

High-Resolution Images, AVO Calibration, Anisotropy Estimation, and Fracture Detection for Enhanced Reservoir Characterization

Halliburton Borehole Seismic Services (BHS) helps enhance unconventional reservoir characterization with customized high-resolution data for Anisotropy Estimations and Fracture Detection from Walkaway and Walkaround VSPs.

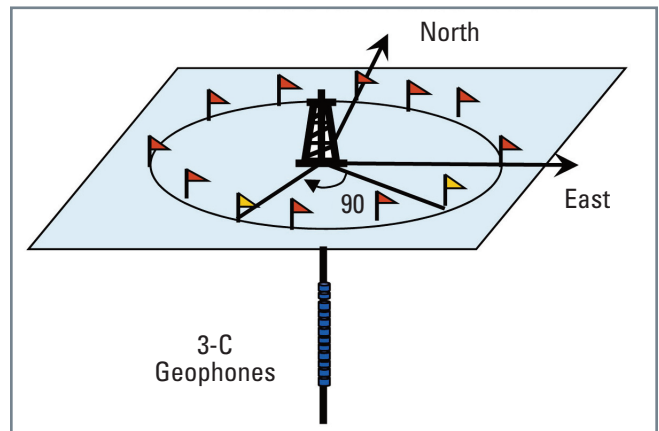
Halliburton uses the latest technology in data acquisition coupled with advanced SeisSpace® BHS VSP software to provide quality VSP images of the borehole and its vicinity. From pre-survey plan design, to data acquisition, processing and interpretation, our fully trained professionals work with you from start to finish, so you get the most value from every project.

Walkaway VSP surveys, in addition to providing high-resolution P and S images, can also provide VTI measurements and AVO calibrations. From multiple shotpoints walking away from the wellbore, we gather a complete set of arrival angles through the overburden. Velocity measurements and arrival angles are analyzed to measure VTI and AVO.

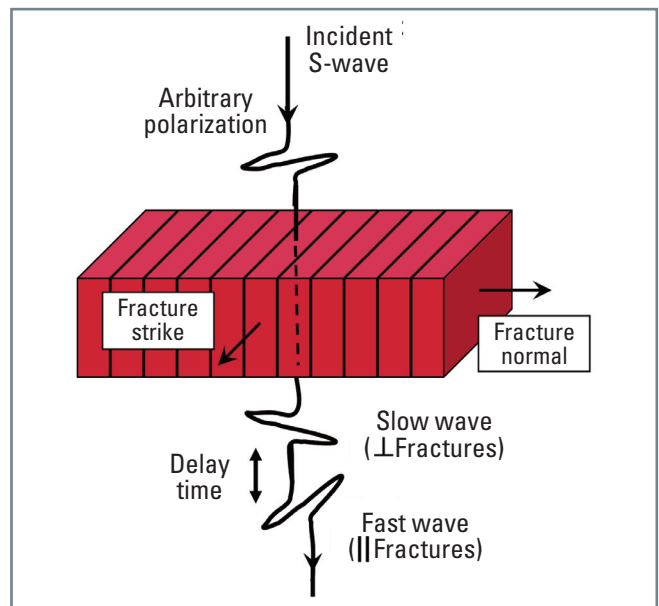
Walkaround VSP surveys are similar to Walkaway VSP surveys except they are acquired in many different azimuths around the wellbore. The idea is to acquire enough azimuthal data to measure the fast (S1) and slow (S2) shear wave splitting. The results from measuring the travel time arrivals from azimuthal offsets will provide the stress field information for fracture detection. Anisotropy parameters of delta and epsilon estimations are provided as post-processing deliverables.

Walkaway and Walkaround VSP Benefits

- 3-component geophones capture all wave modes providing shear and compressional images
- Q estimation, AVO calibration and Anisotropy Parameters enhance surface seismic resolution
- Fracture orientation – fast shear wave azimuth; and fracture intensity – azimuthal velocity anisotropy
- HTI and VTI measurements
- Fast and slow shear wave measurements
- Improved velocity analysis for surface seismic processing with an accurate velocity model
- High-resolution images and attributes beneath and away from the well for inter-well reservoir imaging
- Rock properties/pore pressure indicators
- High-resolution imaging to identify reservoir boundaries and faults in complex areas for correlating VSP to 3D surface seismic



Walkaround VSP



Shear Wave Splitting

Walkaway and Walkaround VSP Applications

- HTI Anisotropy Measurements
- VTI Anisotropy Measurements
- Fracture Detection
- P and Shear Wave Imaging
- Complex Reservoir Analysis
- 3D and Time-Lapse 4D Offset Imaging
- AVO Calibration

Data Processing Software

Developed with Landmark, SeisSpace® BHS “next-generation” data processing software, incorporates advanced proprietary processing techniques to address the most complex challenges.

Pre-Survey Modeling

The key to any successful survey, Halliburton BHS provides accurate 2D and 3D pre-survey modeling to optimize parameters for data acquisition.

Data Acquisition

Crucial to obtaining an accurate and comprehensive geological picture of the well, field, or reservoir, Halliburton BHS industry-leading borehole seismic energy source and downhole array technologies are combined with experienced, dedicated experts worldwide to provide operators improved data quality and reduced rig time.

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MaxiWave® is a registered trademark of Sercel.
Pelton Vib Pro™ is a trademark of ION.

Seismic Recording System

Avalon and Sercel PC-based system provides both digital and analog recording with full QC capabilities, while the source controller interface uses Pelton vib electronics and digital airgun controllers. This technology helps ensure optimization of sources and frequency bandwidth, and enables users to monitor S/N ratio and first-arrival picks with critical velocity data.

Energy Sources for both Marine and Land Applications

Halliburton BHS provides the full range of auxiliary equipment including compressors, Hotshot and Longshot source controllers with constant real-time tuning, near and far field signatures, gun pressure and depth. In addition, we offer a range of tuned gun arrays designed to optimize peak/peak-to-peak barm output; peak-to-bubble ratio, with broad flat frequency spectrum and source directionality.

Our land vibroseis units use Pelton Vib Pro™ electronics for broadband sweep and deliver repeatable/reliable results to match surface seismic acquisition parameters.

Downhole Tools

Halliburton BHS downhole tools are designed for use in open and cased holes using 7-conductor wireline. All tools are 3-component with various options of gimbal and fixed packages in single- and dual-package configurations, and have a high locking force-to-weight ratio. BHS tools can be deployed via wireline, pump, TPL and tractors.

Specifications

Tools	Max Number of Sondes	Length Inches (mm)	Diameter Inches (mm)	Max Pressure psi	Max Temperature °F (°C)	Weight lb (kg)
ASR-1	2	35 (884)	3 (76)	25,000	400 (200)	38 (17)
Geochain™ 48	48	35 (884)	3 (76)	25,000	356 (180)	38 (17)
ASR-EHT	2	35 (884)	3 (76)	25,000	435 (225)	38 (17)
GSR-1	2	44 (1,135)	1-11/16 (43)	20,000	400 (200)	10 (4.5)
GeochainSlim™ 24	24	44 (1,135)	1-11/16 (43)	20,000	356 (180)	10 (4.5)
MaxiWave™	100	17 (440)	3-1/2 (89)	17,400	275 (135)	17.6 (8)

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

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