Denison Gas Uses Wellsite Digital Sonic Data to Optimize Stimulation and Field Development Strategy

Updated data-driven dipole shear sonic inversion algorithm delivers reliable geomechanical insights at the wellsite

Using an updated data-driven inversion algorithm from the Sonic Scanner* acoustic scanning platform, Denison Gas eliminated data processing and transmission time in town and obtained fast, reliable data from the wellsite—optimizing stimulation design, perforation strategy, and well spacing.

Quickly obtain reservoir data to inform field development and completion strategy

A mature gas-producing well in a field in southeast Australia has recovered ~2.5 Bcf to date. Further development of the field had not previously been considered given the degradation in reservoir quality at the location. Recently, however, an extended buildup test indicated significant remaining reservoir pressure and supported the drilling of an appraisal well. The new well confirmed the tight nature of the reservoir across the structure—measuring less than 100-psi depletion at the location—and significantly increased the field's in-place reserves estimates.

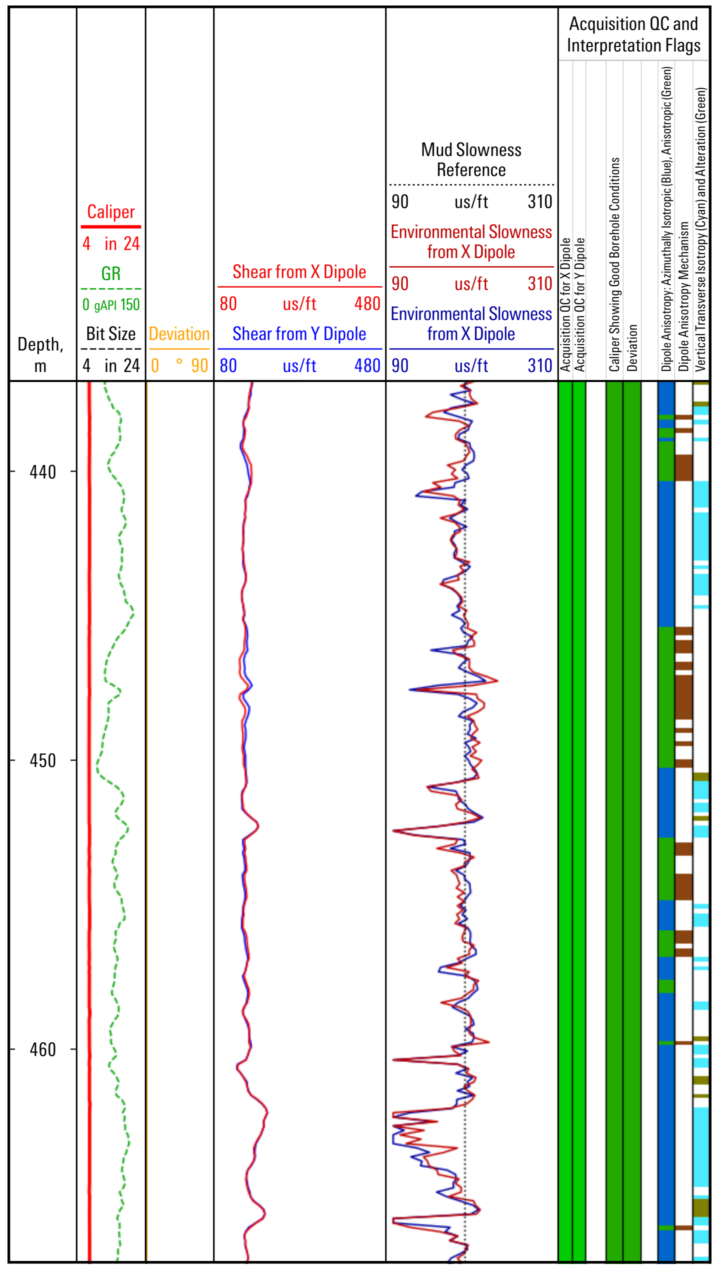
Prior to appraisal drilling, maximum horizontal stress orientation and residual pore pressure were unknown. Denison Gas wanted to gather data as input to the geomechanical and reservoir model to plan stimulation treatments and estimate drainage ellipses to optimize further field development.

