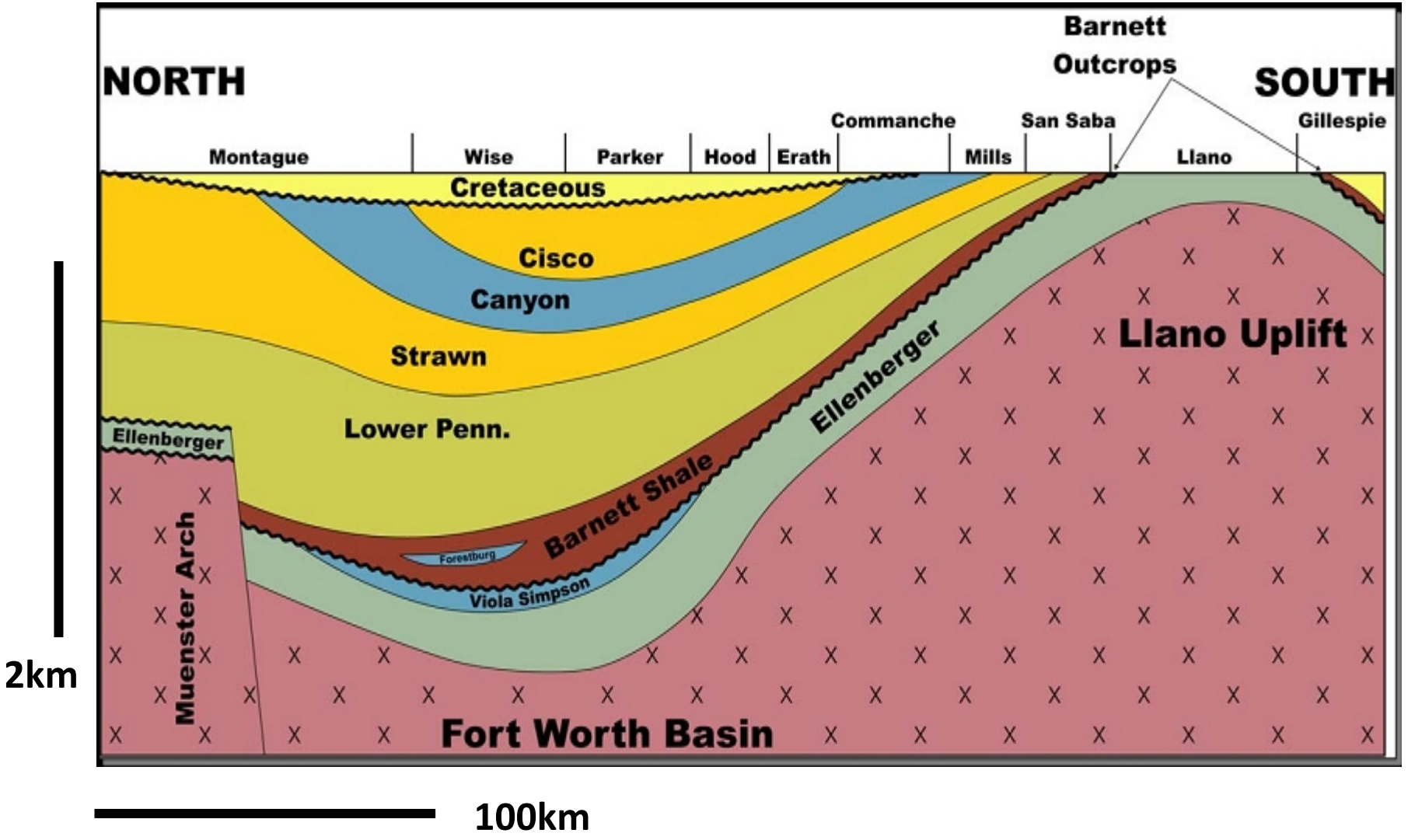
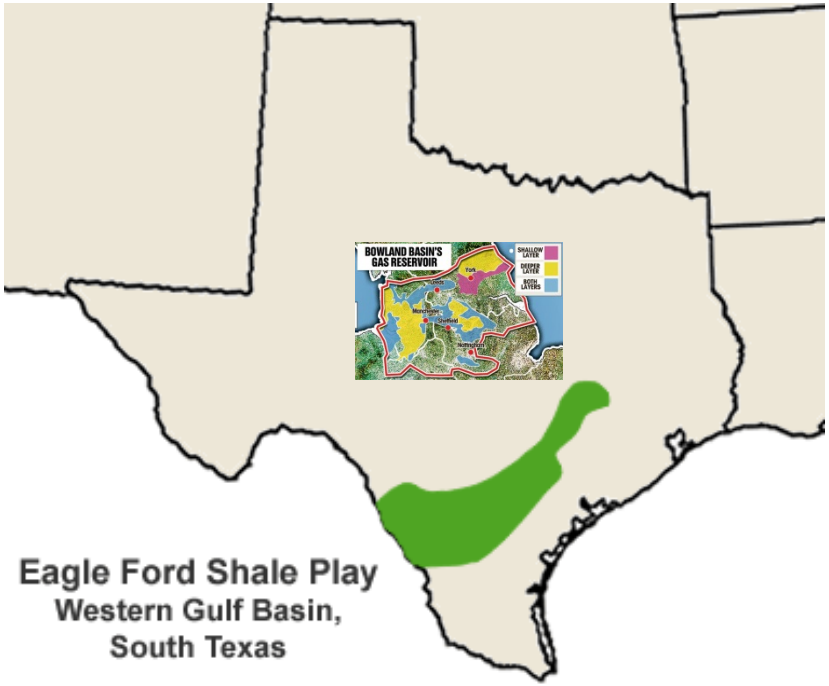
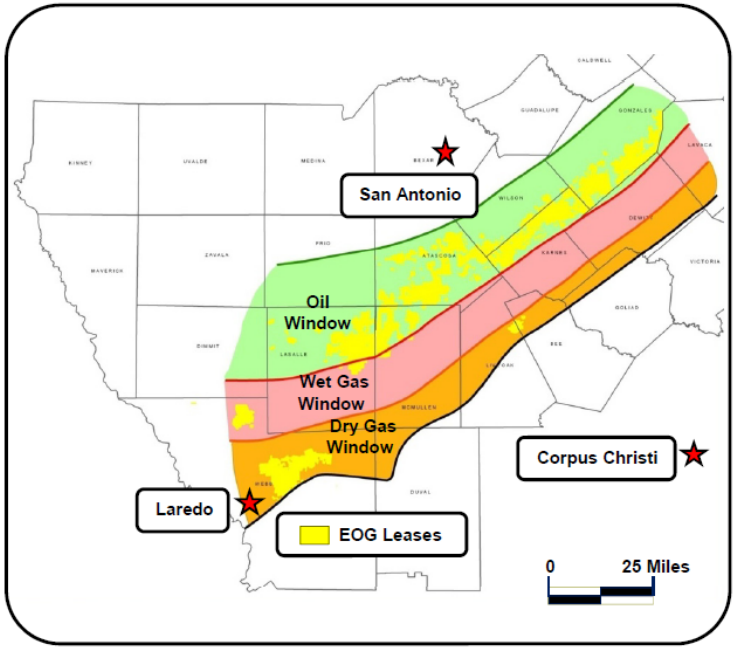
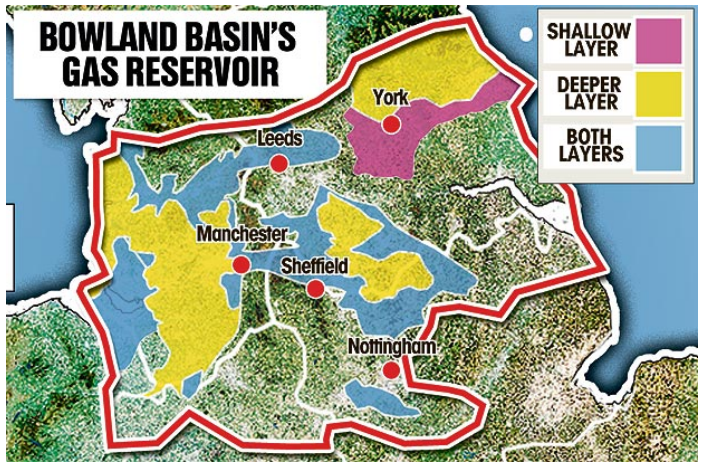
The US Shale Basins are simple……



