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3D Far-Field Sonic Service

Automated subsurface feature extraction

APPLICATIONS

- Determining structural information, such as the dip and azimuth of bedding, fractures, and faults
- Assessing the connectivity of reservoir fractures from near the wellbore to the far field
- Mapping caprock or lithological boundaries in highly deviated wells
- Locating lost wellbores, both open and cased, for relief well planning or collision avoidance
- Cased and openhole wells, from vertical to horizontal, in conventional and unconventional reservoirs

BENEFITS

- Provides quantitative dip and azimuth of reflectors for use in modeling workflows
- Reduces ambiguity in event detection and type
- Performs QC of each event from filtered waveforms rather than migration images
- Expedites processing and interpretation up to 10× faster with automated, consistent time picking and event analysis
- Delivers results at subseismic resolution to better inform completion design

FEATURES

- Deliverables in 3D space as well as a 2D projection image along the wellbore
- Automated processes for rapid, consistent time picking and event analysis
- 3D event analysis and optimized migration for consistent interpretation
- Seamless integration with borehole imaging data for validation of the near-wellbore structural environment
- Individual ray tracing
- Processing of monopole and dipole waveforms for both enhanced resolution and deeper depth of investigation
- Real-time single-pass acquisition of 3D far-field and standard sonic with enhanced telemetry from Sonic Scanner* acoustic scanning platform's eight azimuthal receivers at 13 stations

For modeling fractured reservoirs or conducting structural analysis, 3D far-field sonic service rapidly provides the true dip and azimuth of fractures and formation layers located well beyond the reach of standard sonic logging. The service determines connectivity for open fractures and identifies subseismic structural features, tracing them from the borehole wall through the near-field and far-field reservoir. The results, delivered in days rather than weeks, can be seamlessly integrated with reservoir, drilling, and completion plans.

Complementing traditional sonic imaging techniques and borehole imaging logging, 3D far-field sonic service employs a patented end-to-end workflow to data from the eight azimuthal sensors at each of the 13 stations of the Sonic Scanner platform. Reflectors are determined simultaneously and automatically by using filtered premigrated waveforms for openhole and cased hole environments. The interpreted reflectors are displayed on the migrated image and have full traceability back to the raw waveforms.

Automated time picking and event analysis

Using the filtered azimuthal sonic waveforms, the automated time picking workflow enables rapid, reliable analysis of thousands of shot gathers to identify possible reflection events. Ray tracing inversion of the time picks and 3D slowness-time-coherence (3D STC) analysis of the underlying arrival event determine each event's raypath type, 3D position of the corresponding reflector, and a score value indicating the event's relative quality or prominence. A minimum threshold is applied to the scores, and the 3D event types and positions are used to guide the migration parameters.

Smart migration workflow

Traditional migration-only sonic imaging methods often require long turnaround times resulting from challenges in manually locating and interpreting events in the filtered wavefield based on their visual appearance. Instead, 3D far-field sonic service rapidly derives the migration parameters from the automated event analysis. The imaging results are consistent with event type and orientation of the true reflectors. Direct association of features in the migration image with features in the filtered wavefield (and vice versa) provides significant quality control.