Short turnaround times between wireline logging and fracture stimulation operations required the data to be checked, loaded, interpreted, and incorporated into the geomechanical model promptly to finalize the perforating strategy and treatment design. However, the conventional approach required reprocessing in town, which then required data transmission from the wellsite, taking multiple hours. Analysis would further take a few days before the results could be used in the geomechanical model.

Implement data-driven algorithm to deliver faster, reliable reservoir insights

Denison Gas used an updated data-driven inversion algorithm from the Sonic Scanner platform for shear slowness outputs and dipole anisotropy results for stress orientation to reduce data reprocessing and transmission time in town.

This updated algorithm, applied while logging, provides robust shear and compressional slownesses with associated quality control indicators. The algorithm has fewer user parameters and is accurate within layered, stressed, or damaged formations. Processing quality is determined using the coherency of the measured signal and an industry-standard rock physics model for theoretical validation. With the updated dipole shear inversion and preset smart dipole anisotropy frequency filters, the dipole shear anisotropy processing delivers reliable data at the wellsite—saving days in processing time.



Wellsite shear slowness using the dipole inversion technique for an upper section of the interval.

Optimize stimulation design, perforation, and well spacing

The newly acquired and rapidly processed acoustic data helped finalize stimulation design and perforation strategy as well as provided insight into potential drainage patterns influencing future well placement.

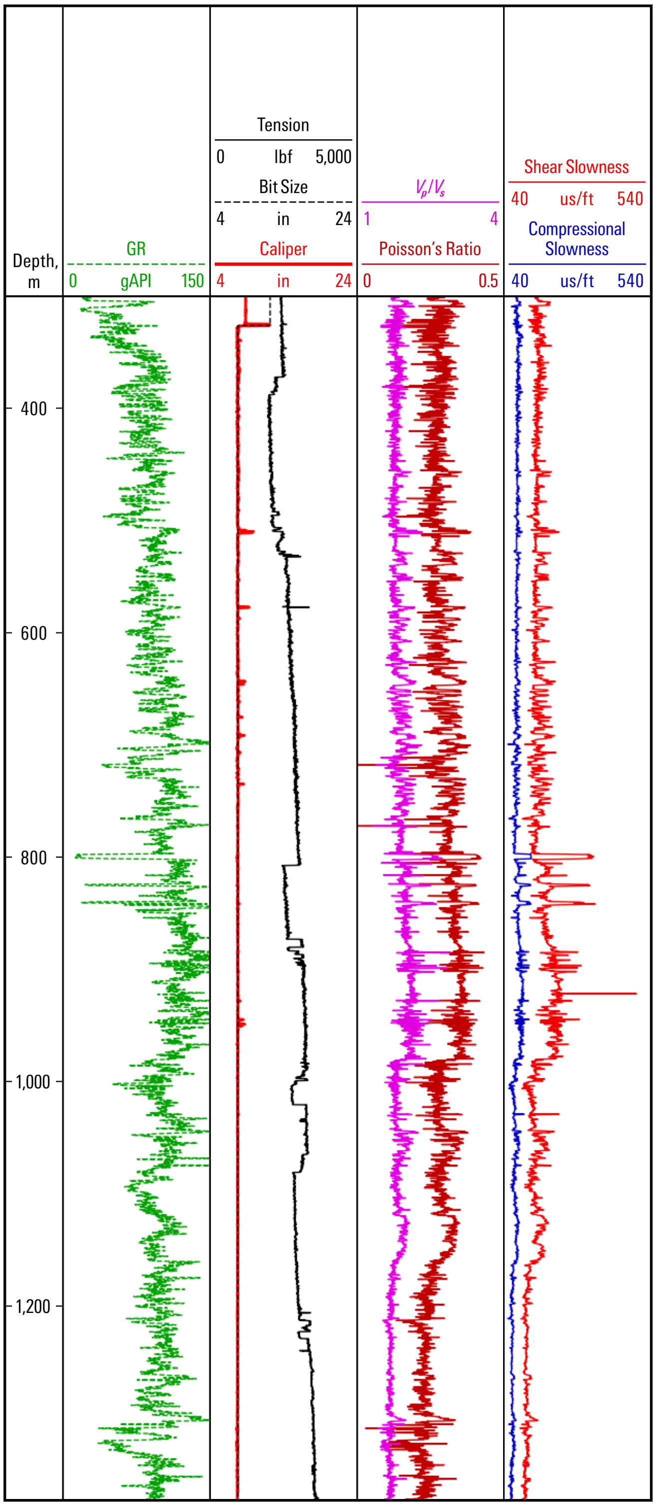
Case study: Wellsite digital sonic data optimizes completions and field development, southeast Australia

