DATA SHEET

HALLIBURTON

Borehole seismic services

FORMATION EVALUATION | GEOPHYSICS

FiberVSP™ service in any environment

Improves reservoir analysis

Overview

Halliburton Borehole Seismic Services (BHS) provides customized, reliable high-resolution solutions that bridge the gap between surface seismic and the wellbore to improve reservoir analysis.

One of the latest technologies in the Halliburton family of fiber-optic services is the FiberVSP™ service – a distributed acoustic sensing (DAS) technology for Vertical Seismic Profile (VSP) data acquisition.

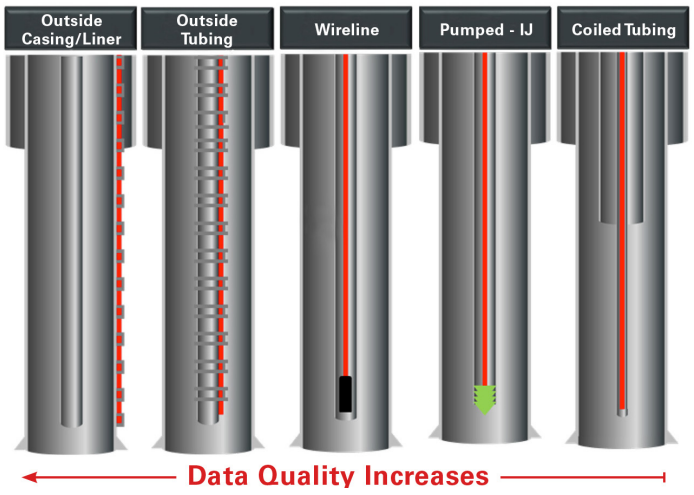
The ability to access and interrogate the fiber-optic cable from TD to surface with each triggering of the seismic source allows for the possibility of acquiring VSP data using DAS for a single survey through time-lapse 3D VSP studies, quickly and economically. It is a risk-averse method for acquiring VSP data on fiber-optic cable at a high spatial resolution.

The schematic below depicts various methods of fiber-cable deployment, all suitable for acquiring FiberVSP data. The first two methods, outside casing/liner and outside tubing, are permanently deployed methods allowing us to access and interrogate the fiber-optic cable without requiring well intervention. This greatly reduces operator costs and is perfectly suited for time-lapse VSP. Retrievable fiber deployment methods, such as wireline, pumped down, and coil tubing, also allow for FiberVSP data acquisition. Although these methods tend to be more susceptible to noise caused by variable fiber coupling, they still provide an increase in data acquisition efficiencies, which in turn save valuable rig time.

We employ a systematic procedure to calibrate and set up the fiber-optic interrogator unit customized for each well. This procedure sets the appropriate gauge length, pulse width, and optical power, etc., which allows us to minimize optical fading, maximize signal to noise, and provide the highest spatial resolution. We record all seismic auxiliary signals (GPS timestamp, time-zero pulse, and reference sweep signal) directly onto the optical data stream. This allows for precise detection of each seismic record's start time in real time at sub-millisecond accuracy.

Part of our unique offering includes in-field data preprocessing and quality control with visual inspection of the denoised seismic data, and a report documenting data acquisition with data images, first-break picks, and interval velocity plots for static-source offsets. We also produce discrete SEG-Y trace files on location with complete header information.

The Halliburton FiberVSP™ service offers customized solutions to access and interrogate both single mode (SM) and multimode (MM) fiber-optic cables deployed permanently (requiring NO well intervention) or retrievable. The data sets below are of FiberVSP data acquired using various methods and modes.



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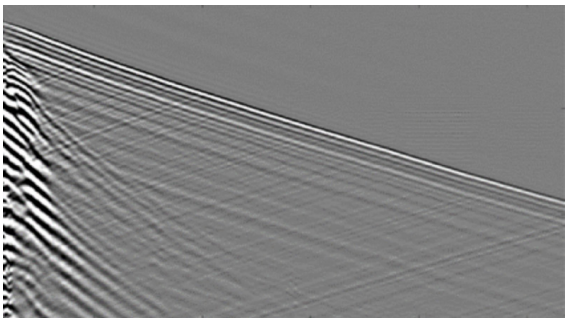
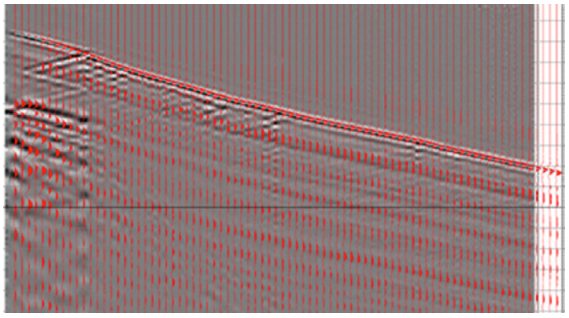
Permanent fiber

This is an example of a Zero-Offset FiberVSP data set acquired with an SM permanently cemented fiber behind casing using 8 vibrator sweeps. After a connection to the permanent fiber is established, this data set is collected in minutes. The data quality is excellent and directly comparable to conventional VSP.



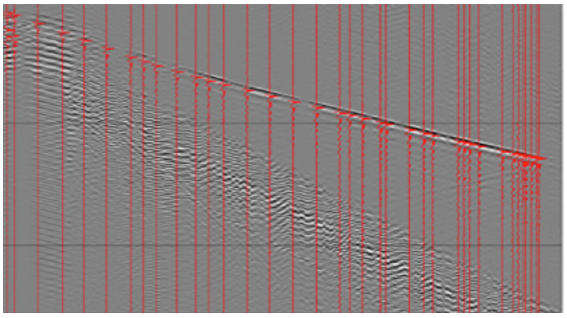
Retrievable fiber

This is an example of a Zero-Offset FiberVSP data set acquired via a retrievable fiber cable with 4 conventional geophones at the bottom. The conventional VSP is overlaid in red. It can be observed that the move out of upgoing and downgoing waves align very well. When compared to conventional VSP, which produces a trace every 15 m, FiberVSP data is sampled at a spatial interval of 1 m, providing a 15 to 1 increase in resolution.



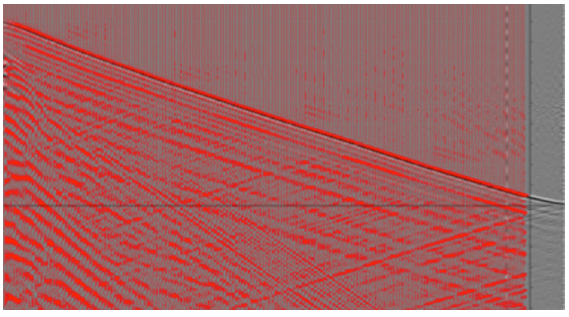
Fiber inside SPECTRUM® coil tubing

This is an example of a Zero-Offset FiberVSP data set acquired inside a SPECTRUM® CT unit where the fiber line is inside the retrievable coil tubing. Although susceptible to tube wave, the first arrivals and reflection data can be easily seen. The red overlay is from a nearby check shot showing an excellent tie in first arrivals between the two data sets.



Comparison of single mode vs. Multimode fiberVSP data

This example is a comparison of data acquired with SM fiber (background in gray) and MM fiber (overlay in red) using the patented Halliburton MM FiberVSP solution. Both SM and MM records provide near-identical direct arrival time/depth information, as well as upwave reflection information, evidencing our ability to provide high-quality VSP data for all fibers in all well environments.



For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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