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Integration of Multi-Discipline Data-sets for Completions and Development Optimization

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Summary

The economics of shale resource development in North America is driven primarily by completions, as this accounts for the majority of the project cost and also arguably has the biggest direct effect on the overall performance of a well or pad with respect to Initial Production (IP) and Estimated Ultimate Recovery (EUR). The exploitation of unconventional resource plays over the last decade or so has led to an environment where the chances of drilling a "dry" hole are essentially zero, and a relic of legacy conventional development. However, due to the massive amount of capital spent on each well from spud to tie-in and production, drilling a well or an entire pad that doesn't meet type-curve expectations is effectively just as ruinous to a budget program. This is further compounded by the fact that ineffective stimulation of our wells can often leave large amounts of resource "stranded" such that it cannot be readily accessed by future development. The margins are slim and the margins for error slimmer yet. For this reason, optimization of completions design is paramount to the successful development of a play on a pad by pad basis, but also from the perspective of long-term full field development. This requires an integrated, multi-disciplinary approach in order to accurately model and account for the myriad of complexities in each system.

Integration of multi-well geological/petrophysical, geosteering, and completions data into a single dynamic visual environment is currently viable with modern software solutions. All of these data-sets can be leveraged to enhance understanding of reservoir drainage and more accurately model downhole reservoir conditions. Furthermore, integration into a single user-friendly platform can help enable peers with varying backgrounds of technical expertise to more easily communicate ideas, and compare and contrast data-sets from across disciplines that are often difficult to mesh. This in turn can help drive improvements in completions and development strategy.

Theory / Method / Workflow

The proposed workflow for the integrated approach will be as follows:

- Use available geologic data to model the reservoir, specifically which parts of the reservoir each well is contacting or is in close proximity to. This results from a combination of geosteering (well placement) data, along with petrophysical and geomechanical data from offset wells, and modeled properties along the horizontal legs of the development wells based on offset typewells with more complete data-sets
- Model the Stimulated Rock Volume (SRV) of each frac based on a combination of geologic data (outlined above), manual inputs from observations (e.g. previous frac hits, offset production history), modeled parameters and observed completions parameters (Fig. 1)

- Model the actual drainage volume of each frac (i.e. what is propped and producing long term) based on reservoir properties, SRV and observed production in relation to estimated resource in place
- Bring all the data and results together into a user friendly, dynamic 3D environment for further analysis

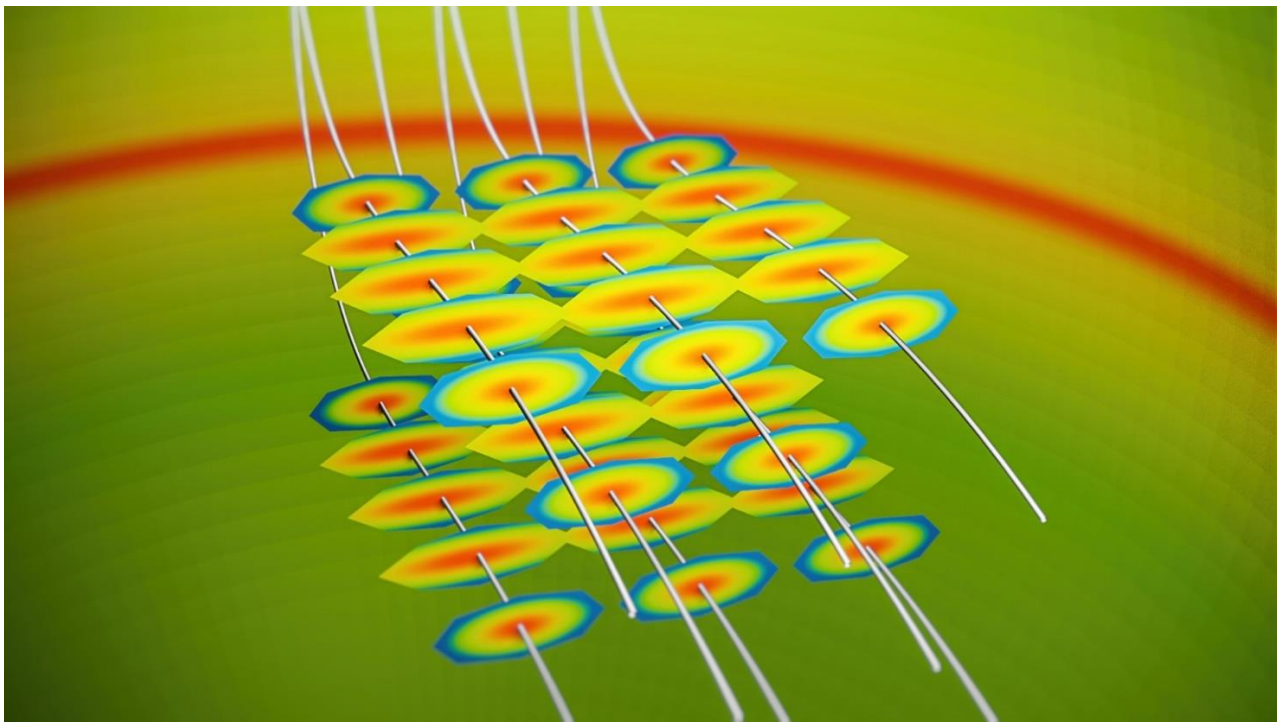

Fig. 1 – Model frac geometries within a multi-well system

Results, Observations, Conclusions

The ultimate goal of this methodology is to help operators better understand the key parameters that drive well performance in their plays. This will be achieved by a combination of increased communication and collaboration across disciplines, and also by the integrated approach outlined above which better accounts for actual reservoir conditions based on existing offsets and legacy production. As our fields mature, we as an industry continually accumulate an excess of data which is difficult to make use of effectively with traditional methods. Integration of large data-sets into a single environment allows for modern data analytics techniques to be applied which in turn will help operators to not only optimize all aspects of both drilling and completions operations, but also to more effectively plan the long-term development of their respective plays.

Novel/Additive Information

The presented approach will be particularly valuable for operators who are infilling mature fields and who face ongoing challenges in their operations due to destructive frac communication, competitive drainage or differential sticking among other potential issues. Recognizing and preparing for these challenges is a key first step to addressing and remedying inefficiencies caused by previous development strategies (or lack thereof). As the industry moves ahead into the future, leveraging the full spectrum of data available will be imperative in order to be able to successfully plan and execute on large unconventional resource plays.