Eagle Ford: Shale Oil and Gas







c/o Andrew Aplin

Better outcrops, seismic, basic geology……

Eagle Ford, West Texas

Bowland Shale, N. England

UKplc needs to: (1) optimise the geological background knowledge of shale gas plays (strategic coring programme, pilot fracking test) and to encourage high standards of technical work from operators….through licensing rounds? BGS leading the way, but needs support?

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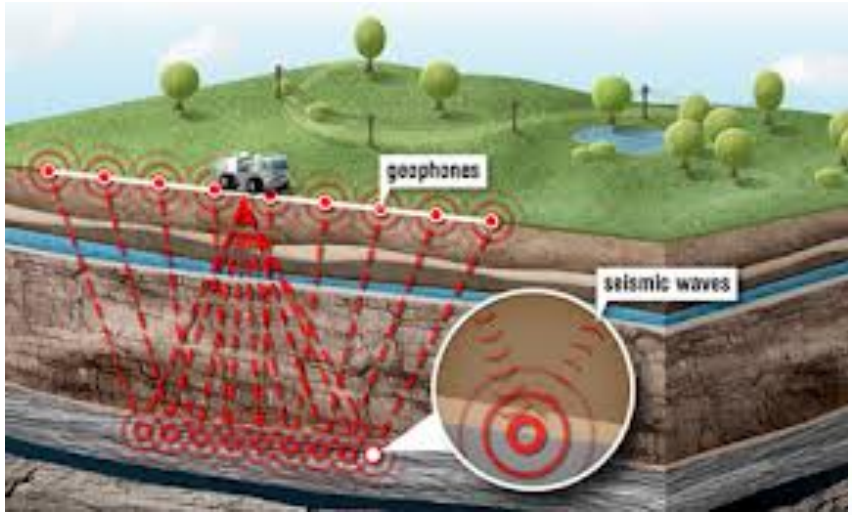
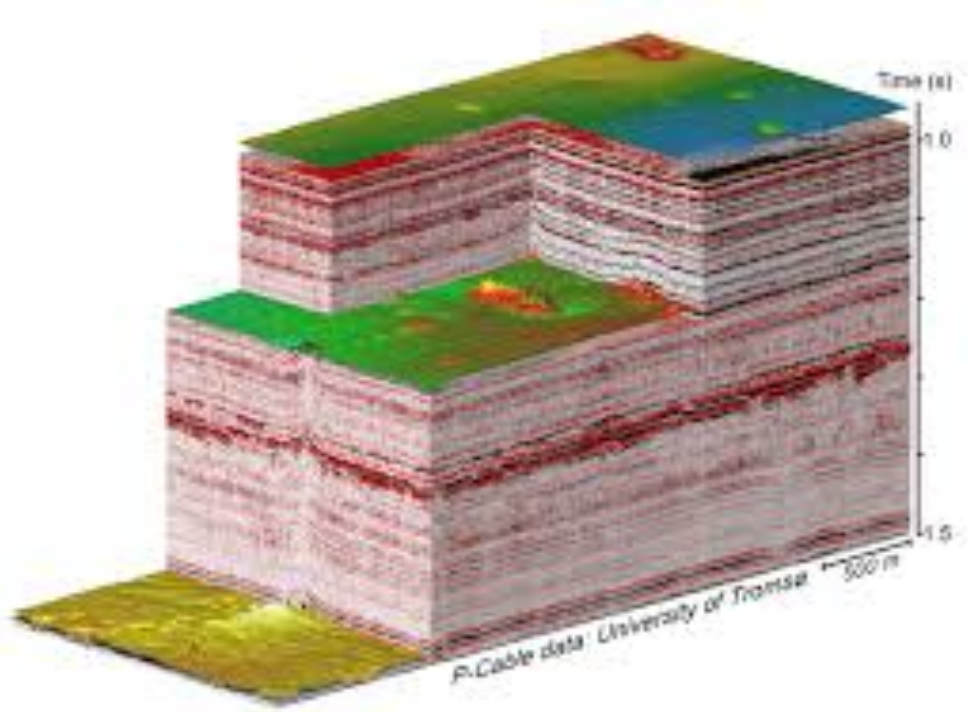
3D seismic technology





