Fracking: Facts and Fiction

A talk on “Fracking – Facts and Fiction” was given by Dr Julie Richardson at Crowcombe Hall on the 8th of September. Report by Philip Comer

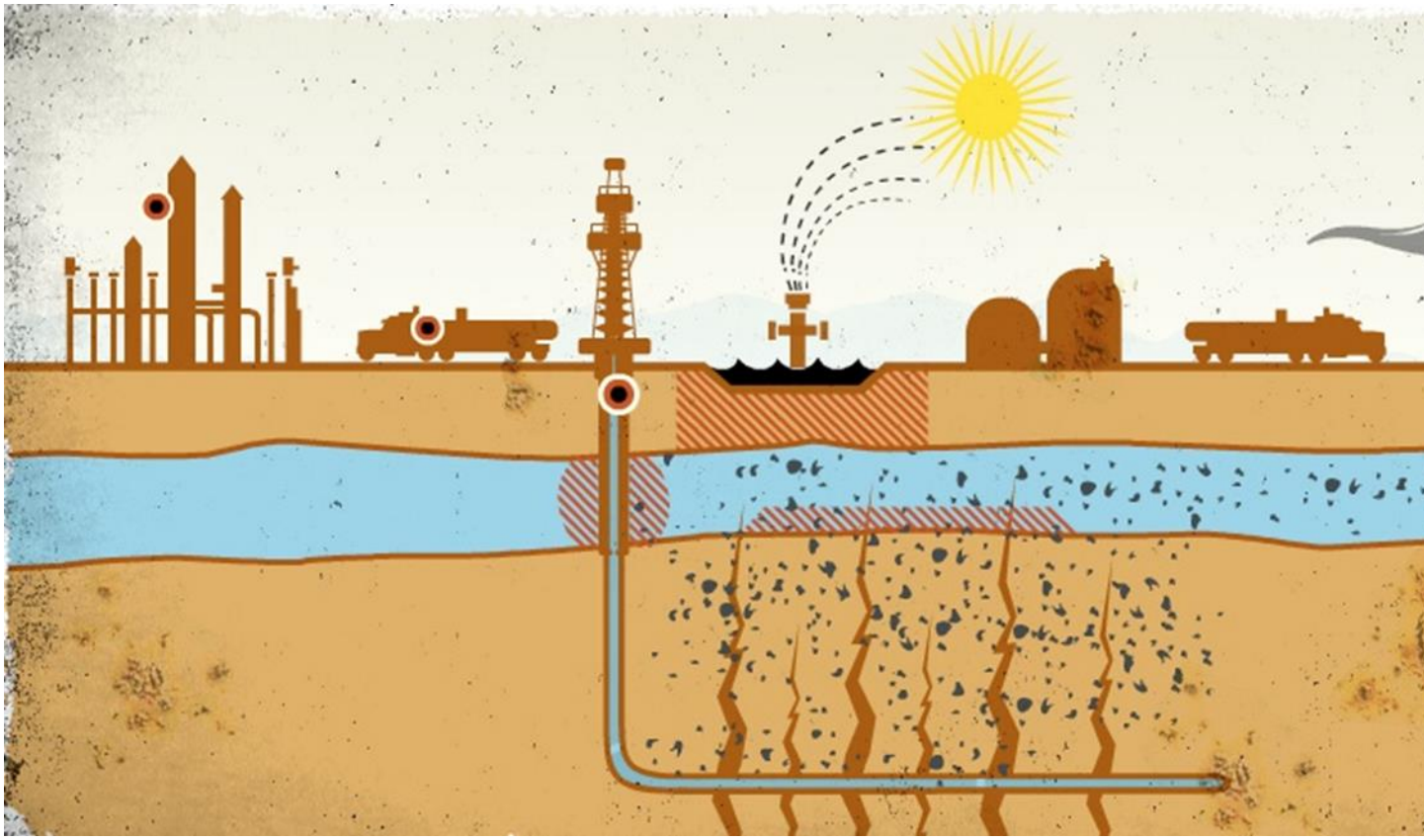

Figure 1: Public Perceptions around “Fracking”

Dr Julie Richardson gave a very interesting and informative talk to Friends of Quantock on “Fracking: Facts and Fiction” to a full hall at Crowcombe in September. Julie was able to use her knowledge and experience to provide a good overview of what “hydraulic fracturing” (fracking) is, where shale reserves can be found both world-wide and in the United Kingdom, and discussed some of the environmental risks. The talk stimulated some lively discussions and questions which Dr Richardson responded to very effectively.

