

Fracturing Treatment Optimization Through Integrated Monitoring and Analysis

Near-Wellbore Monitoring Using Distributed Temperature Sensing Combined with Far-Field Monitoring Using Microseismic Can Help Achieve Improved Fracturing Efficiency

FracTrac® MS and StimWatch® DTS Services Provide Important Fracturing Information

The need for both reliable data regarding fracture location and cost-effective treatments has never been greater than in today's fracturing environment. Two technologies from Pinnacle can be used in combination to provide unprecedented information about the fracturing process.

FracTrac® MS microseismic mapping service provides reliable information on the development of fracture symmetry, half-length, azimuth, width and height, and their dependence on the treatment parameters and reservoir characteristics. Monitoring and controlling these parameters can help maximize stimulated reservoir volume (SRV). In addition, these fracture geometries are used to better understand fracture modeling and production characteristics.

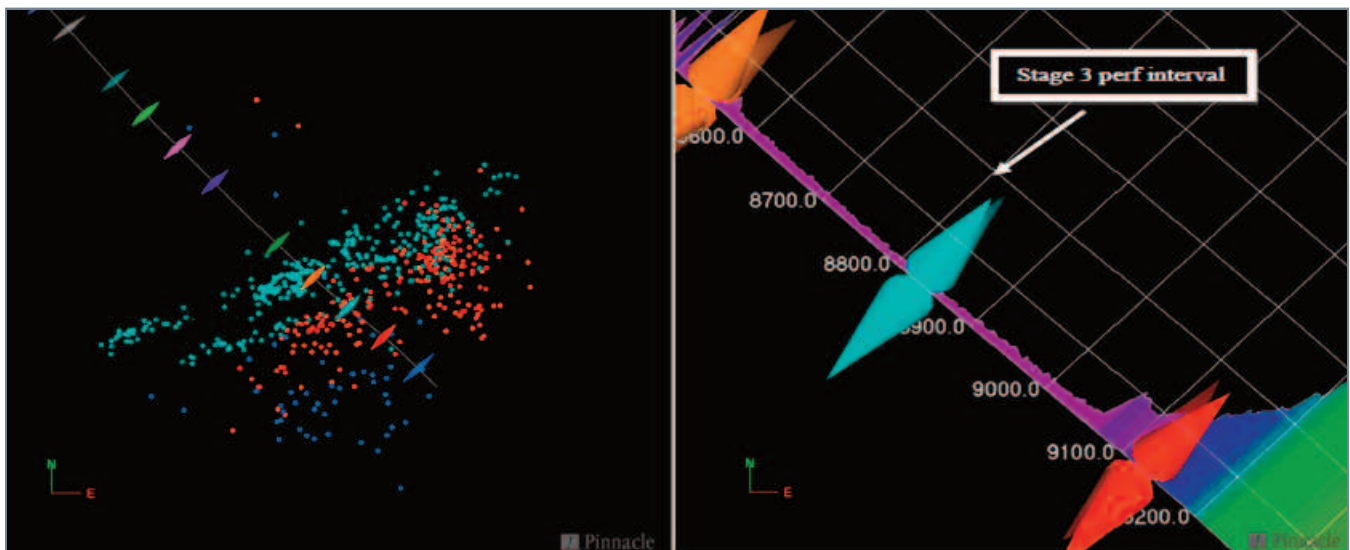
StimWatch® DTS fiber-optic-based distributed temperature sensing service provides almost immediate updates of the near-wellbore temperature distribution in approximately 3-ft (1-m) intervals.

In fracturing treatments, the near-wellbore temperature distribution can be used to determine isolation effectiveness, the relative amount of fluid each perforation cluster takes, fracture initiation points, and effective fluid diversion.