Needs extensive access to land, dynamite sources away from roads

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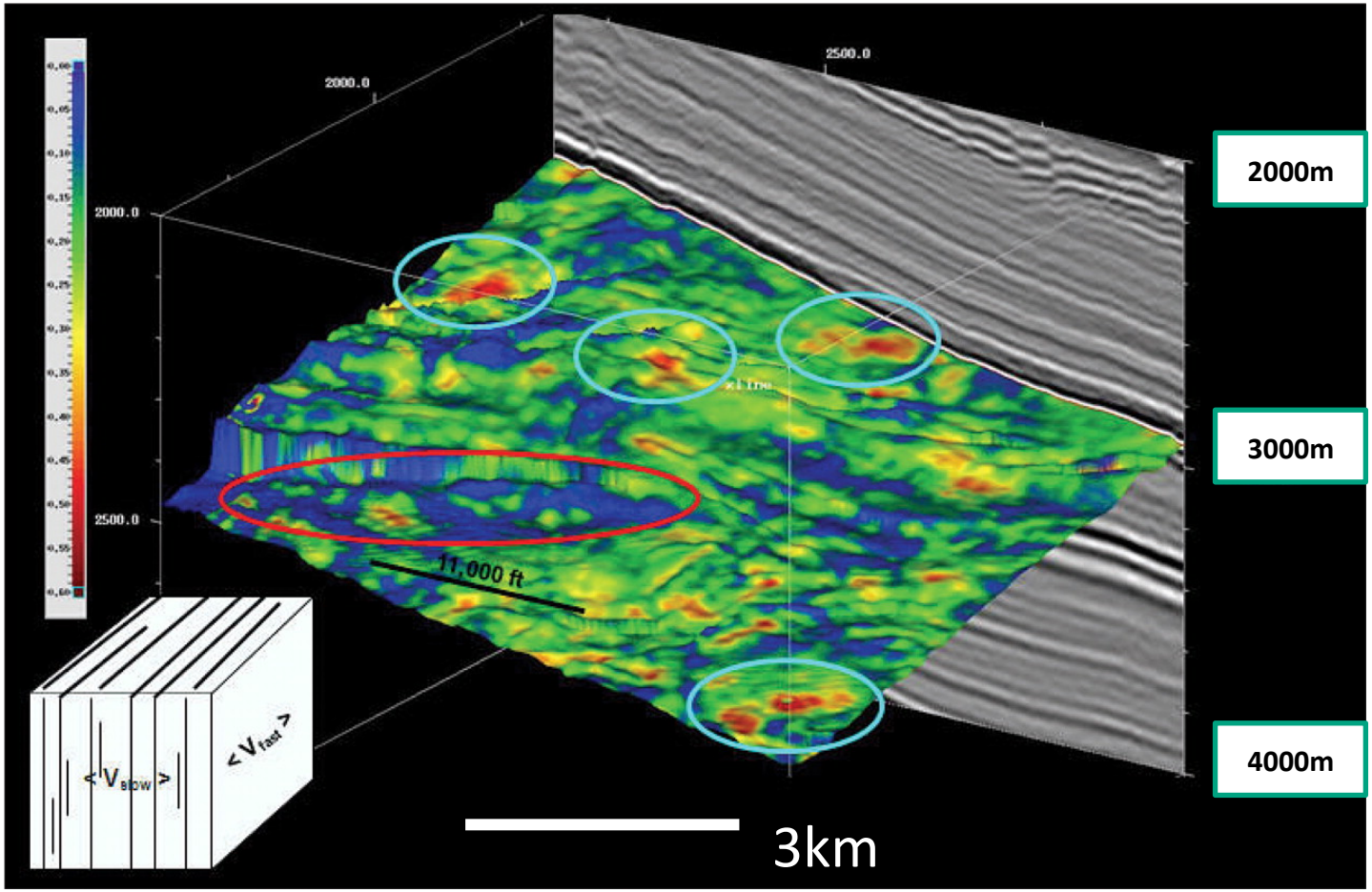
Seismic Data Vital for Success and Safety

US imaging better…. Huge swathes of country covered by 3D seismic….survey lines spaced every 25m



Advanced methods for ‘sweetspot’ detection…

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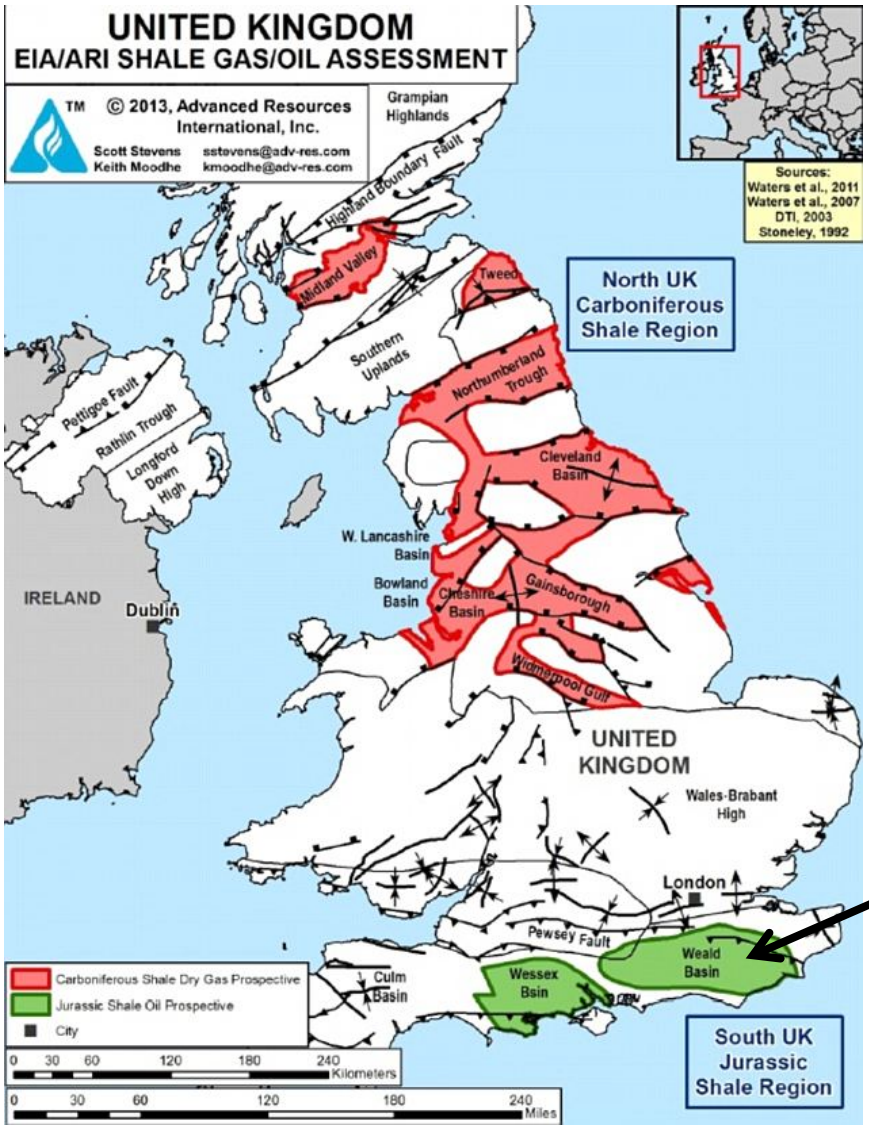
UK shale ‘basins’: pros and cons



Bowland Shale: Northern basins (gas)

Weald Basin Jurassic (light oil)