Dr Richardson started the talk by referring to the “cartoon” drawing that had been used for the publicity material (Figure 1). She noted that the diagram highlighted many of the concerns people had about fracking (contamination of groundwater from the fracking fluids, leaks from waste water holding tanks, flaring, methane escapes, etc), but also that it reinforced some of the misconceptions about fracking.

In particular, she stressed the significant difference in scale between the actual situation that would be found in fracked wells in the UK, illustrated in Figure 2, and that implied by Figure 1. Dr Richardson also stressed that UK regulations stipulate that, in order to reduce the risk of water contamination in certain protected areas, such as an AONB, a shale oil prospect can only be exploited if it lies more than 1200 metres below the surface and 600 metres below any potable water aquifer.

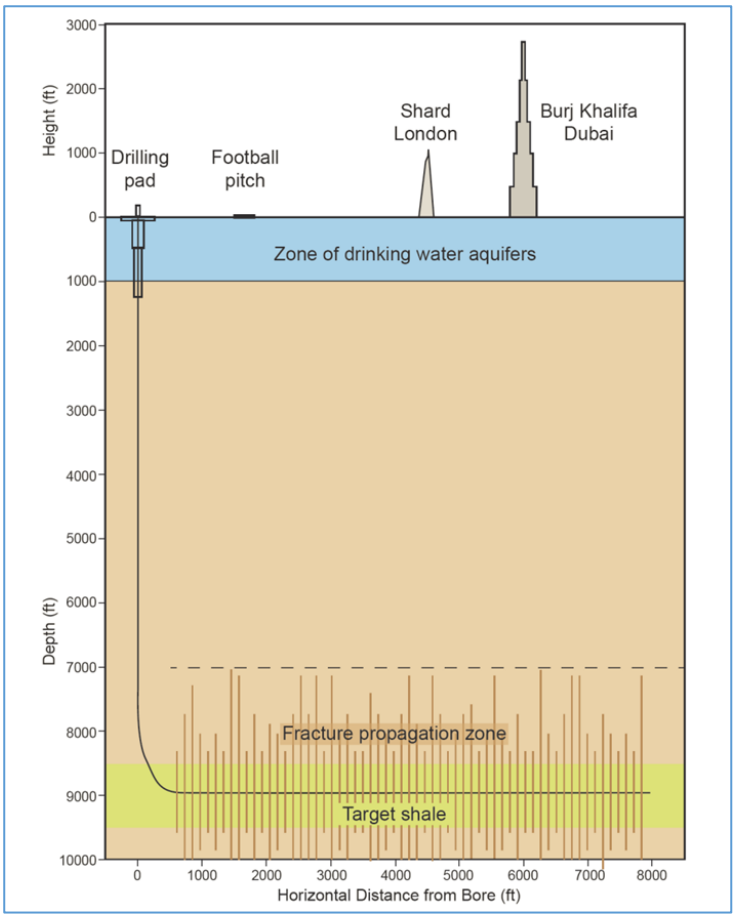

Figure 2: True scale of a Fracking Operation

What is Fracking?

Fracking is the popular name given to a technique properly called “Hydraulic Fracturing.” There is a common misconception that this is a new technology; in fact it has been in use by the oil industry for fifty years or more, and is just one of a range of tools used by drillers to help extract oil and gas from difficult strata.