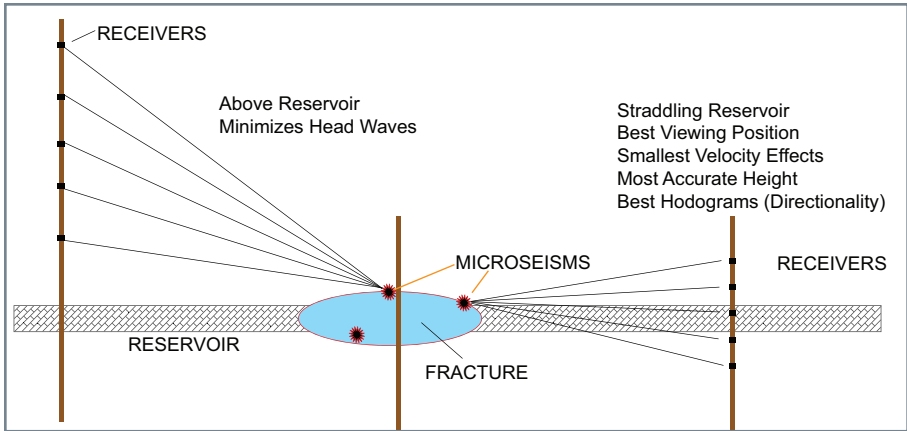
Understand Completion Effectiveness

The detailed near-wellbore data available through StimWatch DTS service coupled with the far-field geometry acquired through FracTrac MS microseismic mapping service provides an accurate picture of the completion effectiveness. Combining the two diagnostic tools is valuable for real-time decision making, post-treatment analysis, and production analysis to assess the completion effectiveness.

Incorrect assumptions about perforation breakdown, fracture-initiation points, interval isolation, or limited-entry effectiveness can lead to misinterpretations of the microseismic results. Likewise, using DTS alone does not reveal important fracture characteristics. Using both diagnostic tools provides firm answers to the overall completion effectiveness.

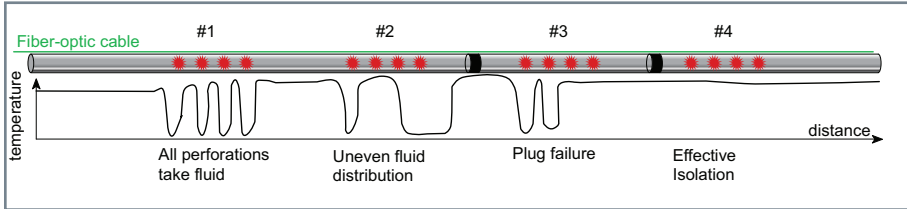


Microseismic mapping (left) and distributed temperature sensing (right) used together can reveal unprecedented information about the fracturing treatment. The case shown above highlights a cemented lateral in the Barnett shale. The light blue diamond shape in the distributed temperature sensing (DTS) image represents the perforation interval for stage three in each image. A clear relationship exists between the DTS image revealing flow behind casing due to isolation issues, and the geometry defined through the microseismic results for this stage represented by the light blue points.



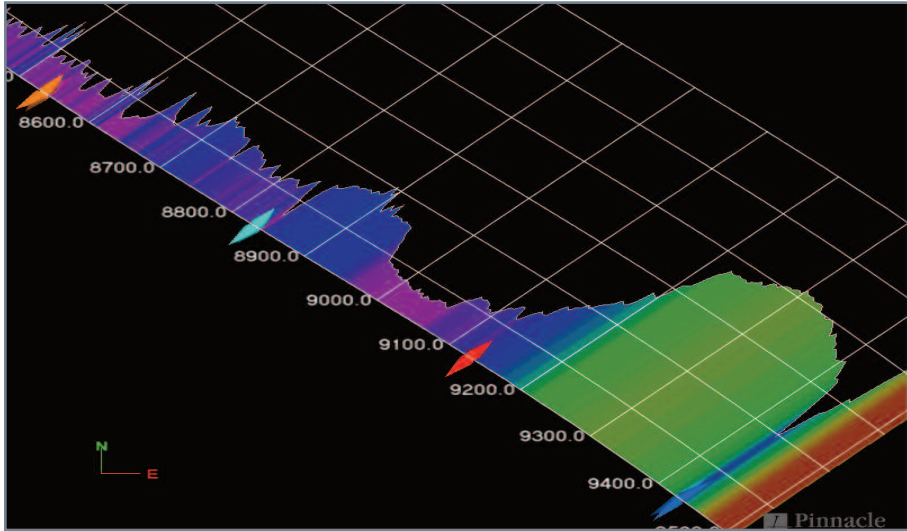
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FracTrac[®] MS service uses geophones deployed in nearby wells to detect microseismic events that occur due to fluid injection into the reservoir. The event distribution describes the fracture geometry, azimuth, half-length, and reservoir coverage.



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StimWatch[®] DTS service uses fiber optic distributed temperature sensing to provide a 3-ft (1-m) interval temperature profile for the near-well region. Temperature changes correlate to fluid injection and production inflow.