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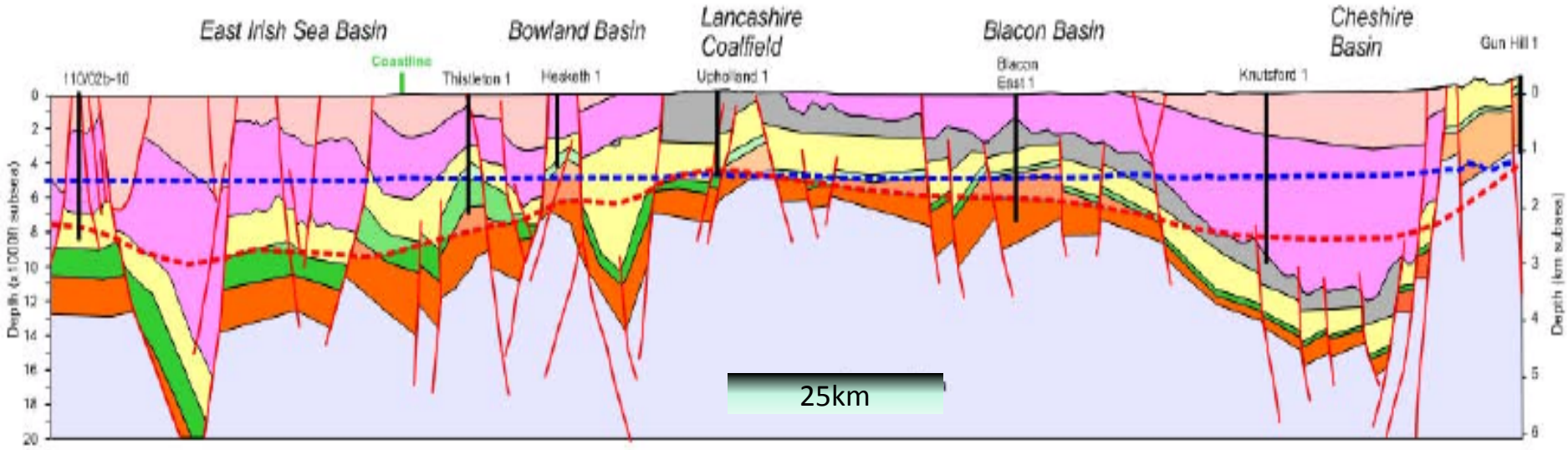
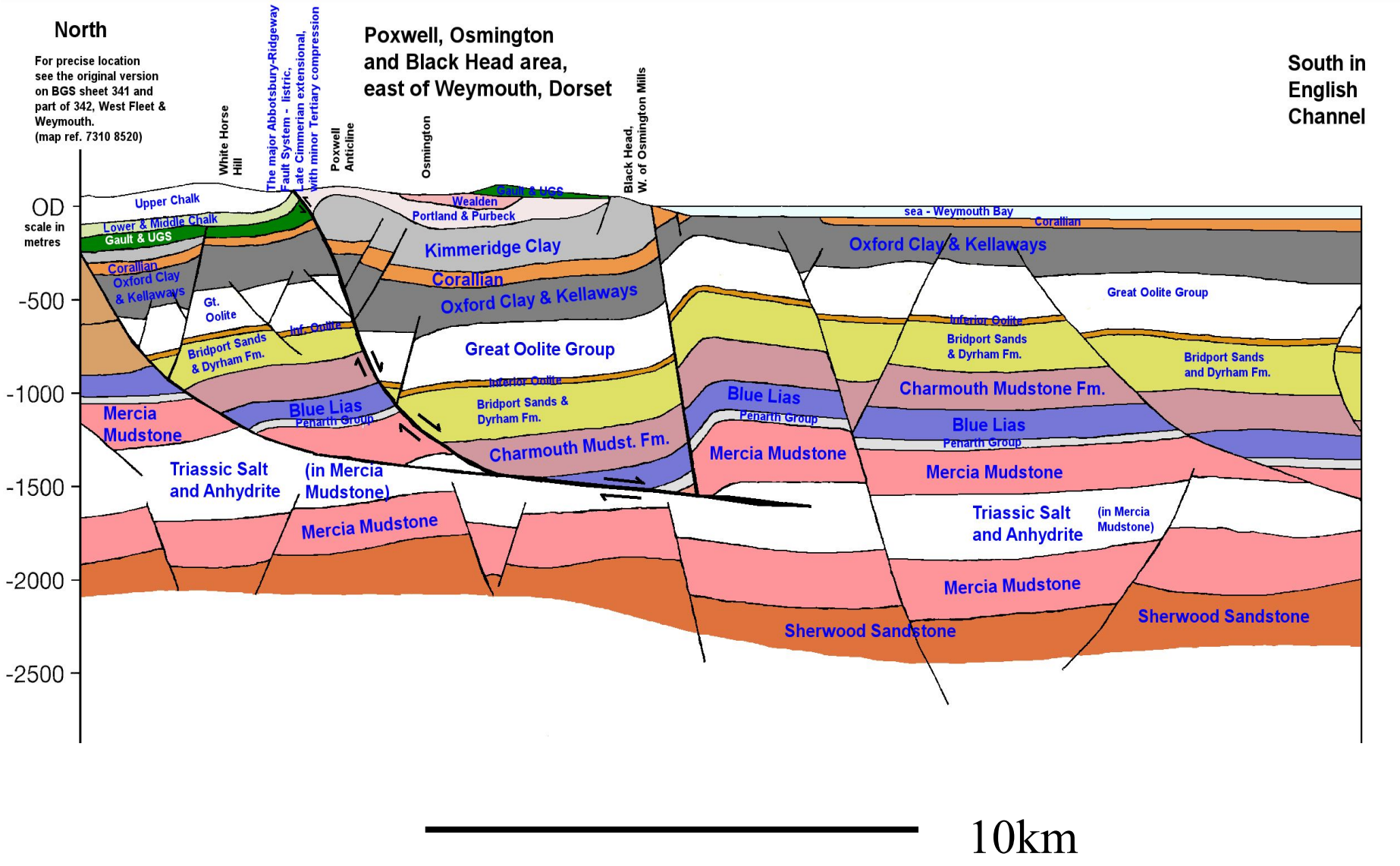
UK geology is complex……highly faulted

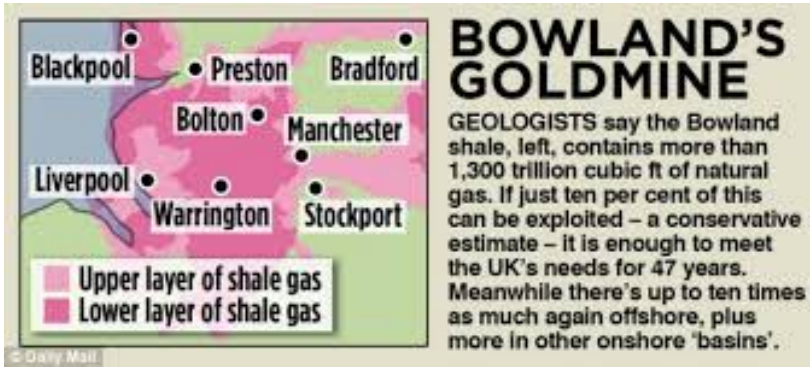


BGS Report for DECC 2013

Cross section Jurassic Coast, Dorset: UK is heavily faulted!



