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Lonestar Confirms Fracture Placement and Scaling Tendency with AvantGuard Flowback Services' Monitoring

Similar geochemical fingerprints during flowback of all three wells indicate fractures contacted sections with the same bounding units and only minor scaling potential

CHALLENGE

Determine if three wells that were landed and stimulated at different depths in the Eagle Ford Shale are in sections with the same bounding units because rock-fluid interaction can lead to the formation of chemical scale.

SOLUTION

Employ AvantGuard* advanced flowback services to sample and analyze flowback for determining geochemical similarities and differences to indicate fracture placement and if ions that cause chemical scale are present.

RESULTS

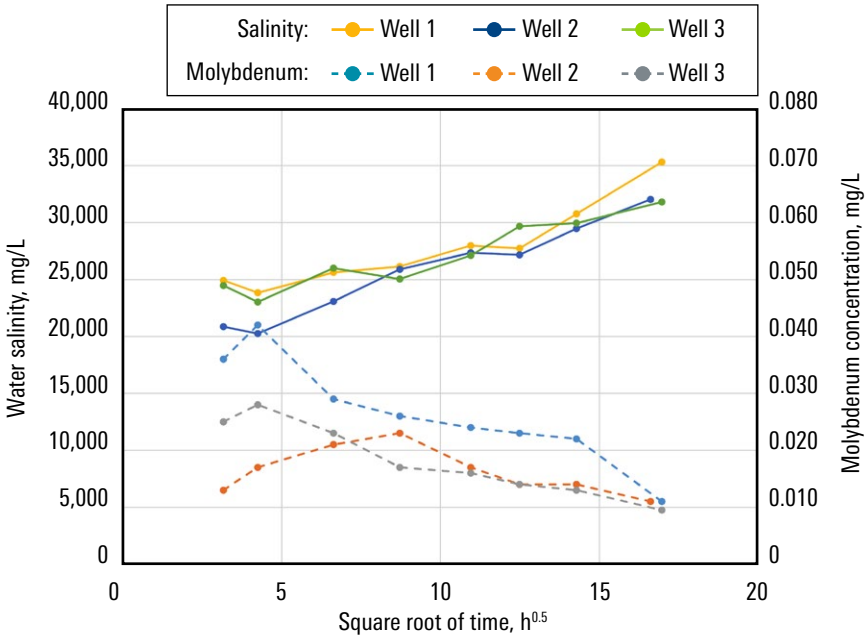
Determined that all three wells are in sections with the same bounding units and that the severity of chemical scale potential is minor, making the addition of scale inhibitor unnecessary.

Characterize flowback water to understand and streamline completions

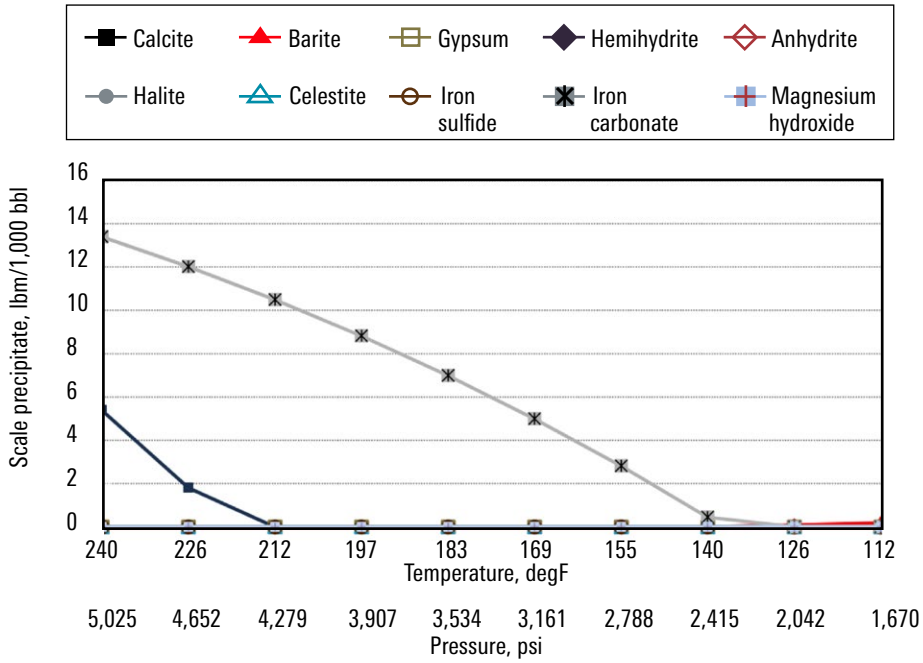
Hydraulic fracturing stimulations of unconventional reservoirs inevitably result in the production of large volumes of water during the flowback process, which is composed of a mixture of the stimulation fluid and connate water. Produced waters may be present in the flowback process if formation water is mobile. Detailed chemical analysis of these fluids can help identify what formations have been contacted by the stimulated fracture network as well as any problematic processes that may be occurring, including scaling.

