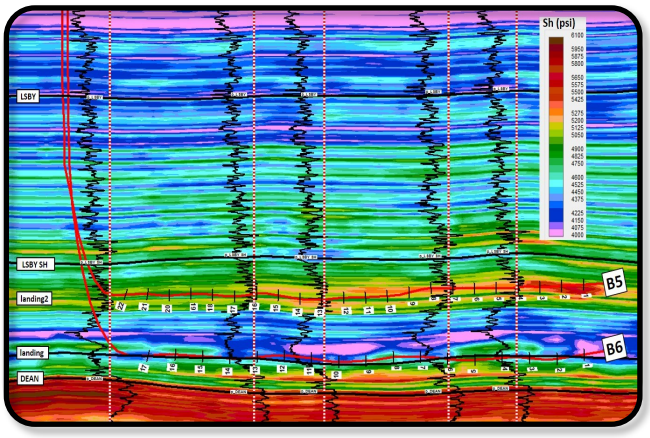
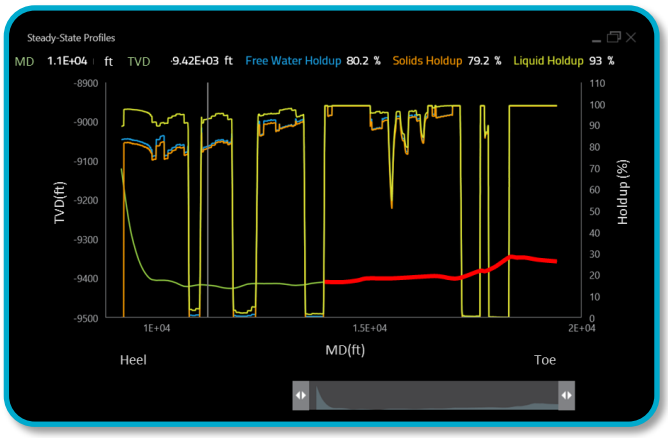
Combining Technologies Increases Well Productivity and Capital Efficiency: 3D Seismic Geomechanics and Real-Time Virtual Modelling of Lateral Wellbores

A solution to maximize recovery and capital efficiency in tight oil and gas fields



SciCat® Stress Solution



LateralFlow™ Planner

Challenges

60% of all hydrocarbons produced globally require some form of fracture stimulation. In fact, in North America alone, around 70 percent of new wells drilled today are horizontal wellbores that require fracture stimulation. Well performance and subsequent capital efficiency is ultimately driven by the stimulated rock volume, governed by rock properties and Earth's stress state. However, operators continue to assume an isotropic subsurface and stress state, implementing cookie-cutter type development and completion strategies. Workers observe that up to 30% of all perforations do not contribute to production. Moreover, recovery factors are being increasingly hindered by interwell fracture communication or "frac-hits" by as much as 20-40% as operators continue to drill "child" wells near "parent" wells as fields continue to mature.

In addition, decreasing the velocities of produced fluids over the life of the well results in solids (fractured rock and/or proppant) accumulation in the production liner or casing until a certain section of the lateral is blocked completely. The inflow rate is zero within the production intervals located between the toe (far end) of the horizontal wellbore and the plugged section closest to the heel of the well. This is one of the main reasons contributing to steep production decline rates, low recovery factors, and abnormally increasing gas-oil ratios (GORs) in shale oil plays.

Solution

Integration of the SciCat® stress solution, which is seismic driven technology that measures in-situ 3D minimum horizontal stress, and LateralFlow™ Planner, which is the SaaS technology to identify locations along the wellbore blocked by deposition of solids, results in an optimal landing and wellbore trajectory design ahead of the drill bit. The near wellbore and far-field 3D stress distribution is measured directly and quantitatively at the well pad using high resolution calibrated mechanical earth models integrated with seismic geomechanics measured in-situ. The measured stress is combined with well performance forecasting, determined by the normalized length of blocked production intervals (or blockage factor), which in turn is used to design an optimal lateral wellbore trajectory that will provide maximum recovery with minimum cost.

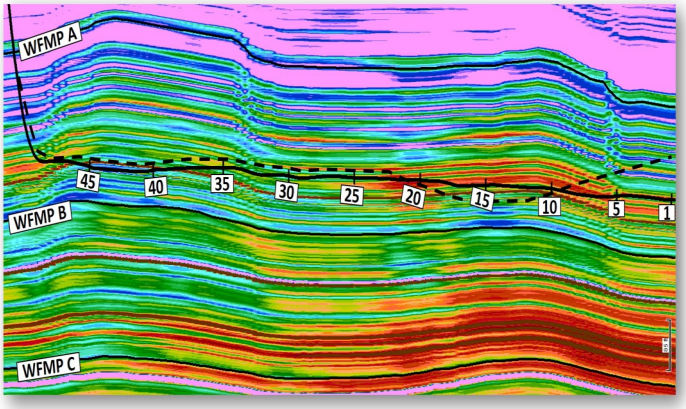
SciCat's stress solution integrated with high-fidelity 4-phase gas-oil-water-solids flow simulations can ultimately be used to create a Digital Twin of the lateral and the surrounding rock. The combined Digital Twins enable E&P operators to gain predictive insight into the performance of drilling, completion, stimulation, and production operations for the wells to be drilled .