The hype and reality of shale gas



Daily Mail September 2013

'North Sea Mk II: Britain is sitting on a **£1.5 trillion gas goldmine** which could bring enormous economic benefits... but is it safe?'

Financial Times, 6th October 2013

Shell's Chairman Peter Voser expresses his regrets at huge bet on US shale gas

'Unconventionals did not exactly play out as planned'

[Response to announcement of 2$Bn right down of Eagle Ford assets]

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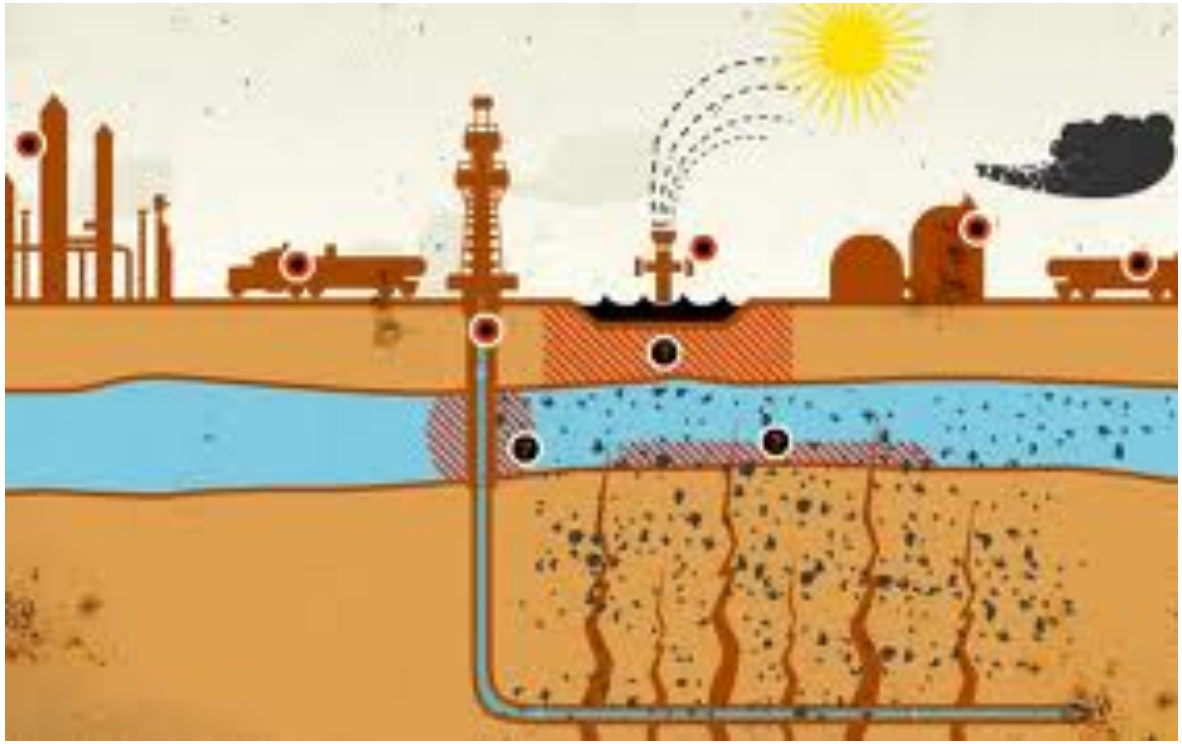
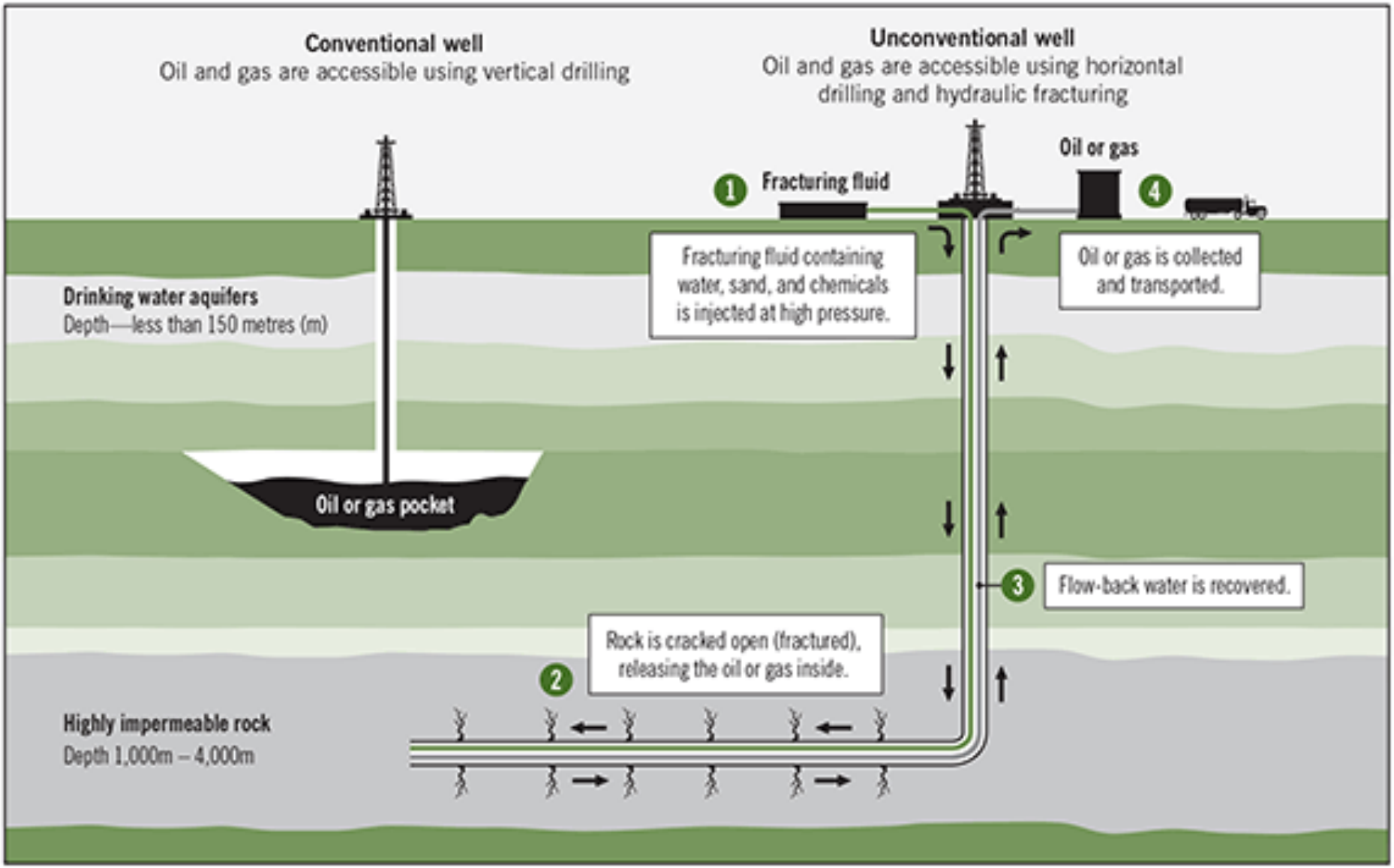
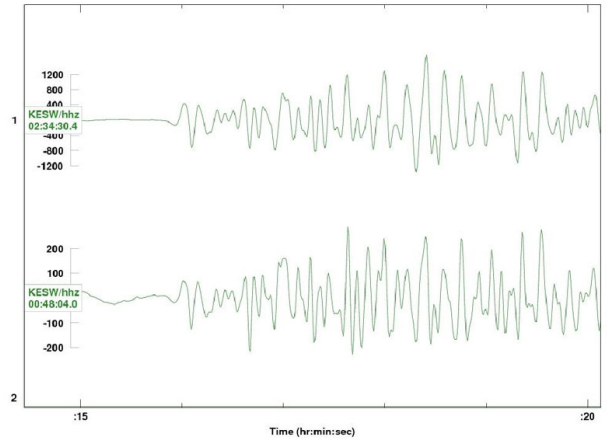
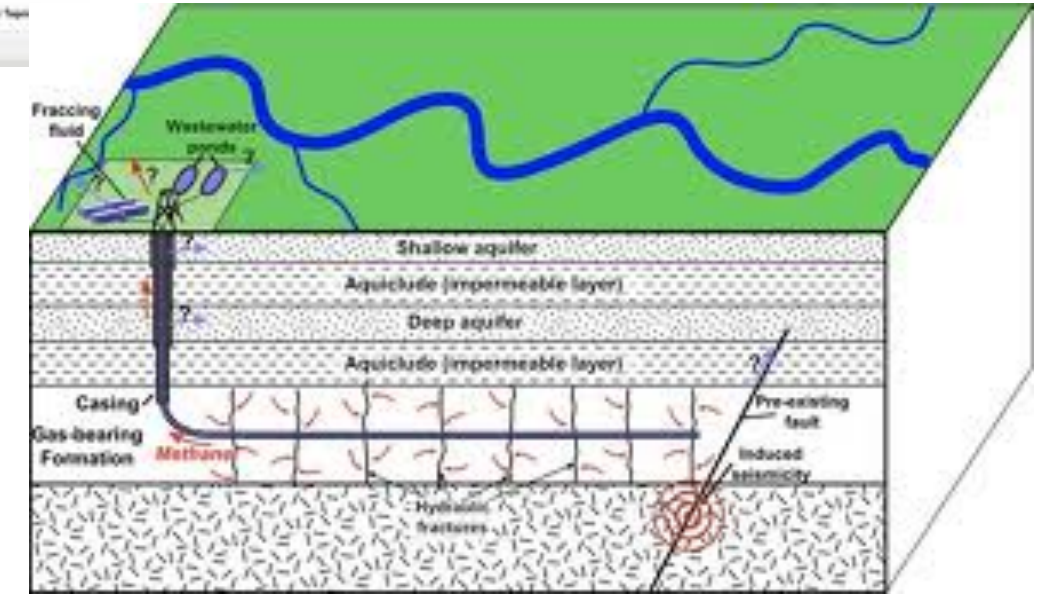
Scale and Illusion




