



geoconvention

Calgary • Canada • May 7-11

2018

Challenges in the characterization of shale resource plays

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Shale resource rocks, being present almost everywhere around the world, offer the possibility of their exploitation. But they are complex and heterogeneous and horizontal wells cannot be drilled anywhere in these reservoirs. Similarly, hydraulic fracturing (fracing) along the horizontal borehole, which roughly constitutes 50% of the well construction cost, may not pan out profitably. In many oil and gas companies, the current practice is to drill closely spaced horizontal wells from a single pad, in the interest of economics, which are then put through to completion. Such a practice adopted without proper attention to their placement does not guarantee success. Repetitive well drilling and completion without attention to placement is commonly referred to as 'factory drilling', which can prove to be a recipe to disaster.

Despite the multiple fracking stages, the use of advanced fracking fluids and the fact that a large amount of gas or oil remains unproduced in the shales, there are other challenges. Why is it that hydrocarbon productivity in some wells decreases rapidly? How are we expected to understand the large variability in performance of the wells drilled in the same or different shale formations? Can we maximize the number of high-performing wells? Is it possible to determine the spatial variation of reservoir properties including fracture barriers? Besides these, there are many other serious challenges that need to be understood and addressed.

The key elements of any shale play include the depth and thickness of the rock, its mineralogy, maturity, organic richness, porosity/permeability, presence of natural fractures, mechanical properties (Young's modulus, shear modulus and Poisson's ratio) brittleness, stress, pore pressure, and the reservoir fluid (oil/gas) in place. Both porosity and permeability in shales are dependent on mineral composition, the quantity and distribution of organic matter, and its maturity. Because the composition and presence of organic matter varies in shales, both laterally and vertically, their interpretation from well logs is less straightforward. For that matter, all the above characteristics vary in shales, between different wells and wellbore intervals, and have a significant bearing on the performance of wells drilled therein. An understanding of all these characteristics is not straightforward and requires integration of different disciplines, that include geology, geochemistry, petrophysics, basin and fluid migration modeling, reservoir engineering, drilling and completions.

Our talk will touch upon many of the issues, and hopefully focus on how an integrated analysis will benefit the characterization of shale resource plays.