Hydrocarbon-bearing formations and their bounding units rarely share the same geochemical fingerprint, and their uniqueness typically can be identified through the sampling and analysis of produced water. For this reason, hydraulic fracturing treatments that are initiated from different landing points often exhibit geochemical fingerprint contrasts because of their individual fracture geometries and resulting reservoir contact area. Thus, the analysis of produced water over time can be helpful when poststimulation fracture geometry is either unknown or could potentially change during production.

Lonestar Resources, Ltd., planned to stimulate three wells in the Eagle Ford Shale. This play contains at least two major subunits, each with its own geochemical fingerprint reflecting their different depositional environments. Wells 1 and 2 were landed in a lower section of the Eagle Ford reservoir to target its high total organic carbon (TOC), whereas Well 3 was landed in an upper section of the reservoir with slightly lower TOC.



Although Well 3 was expected to exhibit geochemical differences because of its different landing point in the uppermost section of the play, water salinity and molybdenum concentration were found to be similar over time for all three wells.



The mass and composition of chemical scales predicted to form during early production of Well 3 are primarily minor scale precipitation downhole (represented by conditions on the left side of the plot) as opposed to at surface (right side). Comparable conditions are expected for the other two wells based on their geochemical similarity.

Use chemistry to characterize fracture propagation and containment

Schlumberger worked with Lonestar to design a monitoring strategy, which would be conducted using the AvantGuard Observe* flowback transient monitoring and analysis component of AvantGuard services. Sampling and analyzing flowback would help identify fracture propagation and containment as well as determine the possibility of scaling.

A number of ionic species were analyzed in the produced waters from all three wells to target these differences, including molybdenum content. Molybdenum is a widely used proxy for anoxic depositional environments and has been shown to be enriched in the lower Eagle Ford.

It was determined that the geochemical fingerprint during the flowback period of all three wells was similar, indicating that the fractures contacted the same formations and were most likely bound by the upper Austin Chalk Formation and the lower Buda Limestone. The chemical similarity also suggests the absence of a potential pinch point that could have isolated the upper and lower Eagle Ford units from each other. These findings indicate that the early production from the wells is independent of landing point in the formation.

Optimize production operations by determining scaling tendency

In addition to evaluating the chemical similarities across the three wells, the flowback water chemistry was used to determine the types and prevalence of chemical scale formation. A total of 18 samples were collected and analyzed throughout the flowback period of the wells, and the types and quantities of chemical scales were modeled as a function of the pressure and temperature experienced by the fluids during production from bottomhole to surface.

The AvantGuard services monitoring strategy resulted in the conclusion that only a few types of chemical scale were predicted to form—calcium carbonate ($CaCO_3$), barium sulfate ($BaSO_4$), and iron carbonate ($FeCO_3$). Furthermore, because the quantities predicted from these studies are minor, it was determined that scale inhibitors are not necessary for maintaining production. This confirmed that the scale management strategy used by Lonestar is ideal for the region and keeps chemical costs low. Monitoring of the produced fluids will continue to provide early warning if chemical scaling becomes problematic at later production times.

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