Conventional well
Oil and gas are accessible using vertical drilling
Unconventional well
Oil and gas are accessible using horizontal drilling and hydraulic fracturing
Oil or gas
1
Fracturing fluid
4
Fracturing fluid containing water, sand, and chemicals is injected at high pressure.
Oil or gas is collected and transported.
Drinking water aquifers
Depth—less than 150 metres (m)
Oil or gas pocket
3
Flow-back water is recovered.
Rock is cracked open (fractured), releasing the oil or gas inside.
2
Highly impermeable rock
Depth 1,000m – 4,000m

RISKS: Earth shakers, or just a rumble …..





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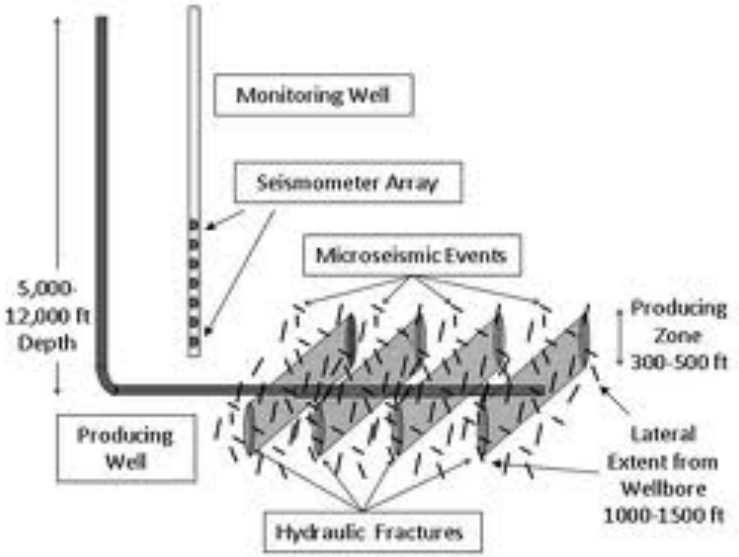
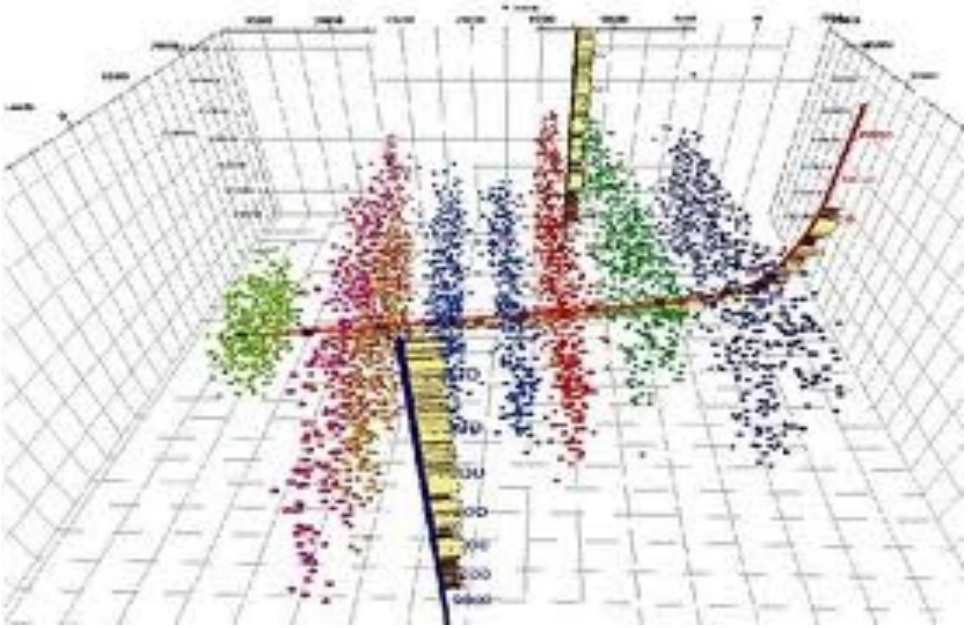
MONITORING: Micro-Seismology





