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Drilling beneath the hype: Technical challenges for the exploration for shale gas’

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The success of the shale revolution in the US is one of the most remarkable examples of the ‘suck it and see’ approach in the history of resource exploration. A bold and visionary exploration model employed by a small number of operators set the wheels in motion just over a decade ago. After initial disappointment, perseverance and doggedness rewarded those that kept the faith, and led to rapid ramping up of drilling activity, such that 100s of thousands of wells have now been drilled on over twenty shale plays in North America. This has been a revolution led by drilling technology, contrasting with the deepwater conventional exploration that was driven by improvements in seismic imaging.

The business model for shale plays that has been so successful in North America is not proving easy to replicate elsewhere for a number of reasons, most of which are non-technical. In the densely populated regions of Europe, public opposition is considerable, and the onus is on explorers to show that they have a good grasp of the technical risks. This requires a sound knowledge of the subsurface in specific areas under consideration, but also a broader understanding of generic risk factors such as the risk of contamination of shallow aquifers, or of induced seismicity. The Industry may place most risk at the door of poor completion technology, but until we have a better grasp of how fracking can trigger earthquakes, the public is likely to remain sceptical.

In addition to refining our understanding of the main risk factors from a public perception point of view, there are a number of technical challenges that have a bearing on the exploitation of shale plays. We do not currently understand how the oil or gas is transported from the shale matrix to the nearest hydraulic fracture, nor do we fully understand where the hydrocarbons are stored in the body of the reservoir. What fractions are in an adsorbed state, in solution, or present as a free phase in pore space, and what kind of pore networks are present? How do these different contributions become mobilised and flow into the borehole during production life cycles? How does the original pressure state impact longer term drive for production? How does the burial history and subsequent uplift history precondition the reservoir for best performance? Most fundamentally, we do not know the geometry or connectivity of the hydraulic fractures we induce. Seismic monitoring gives a ‘fuzzy’ image of the fracture networks, but the precise architecture of these networks is not known, in spite of the vast number of ‘frac’ jobs that have been carried out.

These gaps in our knowledge are hardly surprising given the youthfulness of the enterprise, but they are a challenge both for those wishing to predict commercial viability ahead of major investment decisions, and for those seeking to reassure the public that the Industry knows its own back yard (or more precisely, what is under its own back yard). The climate is changing, and so too is the enthusiasm for the great shale plays of the world outside North America. If the enthusiasm returns, then exploitation should be founded on the best technical case that we can provide, and it is clear that much further research is required to plug the knowledge gaps that currently exist. Time spent on reconnaissance is never wasted, and neither is well directed, fundamental geoscience research, but it may be that nations wishing to exploit this resource in a responsible manner should tackle these research questions collaboratively to the benefit of all rather than individually to the benefit of the few.