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Real-Time Measurements Optimize Marcellus Shale Well Placement

## Marcellus shale operator repeatedly places long lateral in richest target zone

CHALLENGE

Land operator's first Marcellus Shale production well in the best reservoir portion of the Marcellus Shale and place a 4,000-ft lateral section in a narrow target interval.

SOLUTION

Combine real-time geosteering using EcoScope* measurements with azimuthal images and interpretation support from Schlumberger well placement engineers.

RESULTS

Landed well 12 to 14 ft below the top of the target interval; lateral sections steered using EcoScope measurements remained within the target.
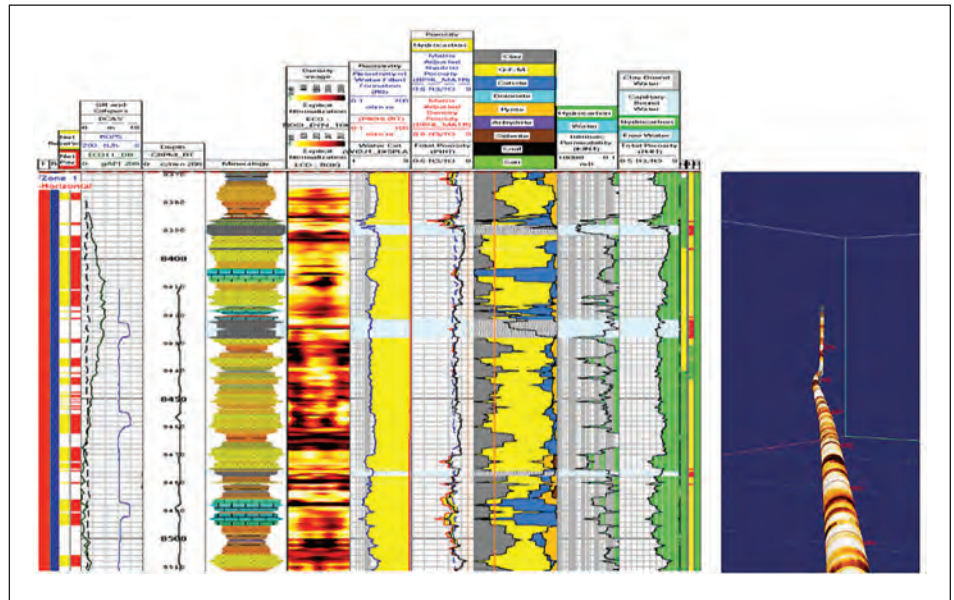
Daily analysis of measurements acquired while drilling helped the operating company place a long lateral with a clear understanding of drilling mechanics, borehole stability, and formation evaluation, which contributed to successful well completions.

Maximize contact with the reservoir target

An independent operator worked with Schlumberger to interpret wireline logs from vertical wells to understand the heterogeneity of distinct layers within the Marcellus Shale. The operator wanted to place its first Marcellus Shale well in a 57-ft [17-m] thick target interval it had mapped using offset well logs and seismic data, noting that the Marcellus dips as much as 2.5º near the potential well location.

The company decided to log while drilling to correlate real-time measurements with seismic data to steer a long lateral section within the target interval. A Schlumberger well placement engineer was engaged to interpret the real-time logging data and advise the operations team from the operating company.

