How Top Performers are Using Microseismic-based Reservoir Simulation

Microseismic monitoring can aid in actionable results to drive meaningful economic decisions.

CONTRIBUTED BY MICROSEISMIC INC.

Market conditions and the depressed price environment have driven unconventional operators to dramatically improve cost efficiencies. Better use of technology to improve drilling efficiency and optimize completion and treatment designs has made a significant contribution to those savings. Recording how the reservoir reacts to a particular combination of treatment parameters through microseismic monitoring and optimizing the design based on those observations has been a key to success.

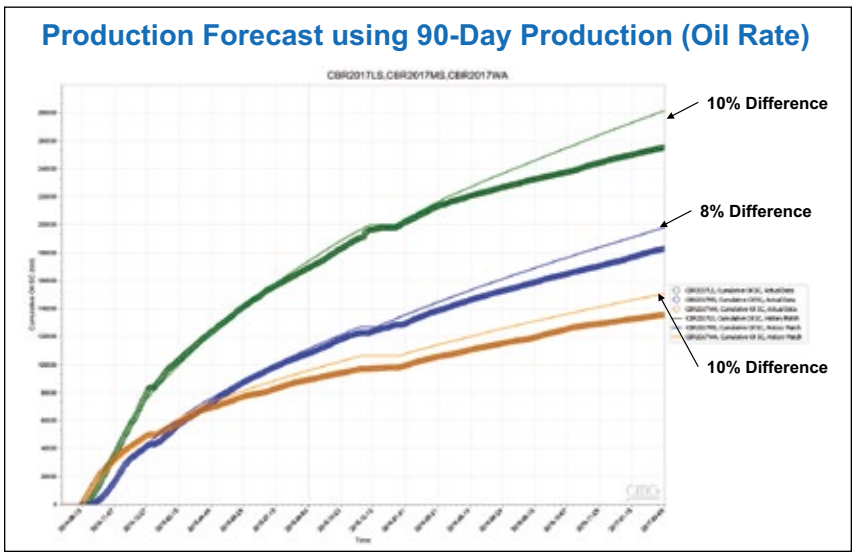
Case study

A three-well example in the Permian Basin illustrates a workflow that translates data obtained from microseismic monitoring into a production forecast and compares it to a well-calibrated history-matched model using more than 2 years of production data. In this particular example, surface acquisition allowed for the determination of a unique focal mechanism, magnitude and size for every event. From the failure plane orientation shown in the mechanism a discrete fracture network (DFN) was built and filled with proppant according to the actual treatment schedule. Based on the number of fractures, their geometry and their orientation in space, the permeability enhancement in the reservoir and its distribution in a geocellular model were calculated. This process produced three different zones within the monitored area that were then imported into a reservoir simulator: the unstimulated background reservoir with matrix permeability, an unpropped portion of the stimulated reservoir volume (SRV) that will lose most of its initially created conductivity with pressure depletion and the propped part of the DFN that follows a different permeability-pressure dependency and will provide substantially better long-term conductivity (Productive-SRV).

Production forecast

To forecast production for the study wells, a reservoir model was built using well logs and pressure-volume-temperature data as well as the microseismic-derived permeability enhancement. The first prediction was made at the time of completion, without production data, to provide an immediate understanding of wellbore productivity and evaluate the effectiveness of completion and treatment designs. Microseismic-based reservoir simulation was able to correctly predict the order of producers at any point in time and predicted 30-month cumulative production within 16% to 22%. These results were used for early wellbore spacing considerations since the model will show pressure depletion over time and wellbore interference with reasonable accuracy. Using 90-day production data, the initial accuracy was improved to predict production within 8% to 10% from the actual data, making the model a solid base for refinement of operator-internal reservoir models that test "what if" scenarios.

The quality of the prediction illustrates the information contained within the microseismic data that was extracted by integrating it with other available data. Given the nonuniqueness of rate transient analysis and traditional reservoir models that lack microseismic data, it is important to observe how the reservoir actually responds to hydraulic fracturing and the location and nature of rock failure. The workflow used in this case study shows how top operators use microseismic monitoring today and turn it into actionable results to drive meaningful economic decisions. ■



This microseismic-based cumulative oil forecast for study wells used 90-day rate and pressure data for history match. Data for Lower Spraberry well are shown in green, data for Middle Spraberry well are shown in blue and data for Wolfcamp A well are shown in orange. Model predictions are shown as solid lines; actual production data are shown as spheres. (Image courtesy of MicroSeismic Inc.)

Extended Lunch Breaks

Don't miss the opportunity from 11:50 a.m. to 1:50 p.m. today to check out the "Focus on Commercial Technology" exhibitor presentations.