Shale rocks are generally dense and black-coloured, formed from mud deposited at the bottom of past oceans, now solidified into rock. This mud is rich in un-decayed organic matter. When heated, which happens when the shale layer is buried deep underground by earth movements, the organic matter is transformed into oil and gas. Some of this oil and gas will usually rise through the overlying strata where it may become trapped in sandstone or limestone layers. This is what would be considered as “conventional” reservoirs that can be exploited relatively easily as the oil and gas can move through the strata to the lower pressure created by a well.

However, much of the oil and gas formed in these processes will remain trapped in the shale layer, which have much lower porosity, so that it is harder for the oil and gas to move through the shale. The process of hydraulic fracturing uses water, mixed with some chemicals, at high pressure to create fissures in the rock strata that will allow the hydrocarbons present to move through the shale to the drill pipe and so be extracted. It was only with the relatively recent development of horizontal drilling technology, which allows one well to cover a large area of the shale deposit, that this technique became economic for deep deposits. Without horizontal drilling it would be necessary to drill many vertical wells to cover the deposit. This has happened in some shallow deposits, but would be uneconomic for deeper deposits, such as those found in the UK.

When a well is drilled, it initially travels vertically down until it reaches the depth of the shale layer. The well would start with a large diameter, and slowly reduce in stages. Each drilled section is

“cased” with steel pipe that is cemented into place. When the required depth is reached the drill pipe is then turned so that it then travels horizontally to follow through the layer that contains the hydrocarbons. Modern drilling technology can enable wells to travel horizontally for up to 10 km but usually they will be 1 to 2 km. Also, it is possible to drill several horizontal laterals from one vertical shaft, so minimising the number of well head installations that are needed.

Once the horizontal well has been drilled, it must be hydraulically stimulated, or “fracked”. This is done in stages, with a section sealed off and high pressure water pumped down and into the rock through pre-prepared holes made in the drill pipe. Various chemicals are added to the water to increase the efficiency of the fracking operation. The water pressure opens up pre-existing fractures in the rock and creates new ones which will allow any oil and gas present to flow through them into the well. At the end of this fracking stage some material, often sand, is added to the water to prop open the fissures and enable the gas to continue to flow. Once all the well laterals have been fracked, the well is ready for production. A set of valves is attached to the top of the well, known as a “Christmas Tree” that allow the flow from the well to be controlled.

Environmental Concerns and Regulation

There are a range of potential environmental concerns associated with a fracking development, although many of these would equally apply to any onshore hydrocarbon extraction operation. These include:

- Contamination of water supplies
  - Fracking fluid goes up faults to aquifers
  - Fracking fluid leaks into aquifers from wells
  - Surface tanks holding waste water leak into groundwater and rivers
  - Unsafe disposal of waste fluid
  - Radioactive content of waste fluid
- Methane leaking along same pathways
- Methane escapes into atmosphere – greenhouse gas
- Flaring of gas – greenhouse gas
- Landscape degradation
- Unacceptable levels of heavy traffic
- Induced seismicity

The first group of these issues, including both contamination of water supplies and methane escapes, essentially come down to the integrity of the well. The well itself in a fracking operation is no different from that in a conventional well and the management issues are very similar. The UK has significant experience with onshore oil and gas exploitation, going back over 100 years. Some 2000 wells have been drilled, and in the UK today there are 120 sites with 250 operating wells. The Wytch Farm oil field, located in an area of outstanding natural beauty, like the Quantocks, was developed in 1973 and is now the largest onshore oilfield in Western Europe.

All of the issues listed are important and need to be properly managed and regulated. Before any shale operation can begin in the UK, operators must pass rigorous health and safety, environmental and planning permission processes. The regulatory process is illustrated in Figure 3. This figure is too small and busy to read easily, though there is a link to enable you to read it more clearly. It does, however, give an impression of the many different stages and layers of regulation that are there to protect public safety and our environment.

