Shale: no great shakes?

Shale gas is the energy miracle that'll keep the lights on once the oil runs out. Or is it the looming menace that's going to trigger deadly earthquakes and set fire to our tapwater? Tom Marshall talks to Mike Stephenson of the British Geological Survey (BGS) to sort truth from fiction.

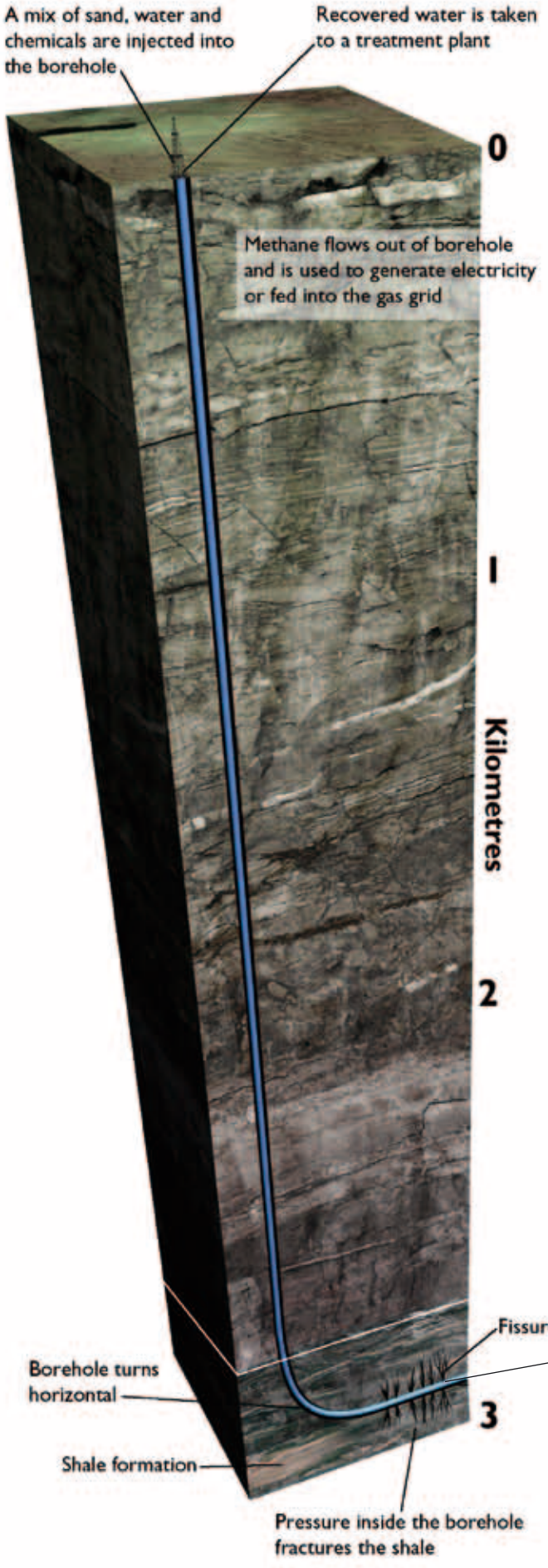
Tom: What is shale gas and how do we get at it?

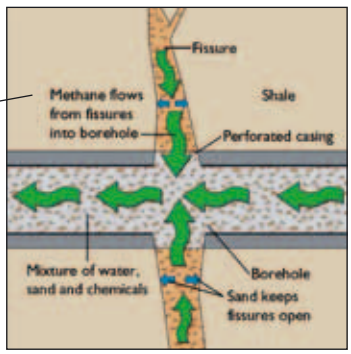
Mike: Shale is by far the most common sedimentary rock on Earth; there are many thousands of cubic kilometres of it beneath the surface. Usually a few per cent of its volume is organic matter. Like other fossil fuels, this is formed from the remains of ancient living things. Under huge pressures and temperatures underground, and over huge swathes of geological time, this organic carbon gets cooked up to form methane.

To get at it, we have to drill down to the shale and pump in high-pressure water, breaking the rock up so we can pump out the gas. There's a fundamental link to the climate here: this ancient carbon cooled the Earth when it was absorbed and sequestered; releasing it back into the atmosphere will cause warming.

Tom: How significant are the UK's reserves in the context of our energy needs?

Mike: Shale gas isn't like oil or natural gas; there isn't a fixed amount of it down there waiting to be extracted. It's more like we're producing it – in the US they talk about underground shale as 'the gas factory'. There's as much gas down there as we choose to produce by fracking the shale, so it's really about how much fracking we want to do. World shale gas resources are estimated at 450,000 billion cubic metres (BCM).





Shale gas is a natural gas locked in the matrix of low porosity shale rocks.