Reservoir insight beyond the reach of standard imaging

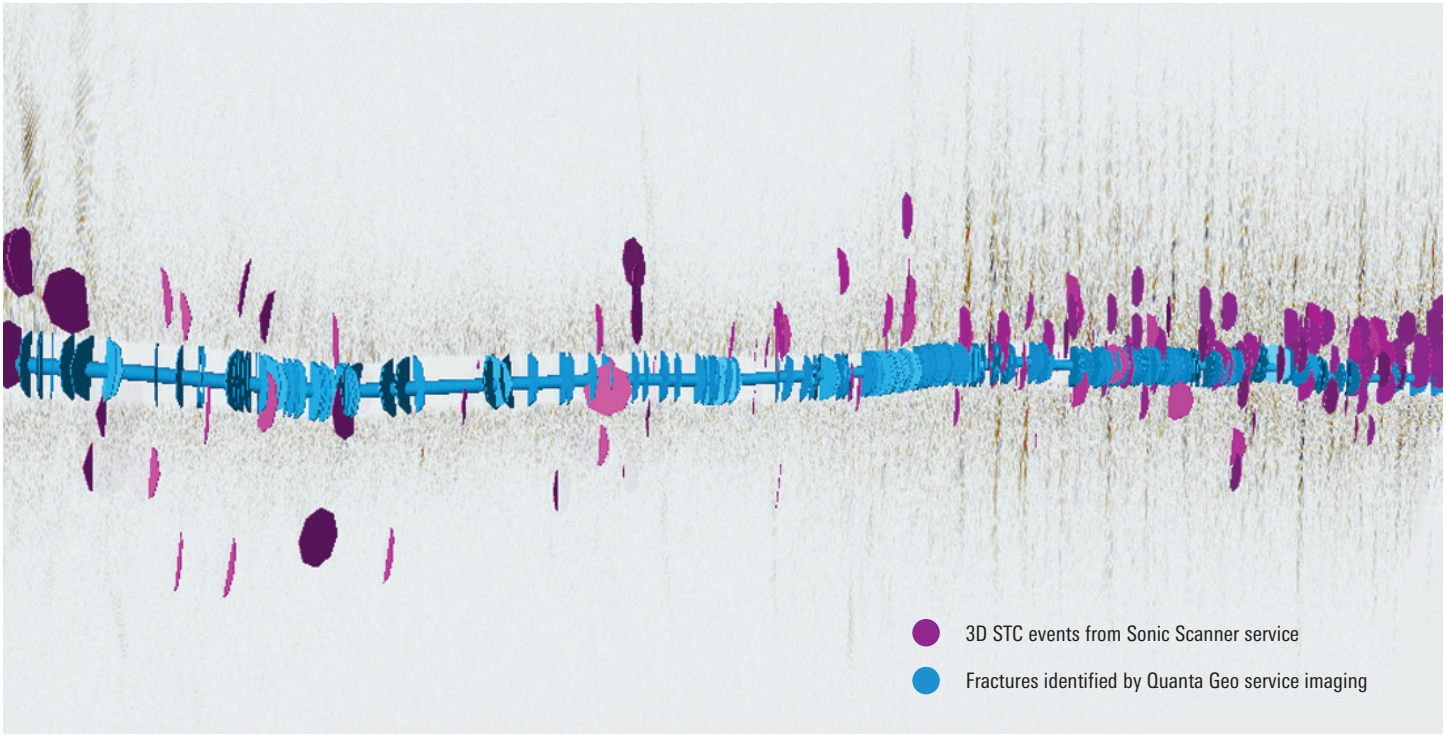
3D far-field sonic service confidently resolves fractures and structural features far beyond the borehole to enable

- selecting perforation intervals within fractured carbonate, clastic, or unconventional reservoirs
- updating structural modeling for field development and appraisal drilling
- identifying lost wellbores for relief well planning or collision avoidance
- characterizing the reservoir, including structural pinchout, oil/water contacts, and stratigraphic sequences where seismic data is insufficient or unavailable.

A single logging pass of the Sonic Scanner platform configured for acquisition with enhanced telemetry acquires 3D far-field and standard sonic data at up to 3× the speed of conventional sonic logging to provide an efficient opportunity to look at far-field reservoir imaging with 3D far-field sonic service. Using this rich dataset, the new automated workflow rapidly delivers consistent, precise quantitative results up to 10× faster than conventional processing and analysis to bring new insight to understanding the reservoir.

Sonic Scanner acoustic scanning platform.

3D Far-Field Sonic Service



In this unconventional well in the Wolfcamp, Quanta Geo photorealistic reservoir geology service and Sonic Scanner platform data were acquired in a single logging pass. The fractures identified at the borehole from Quanta Geo service imaging (blue discs) are displayed with 3D STC events from Sonic Scanner service (purple discs) on the migrated image produced using the Petrel* E&P software platform. Monopole data was used for high-resolution event analysis extending up to 15 m into the reservoir from this well. The completion was designed based on the intensity of the far-field fractures near the toe of the well (right).*

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