Steer within dipping beds

The well was landed in the middle of the defined target, 12 ft shallower than planned. To drill the horizontal section, measurements and density images from the EcoScope multifunction logging-while-drilling service were used to steer the well parallel to the target beds.
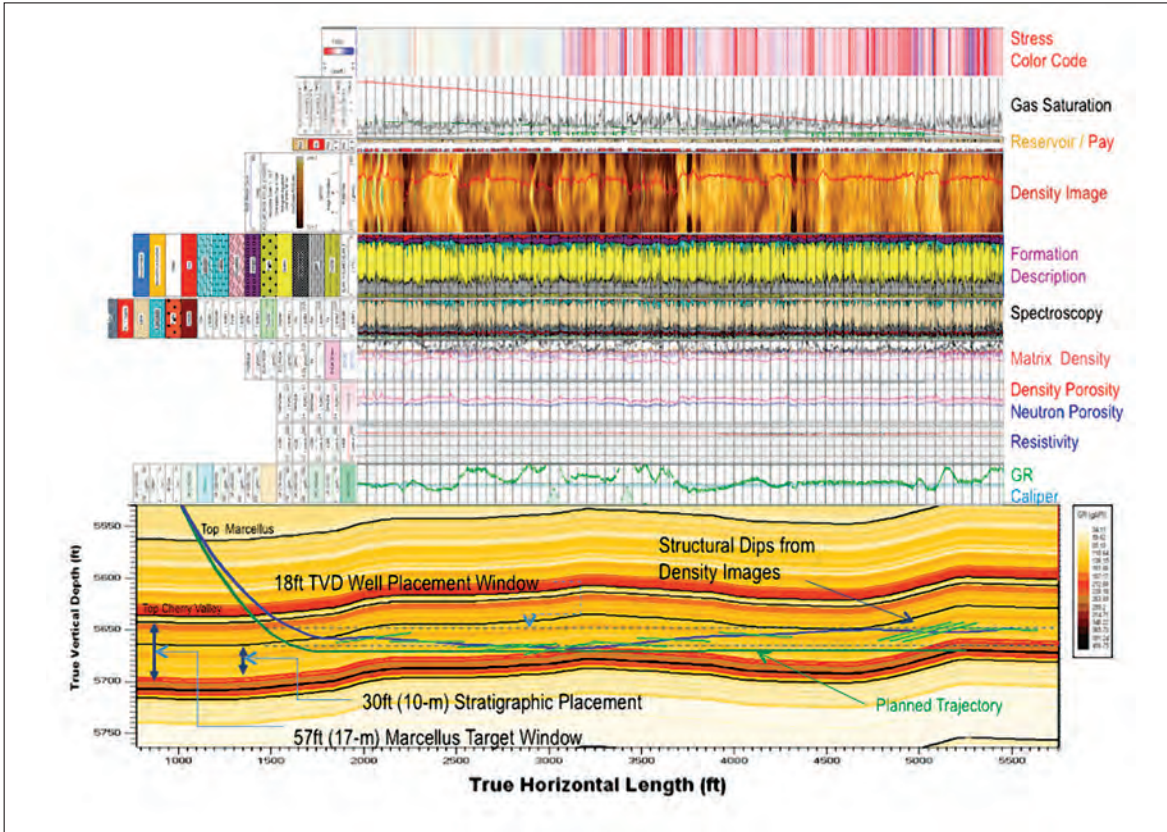
A full suite of EcoScope and sonicVISION measurements shows vertical and lateral changes along the wellbore, with the density images confirming structural dip.

The density images were also used to map individual shale beds. A Schlumberger well placement team worked with the operating company to match the real-time measurements and derived dips from density images with dynamic synthetic models to provide visualization for steering. This cooperation helped improve well placement because the dip of the Marcellus was found vary locally, averaging less than 1°. The lateral was placed within a 30-ft [10-m] stratigraphic window that is only 18 ft thick when converted to true vertical thickness.

sonicVISION* data acquired while drilling was of good quality and showed no obvious indications of open fractures. This data was used to derive rock mechanical properties along the lateral, which revealed significant variations in the minimum horizontal stress. Using Schlumberger LWD Shale Gas Completion Optimization Solutions, perforations were designed in zones of lowest stress, low clay content, and high free gas content along ten hydraulic fracturing stages. This analysis helped the operating company design the stage intervals and pinpoint perforation clusters to target intervals with the optimal properties for hydraulic fracturing.

Optimize future wells

The well penetrated the desired target interval and proved to be a good producer. The excursions of the lateral outside the target confirmed that even subtle dips in the Marcellus Shale should be anticipated when planning wells. By penetrating a substantial section within the target, the operating company optimized the completion for maximum recovery from the reservoir.

The superior production from the new well and wells drilled later using the EcoScope service showed the value of advanced measurement technology for placing wells in the most productive zone. The operating company committed to a multiwell drilling campaign incorporating the EcoScope service and Schlumberger well placement engineering support.

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