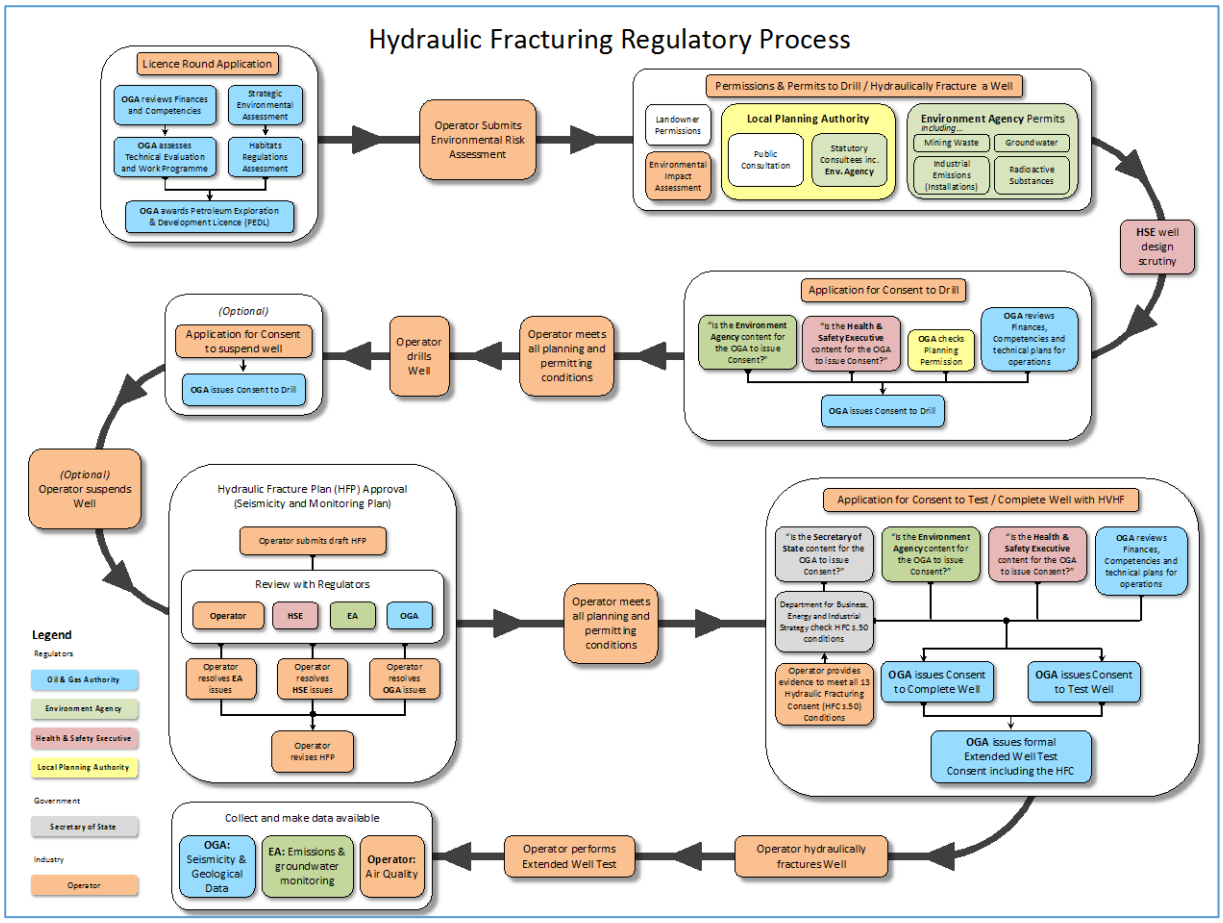

Figure 3: Hydraulic Fracturing Regulatory Process

Source:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/549115/OGA_Well_Consents_process.pdf

The following summary of the regulatory process is based on a UK Government publication that can be found at: https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking/developing-shale-oil-and-gas-in-the-uk

The process of obtaining consent to drill a well is the same whether the well targets conventional or unconventional gas. First, operators bid for exclusive rights to an area in competitive licence rounds. These areas are known as Petroleum Exploration and Development Licences' (PEDLs). The Oil and Gas Authority (OGA) is responsible for issuing PEDLs. The OGA works closely with regulatory partners to make sure any exploration and development activity associated with the development of new oil and gas resources is safe and sustainable. PEDLs have been issued for a number of licence blocks along the North Somerset from the East of Minehead, around Bridgewater Bay up to Clevedon, and include an area that lies within the Quantock Hills AONB.

