

Microseismic Nonstop: Completions Evaluation Analysis in Real Time

Operators now have the ability to change completions activities on the fly.

CONTRIBUTED BY MICROSEISMIC INC.

Real-time microseismic monitoring from anywhere in the world has allowed operators to make better and more economic decisions as they see the impact of hydraulic stimulation on the reservoir in real time. However, in the past this analysis was limited to the location of the fracture, i.e., the microseismic event, leaving other factors such as the fracture orientation and size, location of proppant, and stage productivity to additional analysis after the job was completed.

In October 2017 MicroSeismic will unveil its next generation of real-time monitoring. Automatic moment tensor inversion (AutoMTI) will allow for on-the-spot completions evaluation. The new version will include

- Real-time fracture modeling;
- Dynamic stimulated reservoir volume (SRV) estimation;
- End-of-stage EUR and drainage estimation; and
- Rapid stress analysis.

Real-time fracture modeling

When a fracture ruptures, the generated acoustic radiation propagates in a predictable pattern. Using the radiation pattern recorded by a microseismic geophone array to solve for the mechanism of failure, customers are able to view the discrete fracture network (DFN). The DFN

allows for a better visual understanding of the completion geometry and also enables volume and permeability calculations. A fracture is modeled for every event based on the source mechanism(s) and the moment magnitude of the individual events. Instead of waiting for the DFN modeling for up to a month after the job is completed, operators can now see it in real time. This provides for a better understanding of the completion and allows operators to distinguish between propped and unpropped fractures. For modeling purposes, fractures are filled with proppant from the stage center outward, highlighting the part of the reservoir with lasting permeability enhancement. In conjunction with the SRV flow model operators can change their completion design stage-by-stage or well-by-well, on the fly.

Dynamic SRV estimation

SRV is the volume of rock that has enhanced permeability caused by a hydraulic fracturing treatment. The productive stimulated reservoir volume (P-SRV) is the region within the SRV that contains proppant-filled fractures. Currently, it takes operators up to a month to receive the SRV, which only allows for changes in parameters on subsequent wells. While that is beneficial for overall field development planning, by using dynamic SRV estimation operators now get this information in real time, allowing them to make changes immediately on the next stage.

End-of-stage EUR and drainage estimation

Through the DFN, the SRV and P-SRV contain information about the amount of permeability enhancement in individual grid cells, which can be used to predict production and ultimate recovery from individual stages and wells. Updated after every stage, operators can now get an immediate estimate of wellbore productivity and long-term communication to update spacing decisions for adjacent pads before they are drilled.

The stress analysis is computed by an inversion routine that determines the direction of the three principal stress directions between the observed and predicted slip vectors. The maximum horizontal stress direction and magnitude can then be calculated given the model input parameters of the minimum horizontal stress and overburden stress. Calculating this for every stage quantifies stress shadowing effects and essentially maps how much induced fluid pressure it takes for the rock to fail at every point along the wellbore. If real-time hydraulic fracture modeling is utilized, the models can be updated before the next stage, enabling operators to make changes in the treatment design with confidence.

These new advances in real-time analysis will have a tangible and lasting effect on the bottom line for clients. By having the ability to change completions activities faster and with more confidence than before, operators will have the opportunity to increase productivity and EUR and outperform their competition on the fly. ■

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