geoconvention
Calgary • Canada • May 15-19 2017

3D Hydraulic Fracture and Production Simulation for Improved Completion Design

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The expediency of the factory approach to unconventional resource development has helped to distract operators from some fundamental truths about their reservoirs and how they consider them when planning their reservoir development.

- These reservoirs are not comprised of homogeneous elastic rock
- Despite being highly layered, they represent a complex 3D system with fracture development, inter-layer interference and drainage all representing important 3D processes that results in unexpected behaviour
- Fracture geometry isn't generally simple and its complexity comes from the interaction of 3D heterogeneous mechanical properties, evolving stresses, complex fabric including natural fractures, faults and bedding planes, as well as the adopted stimulation approach, design and sequence
- Further, the assumptions about the geometry of the stimulated system make a material impact on the expected well performance
- These are geomechanically sensitive systems where the permeability of the fractures evolve through time as changing pore pressures and stresses equilibrate and modify critical flow pathways

Perhaps now therefore is the time to rethink how we approach some of these issues and in particular how we model and simulate these systems. Clearly there is neither the appetite nor the resources to accurately capture all of these different complexities but maybe it is also time to no longer accept approaches that sidestep a number of first order issues for simplicity sake. Such simple approaches result in well and completion designs as well as development plans that don't truly consider what is actually happening.

This presentation illustrates some of the benefits that 3D Discrete Fracture Network (DFN) based approaches can yield in tackling many of the issues described above. By utilising a more flexible modelling approach that is less prescriptive, critical completion issues can be determined such as capturing the true geometry of fracs, identification of more favourable landing zones, well spacings to optimise drainage and how the fracture perm and therefore production evolves though time. Clearly the large number of wells being drilled and completed mean that this more rigorous approach shouldn't be performed all the time. However increasingly operators are recognising the number of incidences where behaviours are unexpected is too great to simply "cookie cut" our way to a solution.