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Energy

Brother From the Same Mother?

The Relationships Between Unconventional and Conventional Oil and Gas Resources

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The following is an abstract of the full report. Please email:
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Introduction

Many people in the oil and gas industry talk about unconventional shale plays as if they have no relationship to conventional deposits. This is somewhat surprising since both are generated from the same petroleum system. Our work shows significant relationships between the size of conventional and unconventional deposits within individual basins, and we have found patterns that link the two by studying the petroleum systems of the major hydrocarbon provinces across the world. The implications of this are huge, and we think they must be understood by any company attempting to compete in the highly active area of unconventional exploration.

Surprisingly there has been limited academic research on such an important topic over the last 15 years. We believe that this could be because the oil and gas industry has not focused enough on the science of geochemistry which has tremendous implications for the discovery and success of unconventional plays. This may have made sense when the great discoveries of the 1970s, 80s and 90s were made offshore, using new and evolving seismic technology and when geophysicists were leading the exploration effort. However, as the industry is increasingly looking for unconventional resources, its dearth of geochemistry expertise is a liability, given its critical importance in unconventional exploration.

It's 2012: Do You Know Where Your Hydrocarbons Are?

The reason that unconventional and conventional oil and gas deposits are connected is that they are sourced, or generated, from the same rock systems. When exploring a new or immature area, the logical question to ask is how much oil and gas a basin has generated. Next we would ask how much has migrated and been trapped, becoming the target for conventional exploration; how much has escaped to the surface in the form of natural seeps or is trapped in carrier beds; and lastly what volume of the generated hydrocarbons remains in or adjacent to, the organic rich rocks where it was generated in the first place.

Such an analysis is called a "mass balance" of hydrocarbons in a basin, and what it attempts to do is estimate the quantity of hydrocarbons generated in a basin and whether we can account for the whereabouts of those resources. This is rarely undertaken or publicly documented, and as such the science is surprisingly vague given the implications of the numbers involved. Indeed, based on our research, we believe that in most basins studied, around 50% of the generated hydrocarbons remain in the source rock (and even more if you also count the rocks directly adjacent to the source rock). The remainder is split between amounts that escape to the surface as natural seeps over geological time or are trapped in carrier beds, and a small amount (typically 0.5-10%) that is typically trapped in conventional oil and gas settings (Fig. 1). Since these percentages hold true across many basins, we conclude that the size of the unconventional prize in a given basin can often be inferred from the size of its conventional deposits, although other factors are necessary in the equation as well.

The most significant implication of this is that places that have produced conventionally are not tapped out, and on the contrary, they might be the best places to look for unconventional deposits. For example, in areas that have produced conventionally we can be 100% sure that at least one prolific source rock occurs. What's more, many of the wells drilled for conventional targets will have penetrated the source rock, providing valuable information.

Conclusions and the Size of the Prize

When Kimmeridge Energy is first looking at potential unconventional plays, it does the following:

- Focus on established petroleum provinces, which have produced hydrocarbons from conventional exploration to assess the attractiveness of a source rock
- Model the mass balance of hydrocarbons in a basin and expulsion efficiency as well as estimate the remaining un-expelled volumes of oil and gas, to define which areas and source rocks have the greatest potential for unconventional exploration
- Two key factors that govern the amount of remaining unexpelled volumes of hydrocarbons are, original richness of the source rock (high original TOC and HI) and Expulsion Efficiency
- Marine derived (Type II) source rocks have the best characteristics for unconventional exploration (versus Type I lake/algal or Type III terrestrial), as they are oil prone and highly generative (similar to Type I) but retain a high proportion of oil and gas in the source rock

We estimate that global onshore cumulative production of oil and gas has been around 1.4 trillion barrels of oil equivalent (boe), although considerable uncertainty exists over cumulative global gas production, and that remaining onshore proved reserves equal around 2.2 trillion boe. So we estimate that total onshore conventional known reserves are around 3.6 trillion boe.

Additionally, we have estimated that in-place unconventional resources for the largest global onshore basins totals around 21.6 trillion boe. Applying a 10-20% recovery rate equates to around 2.2-4.3 trillion boe, which suggests that recoverable unconventional oil and gas reserves could eventually equate to a similar amount as conventional oil and gas reserves. Given enough time, and with further technology development and favourable economic conditions, unconventional recoverable resources could even surpass those of conventional resources, which have served the globe well over the past 150 years.

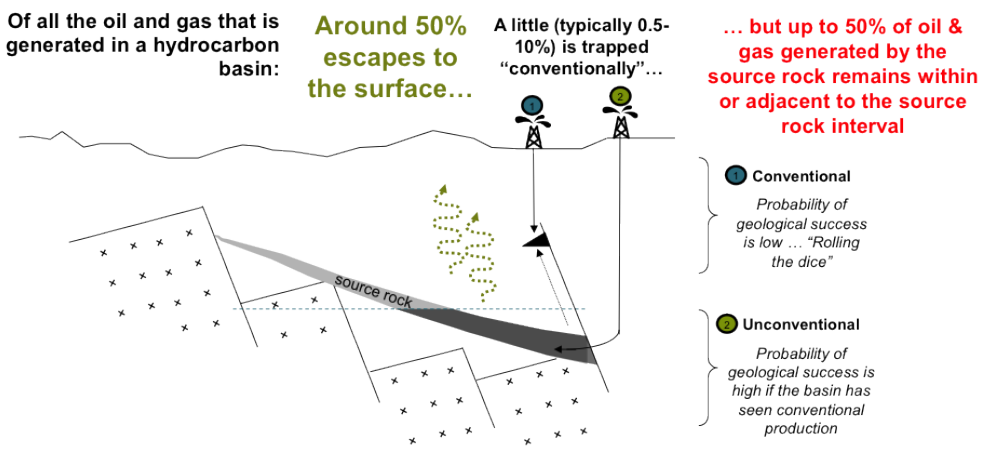

Fig 1. Generalised schematic of a petroleum system.

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