Stress data from the processed logs and geomechanical model indicated that the regionally persistent shale break between the reservoir sands may act as a barrier to height growth. The data enabled placing perforations across both sandstones, and the fracture treatment was applied in a single stage.

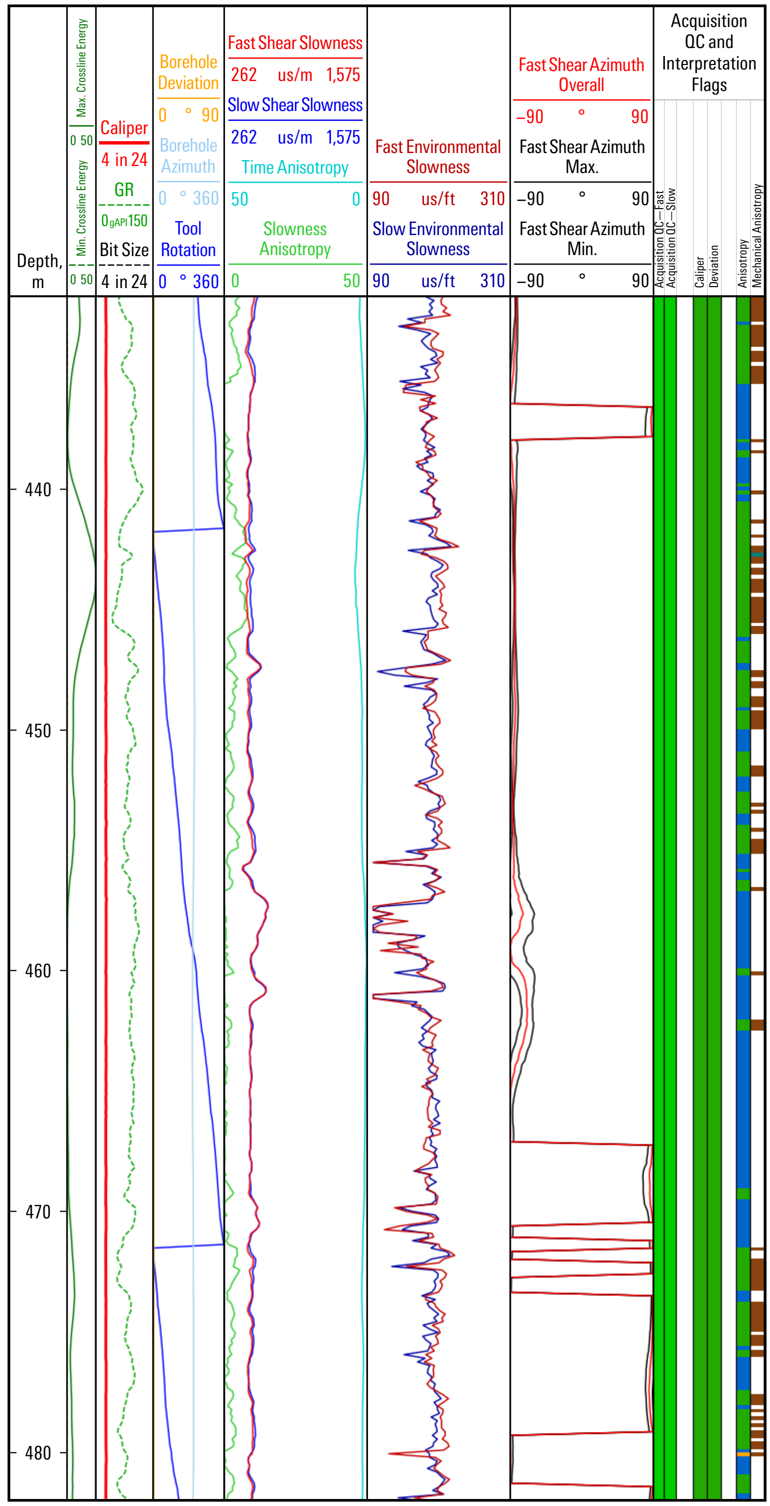
Determining the principal east–west horizontal stress orientation influenced planning for future well spacing and gave insight into the minimal depletion observed in the appraisal well. Propagation of the fracture would align with the current horizontal stress orientation and was modeled to provide elliptical drainage patterns because of the tight nature of the reservoir. This approach to field development planning has resulted in well spacing that is tighter in a north–south direction to account for eccentricity.