The operator then needs the permission from the landowner's and planning permission, which may require an environmental impact assessment. They also need environmental permits from the Environment Agency (in England) who ensure that any shale gas operations are conducted in a way that protects people and the environment. The Environment Agency's environmental permitting regulations cover:

- protecting water resources, including groundwater (aquifers) as well as assessing and approving the use of chemicals which form part of the hydraulic fracturing fluid;
- appropriate treatment and disposal of mining waste produced during the borehole drilling and hydraulic fracturing process;

- suitable treatment and management of any naturally occurring radioactive materials (NORM);
- disposal of waste gases through flaring.

The Environment Agency is also a statutory consultee in the planning process and provides the planning authority with advice on the potential risks to the environment from individual gas exploration and extraction sites.

The Health and Safety Executive (HSE) must be notified of the well design and operation plans at least 21 days before drilling is due to start. The HSE inspects the well design, its construction and upkeep to ensure that measures are in place to manage risks effectively throughout its life cycle. The HSE and Environment Agency will meet all new or first time shale gas operators and advise them of their legal duties under the relevant legislation, and conduct a joint inspection of the key operations at the site. The operator then seeks final consent from the OGA.

Planning permission is one of the approvals required before any activity may start on a site. The planning authority decides whether the activity is acceptable at that particular location, after local communities and other interested people have had the opportunity to set out their view on the benefits and impacts of the proposal.

However, it should be stressed that regulations are pointless unless there is a strong system to ensure that regulations are complied with. It has been reported that there were few inspections at the Preece Hall fracking site near Blackpool, even though the impact of problems would have far reaching consequences for future exploration.

The Potential for Fracking Operations in Somerset

If you walk down to the beach at Kilve on the North Somerset Coast you will see a small building with what looks like a stubby chimney. This is the Kilve oil shale retort. The presence of oil shales at Kilve had been known for some time, and in 1924 a company was formed with grand designs to “mine” the shale and produce oil. Oil shale is organic-rich sedimentary rock from which liquid hydrocarbons, “shale oil”, can be produced by heating the rock to a sufficient temperature. This is generally an expensive process, with major environmental impacts, and is normally only economically viable when the crude oil price is high, and the oil shale (or tar sands) are available in sufficient quantity. The development at Kilve was not a success and the company folded.

The presence of this evidence of oil shale at Kilve is not an indicator that there are good reserves of shale oil or gas that could be extracted by hydraulic fracturing. These “lower lias” deposits are shallow and have never been buried to sufficient depth to be heated in order to produce recoverable oil or gas. It could only be exploited by quarrying the shale and heating it in a retort as had been attempted back in 1924. Even if there were recoverable hydrocarbons present in the deposit, it is too shallow, less than the 1200m minimum depth allowed in an AONB.

This was illustrated by Dr Richardson with a the geological map of the area (Figure 4) and a simple cross section she had produced (Figure 5) to illustrate the general order of the strata in the region. From this it can be seen that the Jurassic lower lias strata along the Somerset coast, shown in green, are very shallow.

