Challenges in Characterizing Tight Reservoirs and their Sweet Spots

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ABSTRACT

Challenges exist for the effective characterization of tight reservoirs and the delineation of their sweet spots. Among these challenges are (1) the need to retool technical skillsets, and (2) the potentially high cost of play assessment during a period of moderate commodity price.

Need to retool technical skillsets.

Rock properties that quantify the hydrocarbon potential of tight reservoirs differ from conventional plays, so required datasets and interpretation processes differ. Two successful play criteria are (1) presence of thermally mature kerogen converted to economic accumulations of in-situ hydrocarbons, and (2) geomechanical properties conducive to hydraulic fracture stimulation that significantly accelerates reservoir drainage.

To make these determinations we must modify conventional skillsets and approaches. Geologists need to incorporate geochemistry, thermal maturity, geomechanics and hydrocarbons generated in-situ. Geophysicists add 3D models of Young's modulus, Poisson's ratio, and stress anisotropy. Completion engineers apply these geomechanical interpretations to increasingly complex hydraulic fracture stimulations involving optimal stage counts, frac fluids, and proppant placement. Meanwhile reservoir engineers deal with rate-time analysis, stimulated rock volumes, and fluid flow in nano-Darcy rock.

High cost of play assessment at moderate commodity price

During periods of moderate commodity price there is lower appetite for expensive assessments of new play types. Testing tight reservoirs often requires multiple horizontal wells with multi-stage fracture stimulations and rapid initial production decline rates. To improve project economics, drilling must start in sweet spots delineated based on the two critical requirements mentioned above. Low cost but effective identification of sweet spots is paramount.

However sweet spot delineation may be the easy part. The hard part might be locating the ideal position within a formation to place horizontal wells for optimized completions that maximize hydrocarbon recovery. Many reservoirs are geomechanically stratified. Seemingly trivial thin beds of high stress or ductility can prevent hydraulic fractures from propagating vertically across reservoirs or result in proppant embedment leading to fracture closure. Isolation of problematic layers refines vertical sweet spots for well placement. This keynote presentation addresses the above challenges and includes related efforts in the Kingdom of Bahrain.