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Routine Drilling Data Reveals Effective Ways To Improve Completions

By Colter Cookson

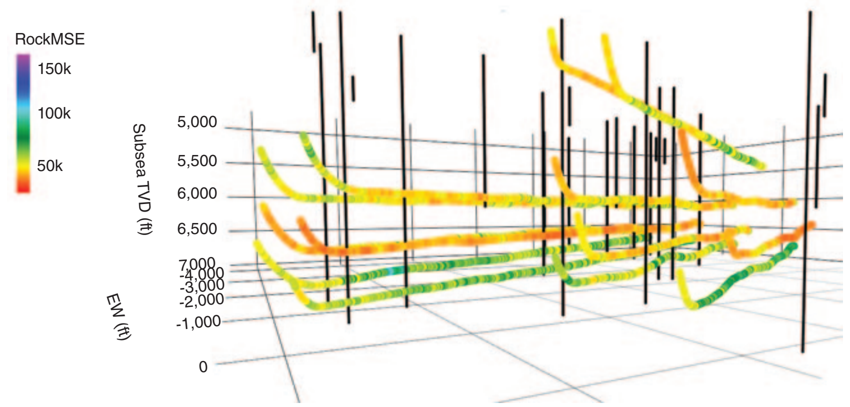
To access more pay zone, operators are working with service companies to drill progressively longer laterals. Not many years ago, a two-mile lateral would have qualified as an impressive feat. But as drilling and completion technology improve, the definition of "long" stretches ever further.

Today, many operators are drilling three- or four-mile laterals. Ideally, service companies note, these wells should be drilled as smoothly as possible to ease the processes of running casing, setting plugs and pumping hydraulic fracturing fluid into the most productive zones. Of course, the well also needs to be drilled and stimulated efficiently to control costs and maximize returns.

Leveraging Existing Data

The data operators routinely collect during drilling holds clues to solving the never-ending question "what is the best way to complete this well?" advises Jason Glascock, lead reservoir adviser for Drill2Frac. "We can use mechanical specific energy, which is calculated from typical diagnostic information, including weight on bit, ROP and torque, to determine how much energy it takes to drill through the rock across the lateral and infer its confined compressive strength," he reports.

Permian Multiwell Trajectory Plot



By analyzing readily-available drilling data, Drill2Frac can quantify rock strength throughout a lateral. The company says many operators leverage this information to anticipate completion hazards and to place stages and clusters in similar rock, which improves fluid distribution.

These strength ratings have several completion applications. "The most basic is identifying which stages have unusually hard rock or exceptional heterogeneity, to proactively assess potential completion hazards," Glascock begins. "Operators use this insight to predict which stages will have anomalous treatment responses and understand why any anomalies occur, which helps the completion crew put contingency plans in place and spot warning signs early.

"For many customers, the data is used to place stage boundaries according to the near-wellbore rock to decrease the level of heterogeneity within each stage. Others go a step further and place the clusters within each stage to be in like rock," Glascock says. "The goal is to create a situation where it takes the same amount of energy to initiate fractures throughout a stage, resulting in more evenly distributed fluid between clusters."

Operators who use rock strength to place stages and clusters often see lower treatment pressures and fewer screen-outs, Glascock reports. "One operator went from three-four screen-outs on every well to zero once it started placing clusters in similar rock strength." he illustrates.

Drill2Frac's process also can significantly decrease the risk of frac hits, Glascock adds. "When a fracture network is depleted and a child well intersects that depletion, it takes more energy to drill the rock," he explains. "By looking for anomalous spikes in rock strength and other drilling data signature variances, we can see where a new well has intersected existing localized depletion and hydraulic stimulation is highly likely to immediately connect to, and communicate with, the existing offset producing well."

Based on comparisons using additional data to validate depleted fracture identification results, Glascock estimates that the process identifies depleted fractures with 87% accuracy.

Once an operator knows the location of a potential depleted fracture, it can utilize the data to determine what best fits current operations. Some operators watch for communication as they frac the stages with identified existing depletion, and stop pumping if it occurs, while others move their cluster location to avoid the existing fracture network.

"How much space operators put between the existing depletion in the new wellbore and the planned hydraulic fractures will vary based on their experience, risk tolerance and supporting contextual knowledge; some use 30 feet and some as much 100," Glascock says. "One operator that capped the space gap at 40 feet eliminated frac hits in areas where it used to see multiple immediate interactions during every infill well completion.

"Even with implementing gaps, the newly initiated fracture might eventually connect to the existing fracture networks," Glascock acknowledges. "However, the longer that takes, the more stimulated rock volume the completion will create."

In addition to guiding initial completions, Glascock says rock strength can help operators evaluate refrac candidates. "By looking at how rock strength varies along the lateral and comparing it to the as-pumped completion design, we can simulate how the frac fluid distributed between clusters during the initial treatment, then highlight understimulated areas of the well," he says. "When we do that across a field, the operator can best determine which wells are the low-hanging fruit where a refrac is most likely to deliver impressive returns."

Ensuring Accuracy

Analyzing drilling data from a well usually takes about 24 man-hours, Glascock reports. "Standard drilling MSE embodies drilling efficiency artifacts and the strength of the rock," he explains. "To isolate the rock's strength, we have to clean up the raw drilling data to filter out noise and account for changes caused by drilling artifacts and operations."

Those changes often come from routine events such as swapping bottom-hole assemblies or varying the mud's viscosity, but also include less common events. "For example, if a mud pump goes down and gets replaced by a less efficient backup, the reported flow rate will often stay the same even though the actual flow rate has dropped. Our process accounts for this change," he illustrates.

The output's resolution is between one and three feet, depending on the quality of the drilling data, Glascock mentions. He says the results match closely with rock characteristics inferred through other measurements, such as petrophysical logs and fiber optics.

"To validate our data and results of our applications, we have executed numerous blind studies," he assures. "Typically, the operator will send us data on a well it has studied using other techniques. This allows the operator to evaluate how our data can enhance what it already knows and add efficiency to its current operations."

Because analyzing drilling data requires no downhole tools or operational changes, Glascock says it carries no risks. "It's an inexpensive way to turn available data into actionable insights providing the opportunity to improve completion efficiency, designs, increase production and mitigate risk," he summarizes.

To get even more from the data, Glascock says Drill2Frac continues to refine its internal tools to speed up processing while migrating data and calculations to the cloud. "Our goal is to enable operators to pull mass quantities of their well data from our system, import it into their software, and conduct large-scale, field-level analyses more efficiently," he outlines. ❒