Fracking results in a swarm of
Micro-earthquakes M-0.5)

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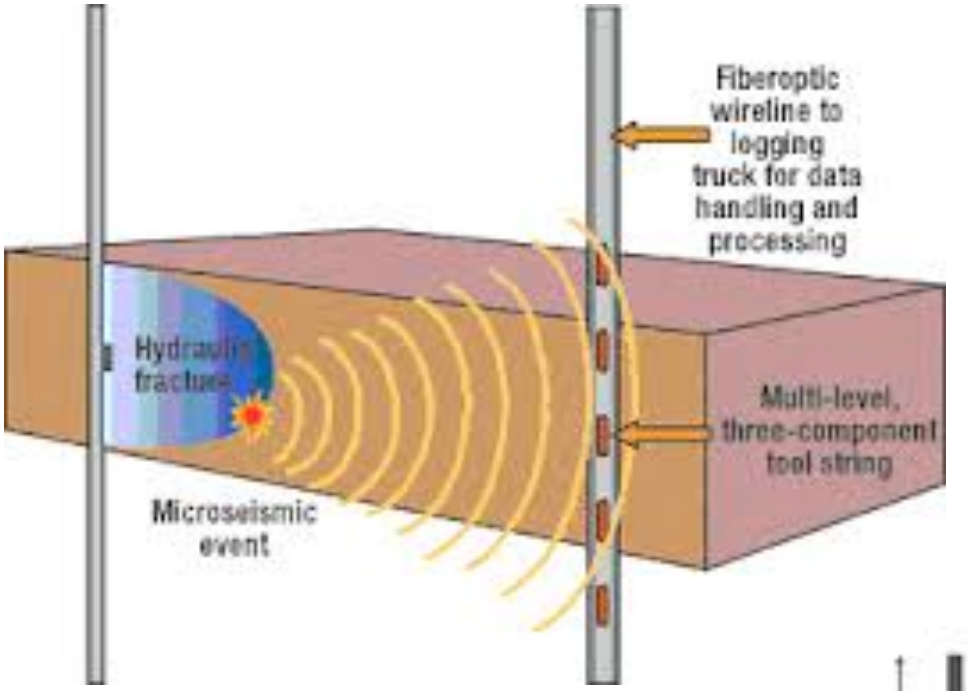
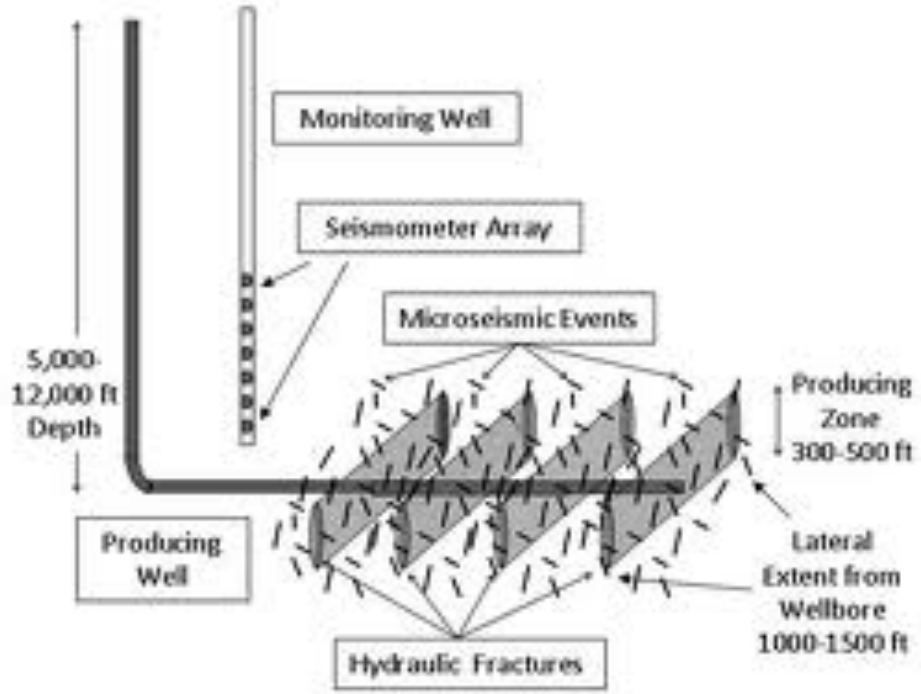
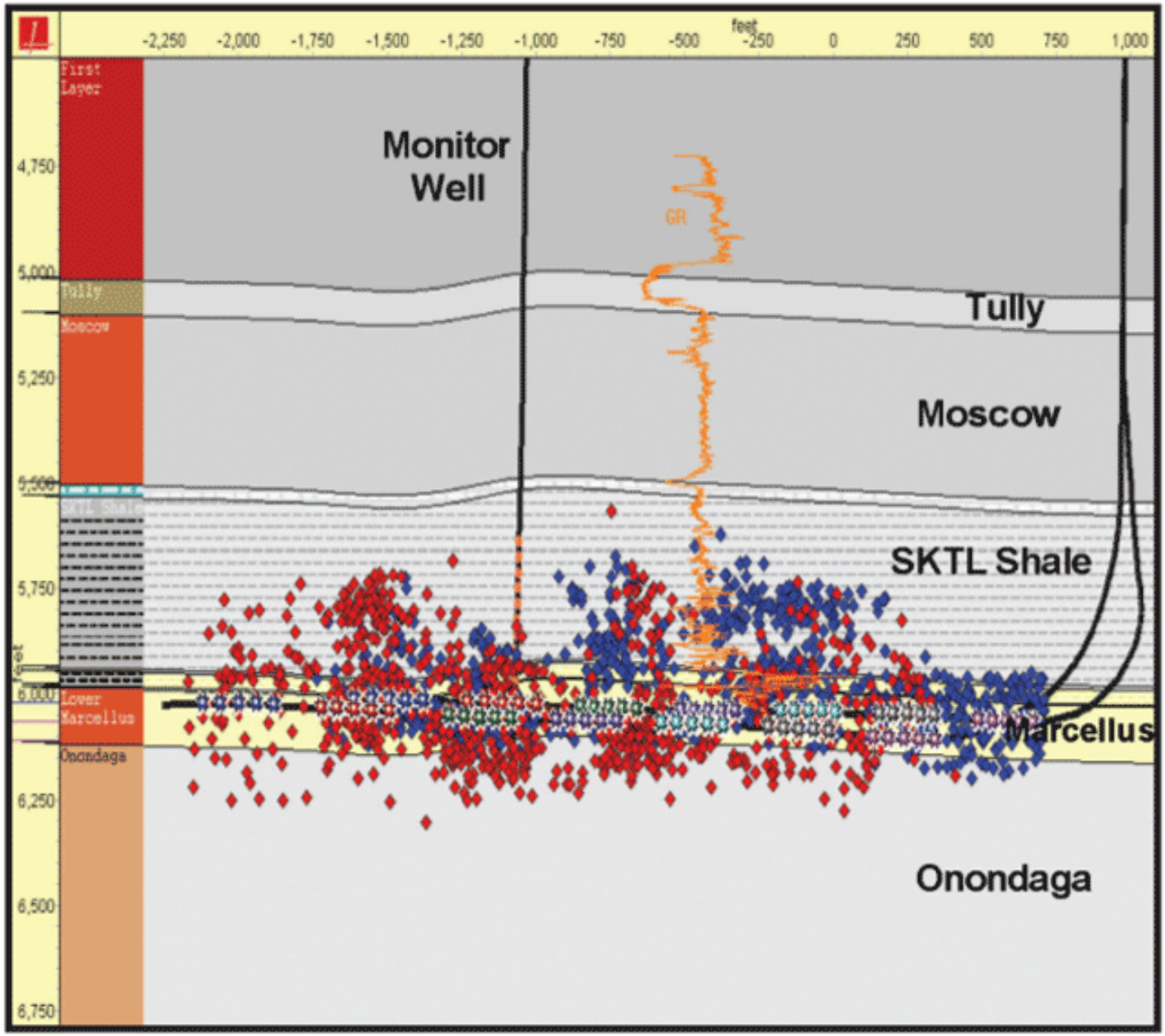
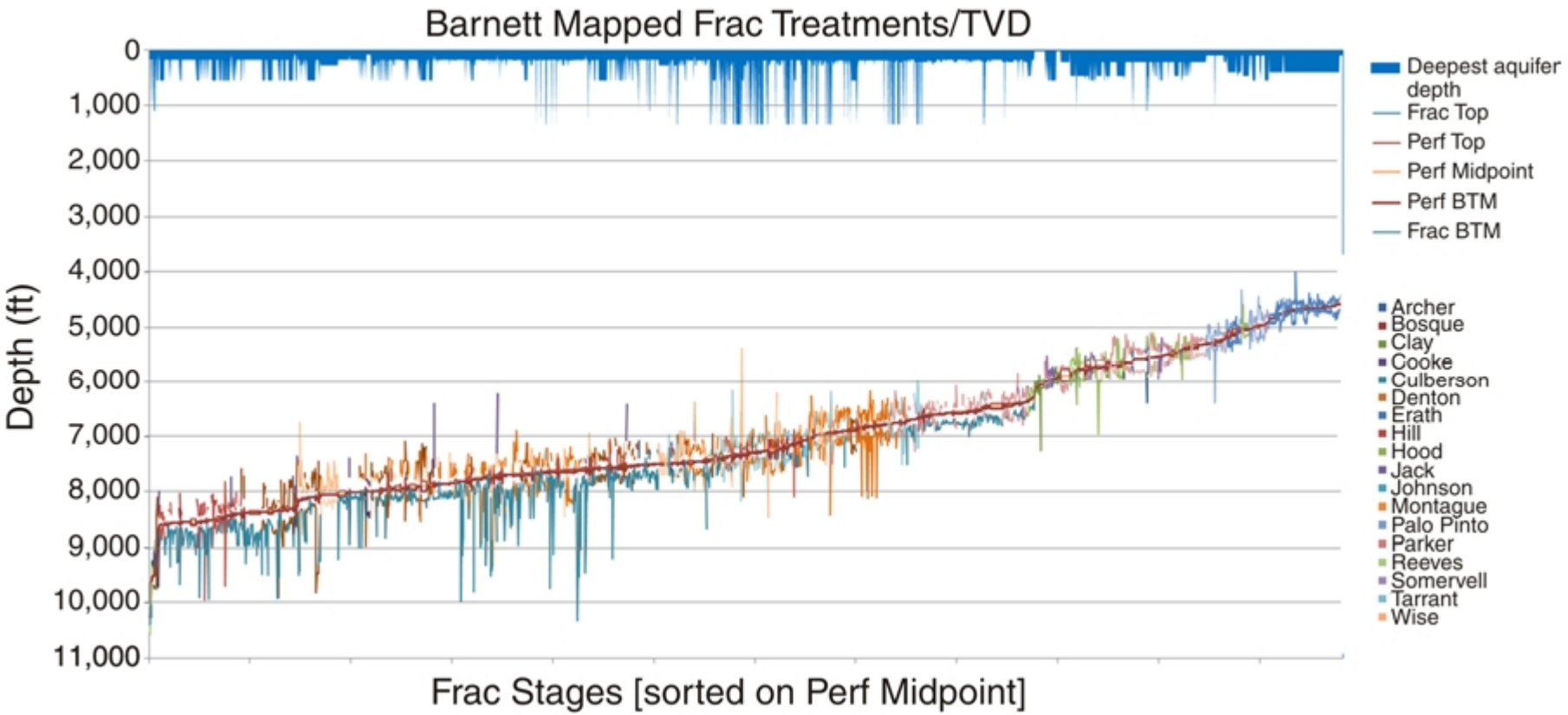






Mayerhoffer et al. 2011

Is it Safe? Can fracks reach groundwater aquifers?



Concluding remarks

Should be careful when comparing UK with US…or anywhere else

Geological uncertainty is substantial (10 critical variables): resource estimates may be out by 100x or more

Subsurface technology is safe: low risk of pollution, earthquakes, subsidence- but high risk of surface impacts

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