In the US they've been incredibly successful in growing the industry – shale-gas production more than tripled between 1996 and 2006, and natural gas now meets 20 per cent of the country's energy needs. One recent study suggested this will be around 45 per cent by 2035, partly thanks to abundant shale gas. But we're a much smaller and more densely-populated country, and probably less accustomed to subsurface activity, so we may want to take things more slowly.

It's certain that shale has much of the Earth's reserves of organic material, but there's a lot of variation in estimates of its energy potential. To give you an idea, the company that's fracking in the Bowland Shale around Blackpool, Cuadrilla, says there's about 5664BCM of gas down there; at BGS we think 133BCM might be recoverable. So the numbers are quite uncertain, but everyone agrees our shale-gas resources are significant. We estimate there's something like 150BCM of recoverable shale gas under the UK, which would be a significant boost to our energy reserves.

Tom: People are worried that fracking will contaminate drinking water with methane. Do you think that's a real risk?

Mike: For a geologist, it's hard to believe fracking itself could do this. The distances are just too great. The aquifers that provide groundwater are only a few hundred feet deep. The shale deposits we're interested in are far deeper than that – the Cuadrilla fracking was about three miles beneath Blackpool – so there's a huge amount of hard, dense rock in between. I can't imagine how the gas could possibly make it through this and into aquifers. But that feeling's not really good enough. The public and policymakers have legitimate concerns, and we should be producing the science they need to make informed decisions.

A more realistic concern is that the casing around the boreholes could fail near the surface, letting methane escape into groundwater. This is certainly possible, although the energy industry has a lot of experience with designing casings that don't leak – there are hundreds of thousands of oil wells around the world, and most of them work fine. But casings do go wrong, and sometimes this has catastrophic consequences, as we saw with the Deepwater Horizon disaster.

In the US it may be that there's been a certain amount of cowboy fracking going on, and that contractors haven't always been as careful as they should be. [For an example, see www.epa.gov/region8/superfund/wy/pavillion/]

But in a lot of cases what's probably happening is that the methane in drinking water is a naturally-occurring gas created by microbial activity, and has nothing to do with fracking.

Tom: How can we tell if methane was there naturally or not?

Mike: One way is to analyse the ratio of different isotopes of carbon in the methane. Biogenic methane (produced by living things) is much younger than the thermogenic (produced by heat) methane that's cooked up deep beneath the surface, which is what we're trying to extract for energy. This means it has a different mixture of carbon isotopes.

So if groundwater contains methane, in theory we should be able to tell where it comes from, and whether it was there naturally or is the result of shale-gas extraction, although the situation becomes more complex if there has been mixing between methane from different sources. It's not cut and dried, but these techniques could certainly help trace the source of methane.

In a lot of the high-profile cases in the US we can't be sure what caused the problem because we don't know what the situation was before fracking started. It's vital that we do monitoring and establish a baseline, or we'll never be able to tell what's natural and what's caused by shale-gas extraction.

Tom: Beyond any risks for groundwater, there are also concerns that fracking could trigger earthquakes. Are they realistic?

Mike: The earthquakes in Blackpool last year were caused by fracking; there's no doubt about that. But they weren't responsible for the damage to structures in the area that some people have claimed. Fracking does cause tremors, but they're generally far too small to be noticeable. From a geologist's perspective, there are faults everywhere underground and they move all the time; if you add high-pressure water they'll probably move a little more.

Generally this isn't a problem; these quakes aren't powerful enough to cause damage – they happen naturally all the time in the UK. But we should be giving people the information they need to understand the risks, rather than just telling them there's nothing to worry about.

Tom: What should be done?

Mike: Again, we need better monitoring so we know what the situation was before fracking started. There's a proposal being considered at the moment under which companies would use a traffic-light system, so that if there is any sign of a build-up of pressure they stop for a few hours and let things settle down again. Probably there will need to be some kind of independent monitoring of fracking operations, perhaps by an organisation like the BGS.

Tom: It seems there's surprisingly little research available on this. In your recent presentation to the Royal Society, you identify just two papers in the area.

Mike: The energy companies have done lots of research, but they don't release it. The public don't really understand the process and its risks, but they have justifiable concerns. The whole area's a perfect breeding ground for hyperbole and paranoia. But it's also a perfect opportunity for science! If we can get the science right, we can support regulators, reassure the public and make sure that if something goes wrong, we know about it and can hold the appropriate people responsible.

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MORE INFORMATION

Professor Mike Stephenson is head of energy science at BGS. He recently gave a presentation to the Royal Society about the possible risks of shale-gas extraction. Listen and watch an accompanying slideshow at:

www.foundation.org.uk/events/audios/audiopdf. htm?e=448&s=1226