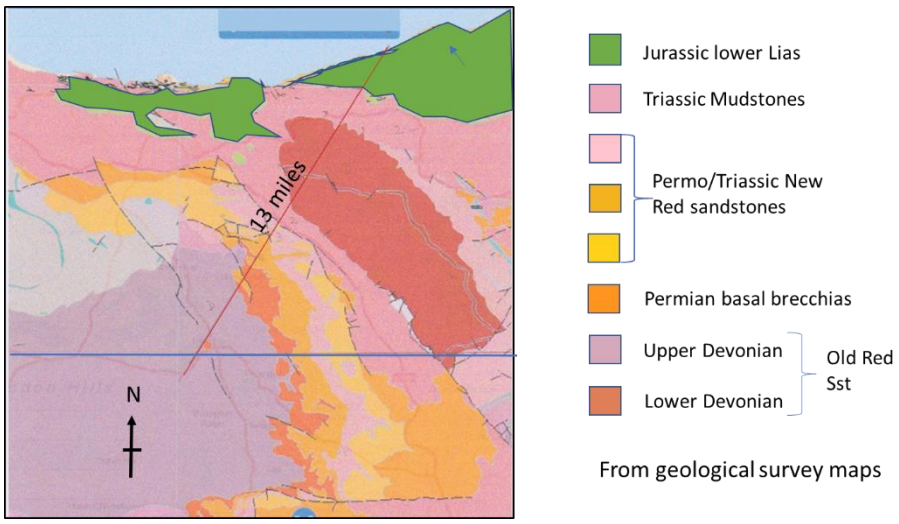

Figure 4; Extract from Geological Map of the Quantock Hills Area

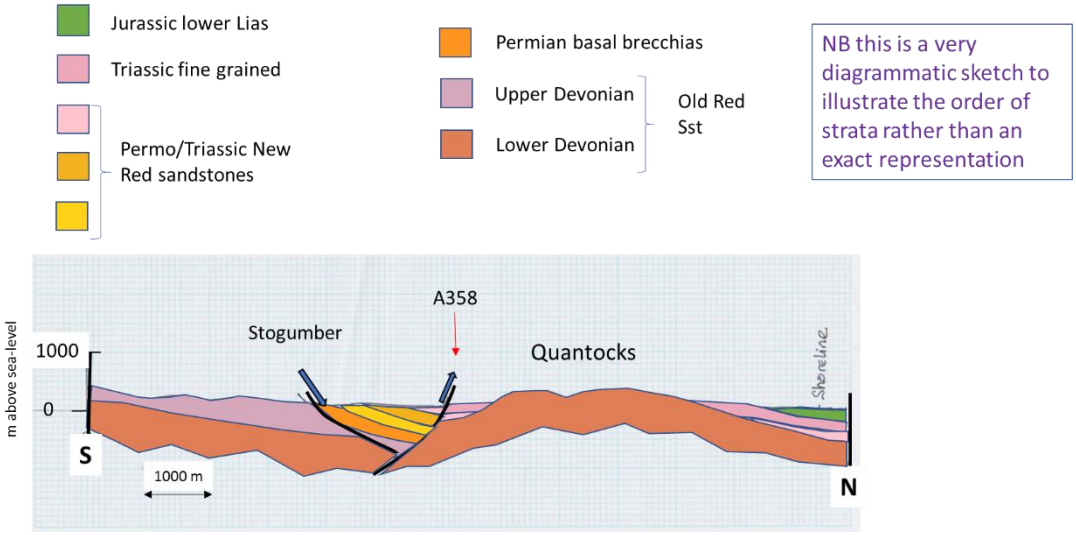

Figure 5: Schematic Geological Cross Section of the Quantock Hills

Conclusion

Dr Richardson concluded her talk by saying:

1. That “Fracking” is an effective, and now well tried, method for extracting useable hydrocarbons from suitable shale deposits. It carries some risks, as with all oil and gas field developments, but these are not significantly different from conventional recovery methods and can be managed by good design and effective regulation.
2. The situation in the UK, and especially the regulatory environment, is very different from that found in other areas where fracking has been controversial (such as the USA), and comparisons need to be treated with caution.
3. That, in her opinion, the geology of the Quantocks make it very unlikely that there would be economically viable deposits present.
4. In conclusion, it is very unlikely that fracking operations would happen in the blocks that have been licensed along the North Somerset coast.

Dr Richardson is a local geophysicist, with a BSc in Geophysics from Edinburgh University and a DPhil from Oxford University. She worked for BP from 1980 to1987, initially as a Research Geophysicist and then as a Senior Geologist working on basin modelling, seismic interpretation and prospect development for the South China Sea and Hainan exploration prospects. After having a family she had a mixed career, in and out of geosciences. Recently she has been working as a Geological Consultant analysing data from Libyan oil fields and looking speculatively at the shale oil and gas potential.