Technical details

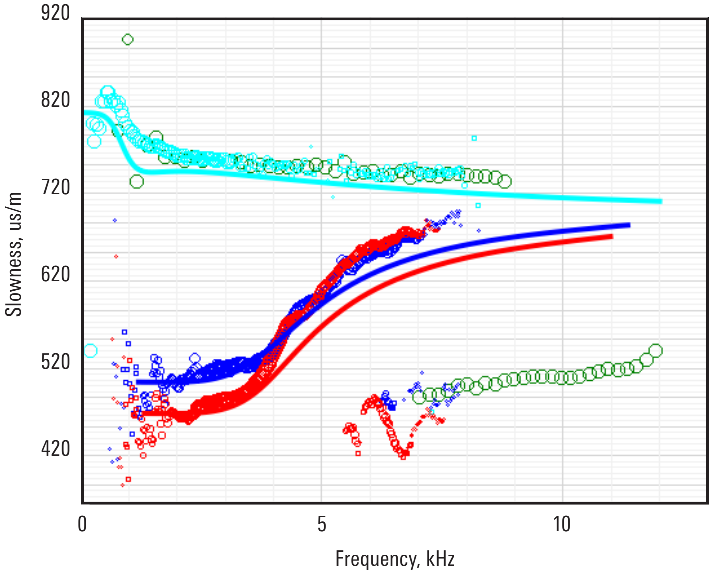
For more information, read SPWLA-2021-0022.



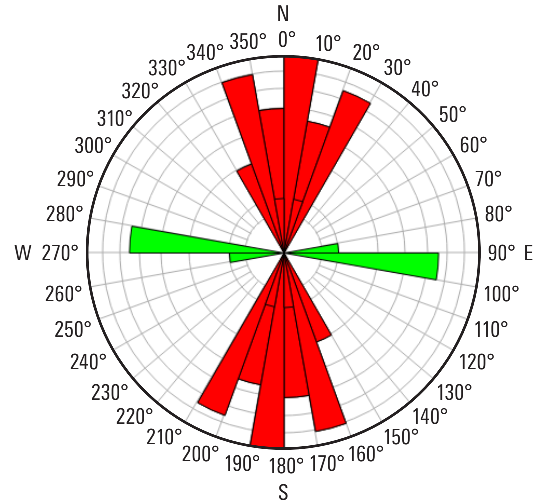
Composite sonic log for the appraisal well using the new dipole inversion.



Wellsite QC summary plot for dipole anisotropy.



Slowness dispersion analysis for the depth interval showing stress-induced anisotropy. The fast (red) and slow (blue) dipole signals cross over at ~4 kHz, indicating horizontal stress imbalances. The solid lines represent the homogenous and isotropic models for each of the dipole and Stoneley (cyan) modes.



Fast shear azimuth: nine zones, 40 m, average 95°, standard deviation of 3°
Borehole breakout: 20 zones, 16 m, average 3°, standard deviation of 15°

Strike plot of the fast shear azimuth (green) for stress-induced anisotropy and strike of the borehole breakout (red) observed on the resistivity image.

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