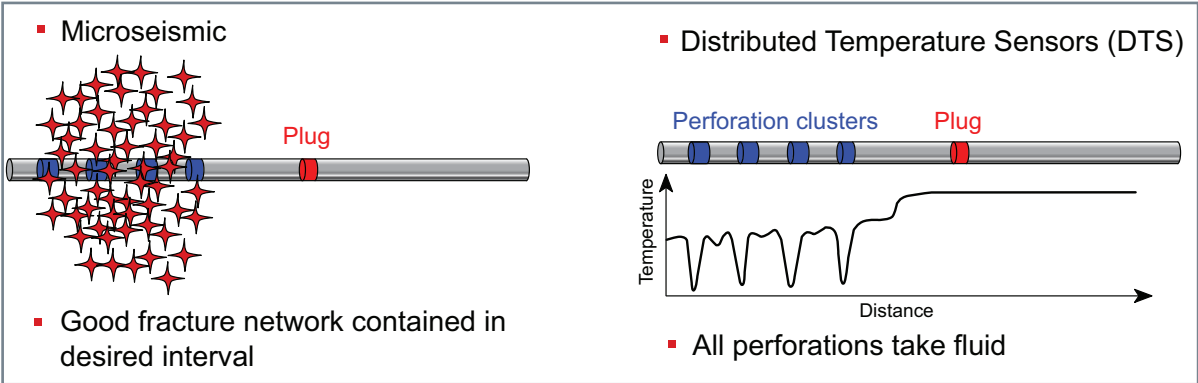


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Temperature restoration after injection is another information path using DTS. The temperature profile above shows an instance roughly 20 minutes after pumping is completed at the light blue perforation interval. Clearly the coolest point is the purple area between the light blue and red perforation intervals. This indicates that most of the treatment fluid entered the reservoir at this point, again indicating possible isolation issues behind casing.

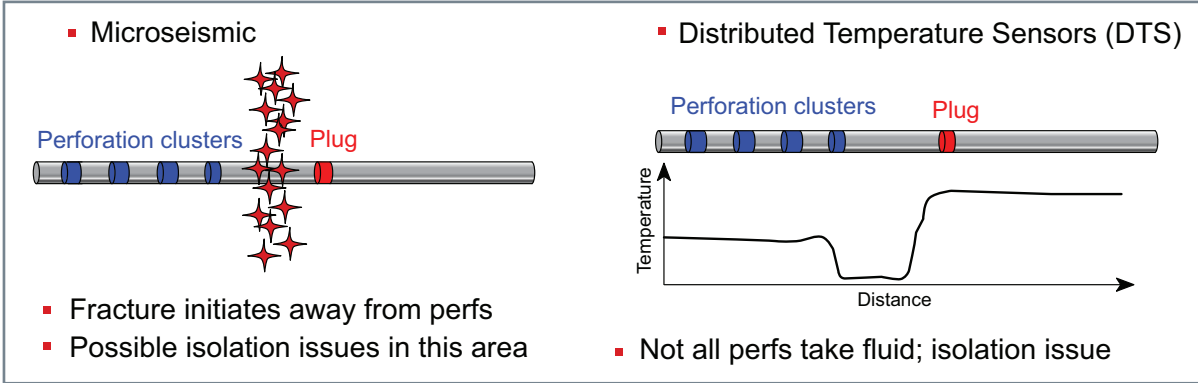
Example Scenarios That Can be Detected Using Integrated Monitoring

Validate Expected Outcomes



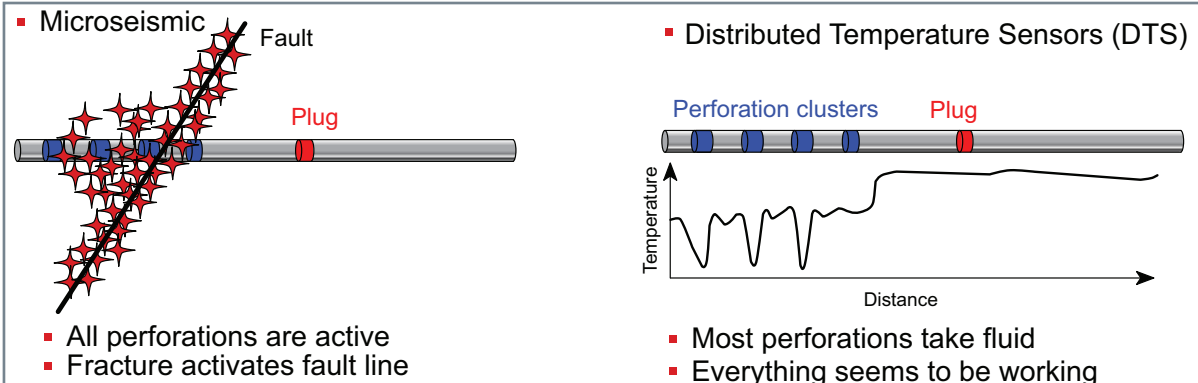
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Treatment Not Distributed as Planned



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Fault Identification



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For more information about how integrated monitoring and analysis can help you achieve optimum well performance, contact your local Halliburton representative or email fracturemap@halliburton.com

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