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Perforating Design Using Sonic Scanner Platform's Acoustic Data Reduces Skin by >60%, Colombia

Successful perforating program based on radial profiles of the alteration zone and geomechanical parameters, Llanos basin

CHALLENGE

Improve perforating design to penetrate beyond near-wellbore formation alteration and reduce skin effect.

SOLUTION

Incorporate radial profiles of petrophysical and geomechanical parameters measured by the Sonic Scanner* acoustic scanning platform to fully characterize the formation for modeling perforation performance downhole using SPAN Rock* stressed-rock perforating analysis.

RESULTS

Penetrated beyond the alteration zone while reducing skin by more than 60% by perforating with PowerJet Nova* extradeep penetrating shaped charges identified using inputs from the Sonic Scanner platform.

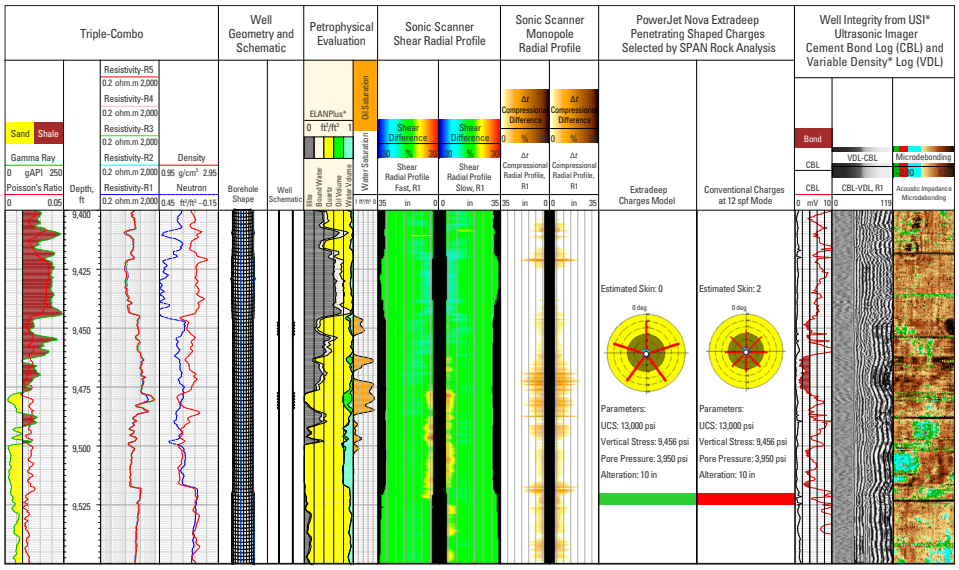
Understanding formation geomechanics

An operator in the Llanos basin, Colombia, wanted to include geomechanics data in designing the perforating program for an exploration well. The unconfined compressive strength (UCS) and stress regime of the reservoir significantly influence the success of perforating operations. An analysis based solely on conventional petrophysical data would not be able to fully assess near-wellbore alteration for specifying a gun system configuration and shaped charges to reliably penetrate into unaltered formation and minimize skin.

Acoustically characterizing the reservoir in three dimensions

The Sonic Scanner acoustic scanning platform measures the formation axially, azimuthally, and radially to deliver a fully 3D acoustic characterization that addresses both intrinsic and drilling-induced anisotropy. The platform's multiple monopole and dipole transmitters produce compressional, shear, and Stoneley waveforms of unprecedented quality for advanced processing of slowness values that delivers the most comprehensive geomechanical understanding.

The shear radial profile indicated a 6-in depth of alteration whereas the monopole radial profile showed 8 to 10 in. The more extensive monopole-based depth of alteration was conservatively employed for conducting SPAN Rock stressed-rock perforating analysis to specify the perforating gun system and select shaped charges that would penetrate beyond the alteration zone while minimizing skin.

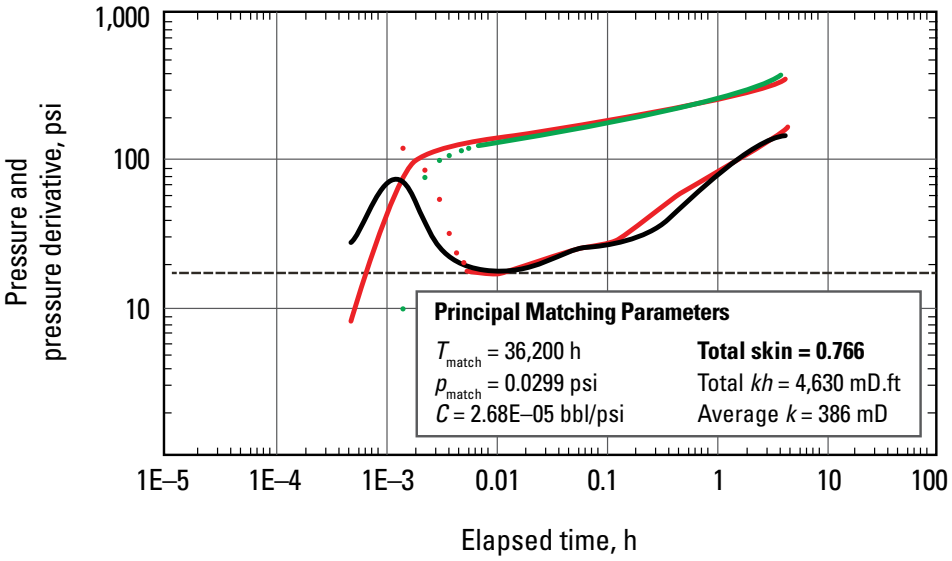


SPAN Rock analysis incorporated high-quality acoustic measurements by the Sonic Scanner platform to fully account for the depth of alteration and geomechanics of the formation. The recommended PowerJet Nova extradeep penetrating charges successfully penetrated beyond the alteration zone.

Reducing skin by more than 60%

Petrophysical evaluation determined that the sand body had 10% to 15% porosity and 5% to 10% clay volume. The predicted UCS was 13,000 psi. These data and the geomechanics information from the Sonic Scanner platform were used to evaluate PowerJet Nova extradeep penetrating charges in comparison with conventional charges at 12 shots per foot (spf). The predicted skin factor for the conventional charges was 2.

Following the perforating operation using the specified PowerJet Nova charges, the perforated zone was tested with the drillstring still in the well. The log-log plot of the first derivative matched to the test parameters determined that the resulting skin was only 0.766, which is a more than 60% reduction from the modeled conventional perforations to a value with practically no adverse effect on flow performance. Perforation penetration beyond the alteration zone and the reduced skin confirmed the benefits of including Sonic Scanner platform's geomechanical data in the perforating design.



Analysis of the drillstem test conducted after perforating indicated a total skin of only 0.766, which is a more than 60% reduction from the skin estimated for conventional perforating. T *= time,* p *= pressure,* C *= wellbore storage constant,* k *= permeability,* h *= height.*

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