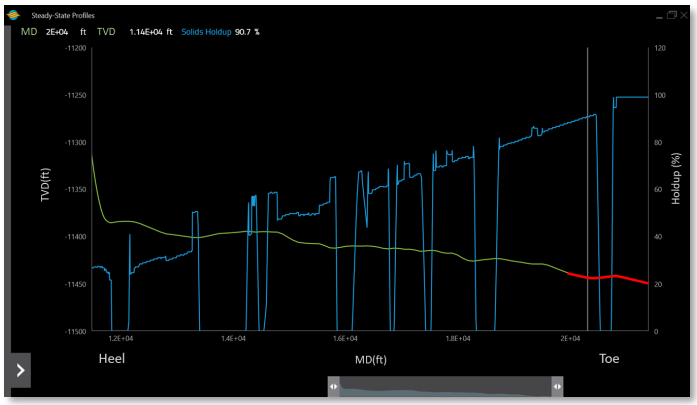
- Maximized hydraulic fractures near wellbore and far field
- Reduced drilling and completions costs
- Acreage development/prioritization for capital efficiency
- Maximized well performance
- Maximized hydrocarbon recovery
- Reduced workover costs related to pump repairs

Case Study: Delaware Basin

Minimum horizontal stress in a cross section plane along a 10,000+ ft. lateral is shown in the figure on the left. The wellbore (the black continuous line) was landed in the lower Wolfcamp A, where vertical stress differentials greater than 1,000 psi are observed (red to purple). Hot red/yellow colors define areas of greater in-situ minimum stress (more ductile) and cooler blue/purple colors define relatively less stress (more "brittle"). The wellbore was completed geometrically with equal stage and cluster spacing. The portion of the lateral extending from the toe-end of the well to Stage 23 is drilled through higher stress rocks having a higher clay and organic matter content (confirmed by petrophysics) by volume, relative to low stress zones with proportionately more lime. In this part of the lateral, an aggressive frac design with tighter stage and cluster spacing would be warranted to enhance production.

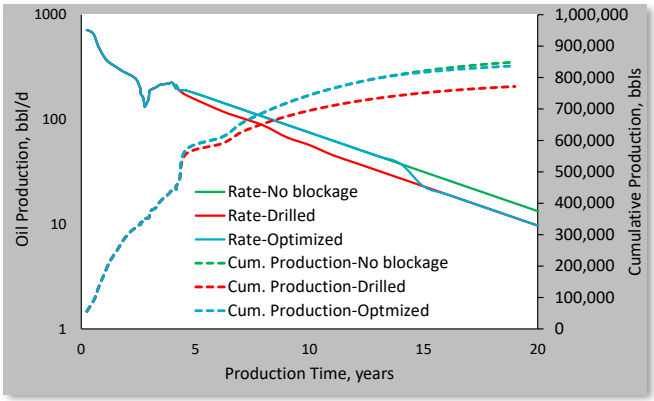
The figure on the right shows the profile of solids holdup along the lateral predicted by LateralFlow Planner for a total flow rate of 700 bbl/d (133 bbl/d of oil and 567 bbl/d of water). The red line shows the production intervals that will be blocked at these flow rates. As the production rate declines, the length of the blocked intervals increases, resulting in a growing oil recovery (EUR) loss.

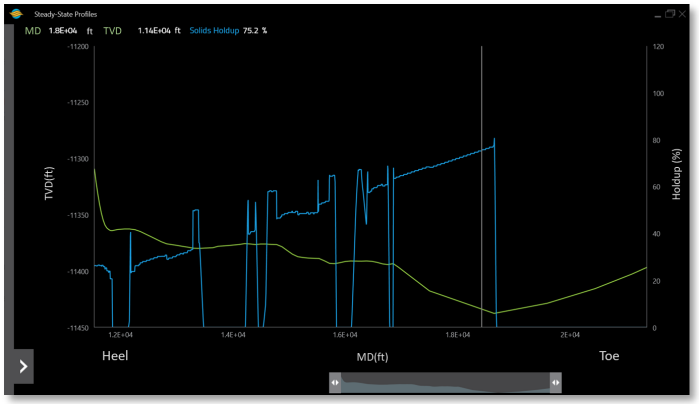




The dashed line in the figure above on the left shows the lateral trajectory in one of numerous cases that were analyzed using the SciCat-LateralFlow Planner solution. In this case, only the end-section of the original trajectory is modified (from the toe to Stage 23) and the landing point is raised by approximately 20 ft with respect to its original position to a relatively lower stress zone characteristic of less organics and clay. This results in improved fracture initiation and can decrease potential for costly screen outs.

Solids deposition does not occur in the toe-end of the lateral, as shown in the figure below on the right. This enables the operator to avoid an EUR loss of approximately 66,000 bbls in the period from 5 to 15 years from initial production (IP), as shown in the figure below on the left. Thus, the relatively small modification of the lateral trajectory could have added about $4 million in revenue during this period. Also, lower stress and an optimal stimulated rock volume (SRV), IP rate should significantly improve.





Next Steps

To learn more about how the SciCat-LateralFlow Planner combined technology solution can make a difference in your fields, visit **www.scicatoil.com** and **www.mpecorp.com** or contact:

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