

# Geophysical Attributes Acquired with the Halliburton FiberVSP™ Service Enhances Surface Seismic Data Processing

## 3D EARTH MODEL GENERATED FROM DATA TO INCREASE ACCURACY IN DRILLING FUTURE WELLS

THE ROCKIES, USA

### CHALLENGES

- » Acquire the first arrival times along the entire wellbore from near- to far-offset source locations to provide an estimation of the Delta and Epsilon anisotropy parameters
- » Acquire the first arrival times from the required survey geometry in one pass of the walkaway source line, which would be much less time consuming and cost effective than using conventional geophones

### SOLUTION

- » Halliburton recommended the FiberVSP™ service to acquire a vertical transverse isotropy (VTI) walkaway vertical seismic profile (VSP) using retrievable wireline with fiber and conventional geophones to efficiently and quickly acquire the first arrivals every meter along the entire wellbore

### RESULTS

- » Cost effectively recorded first arrivals from surface to TD in just a few sweeps of the vibrator at each offset source location starting at 200 ft and ending at 27,000 ft
- » First arrivals were picked from each source location and were plugged into calculations for the estimation of the Delta and Epsilon anisotropy parameters to insert into a 3D earth model that greatly enhanced the surface seismic image

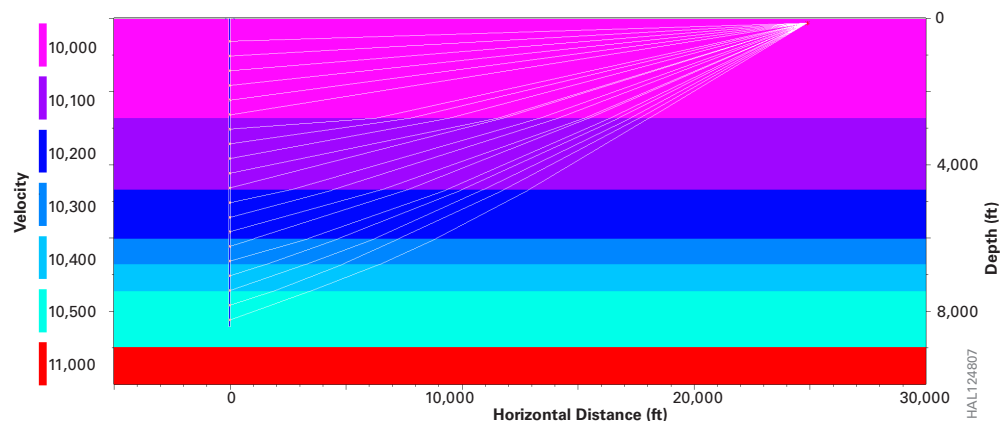
### OVERVIEW

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 retrievable fiber-optic cable from total depth (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 a retrievable fiber-optic cable at a high spatial resolution.

Recently, the FiberVSP service was used to run a vertical transverse isotropy (VTI) walkaway VSP survey to obtain an estimation of the Delta and Epsilon anisotropy parameters necessary to fine-tune the geophysical 3D earth model used for surface seismic imaging on a project in the Rockies. Data from the FiberVSP service was processed to obtain the VTI parameters from surface to TD while the vibrator moved away from the wellbore. Measuring the traveltimes and how they propagate through the earth at different angles can provide anisotropic velocities that help an operator better image its surface seismic. With more accurate anisotropic velocities, the operator can generate a more accurate 3D earth model, which will increase drilling accuracy, provide a better well tie to surface seismic, identify potential drilling hazards, and identify the local stress field.

### CHALLENGES

An operator requested Halliburton to record and process the first arrival data over the entire well in an accurate and cost-effective manner. The first arrival times were then plugged into



Ray tracing model for anisotropic analysis showing coverage in entire wellbore from a single source point.

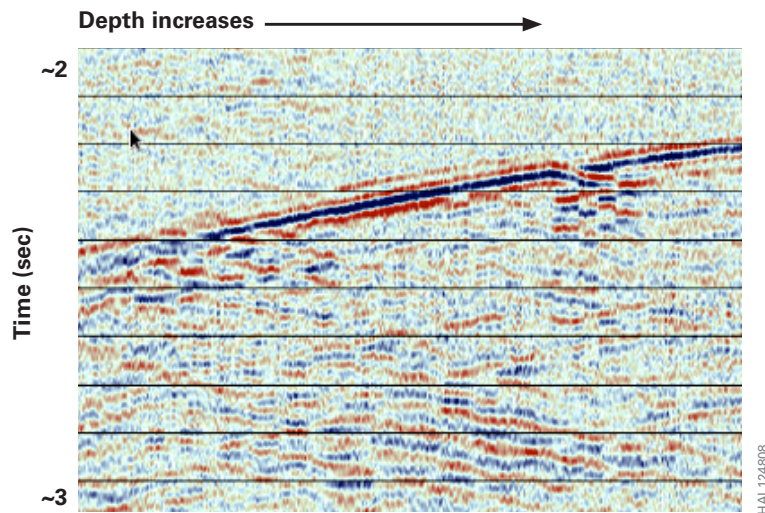
calculations for the estimation of the Delta and Epsilon anisotropy parameters. These anisotropy parameters greatly improve the 3D earth model, which helps in the placement of future wells. VTI walkaway VSP surveys have traditionally been acquired with conventional geophones in the well. It takes multiple passes of the source along the walkaway line to record into conventional geophones as the geophones are moved up the well after each pass of the source on the walkaway line. This methodology requires substantially more time and a higher cost to the operator to acquire.

**SOLUTION**

To acquire the desired first arrivals, Halliburton used the FiberVSP™ service to run a VTI walkaway VSP survey. An advantage of using the FiberVSP service over conventional geophones is that it can interrogate the entire wellbore in a single sweep with a vibrator during the acquisition of each source point in the VTI walkaway line. By acquiring the entire VTI walkaway line in one pass, it greatly reduces costs and data acquisition time. The one-meter channel (depth) spacing on the FiberVSP service provides more robust and higher-resolution measurements when compared to traditional geophone data acquired every 15 m.

**RESULTS**

Data was recorded in a single pass of the vibrator with the FiberVSP service recording data from the wellhead to 27,000 ft away from the wellhead. This single pass of the walkaway line resulted in a much more cost-effective survey than a survey with geophones only. The retrievable wireline with fiber in the vertical well recorded the seismic signal from three vibrators acting as the seismic source at each location. SEGY traces were generated in the field and sent to Halliburton Formation Evaluation and Reservoir Solutions (FERS) where data was further processed, and the first arrivals were picked and sent to the operator. The first arrival times were plugged into calculations for Delta and Epsilon to build an earth model to enhance the operator’s previously acquired surface seismic image. This allowed the operator to better position its wells to minimize risk and uncertainty.



FiberVSP™ data acquired from a 23,500-ft source offset from the wellhead.

[www.halliburton.com/FiberVSP](http://www.halliburton.com/FiberVSP)

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