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Hydraulic Fracture Characterization through Visualizations, a Catalyst for Collaboration, Engagement, and Reducing Bias

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Summary

Effective hydraulic fracturing treatments requires an understanding of the geology, geomechanics, stimulation fluid systems, and how induced fracture geometry is affected under differing stress and pressure conditions. Through development of a unique multi-disciplinary visualization, collaboration and engagement can be facilitated by framing the analysis holistically. Through clear presentation of the most relevant data, geoscientists and engineers are able to have a stage-level snapshot of how the key properties are varying across disciplines, and along the wellbore.

Due to increased volume of data and number of variables, workflows are becoming increasingly specialized and it's important to understand how analytical bias can play a part in shaping outcomes. By offering a visual aggregation of key information, consensus, and technical work is accelerated due to the easy interface to deep data sets, helping explain past performance and optimize performance in the future.

Theory / Method / Workflow

The theory is methodical construction of a central visualization for each well of interest to present multidisciplinary data on a per stage basis. This visual montage serves as a focal point for teams to engage in data-driven discussion over well and stage performance. Through collaboration and placing a focus on the intersection of disciplines, engagement is increased in hydraulic fracturing workflows.

Relevant data sources include high resolution 1 second treatment data, well-site geological reports, geological interpretations, geophysical mapping, vertical and lateral stage placement, and drilling data. Key steps of the workflow are to understand the geological and business context, the data quality and extent, the use of exploratory analytics, and generation of appropriate visuals for the application.

Results, Observations, Conclusions

The result is a Montage, a visual summary that increases the accessibility of hydraulic fracturing data and helps target further work (see Figure 1). The visual interface to the data allows quicker detection of underlying correlations and patterns. Through more intensive integration of the data into workflows, opportunities for deeper data collection initiatives are highlighted.

Completions and hydraulic fracturing data was parsed, presenting a large number of relevant additional variables in a form suitable for statistical and machine learning workflows.

Novel/Additive Information

Internal data manipulation techniques and tools have been developed to parse the high-resolution hydraulic fracture data into per-stage summaries suitable for visualization, as well as a numerical form suitable for use in statistical analysis and machine learning, unlocking additional insights from the data collected during the treatment.

A new method of normalizing tracer data to reduce the impact of early-time production during well and fracture flowback and cleanup has been developed and is under refinement.

Example

Figure 1 Hydraulic fracture characterization montage example, color coded to suggest potential impact on stimulation performance and economics, actual size: 36” x 42”

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