Zero-Offset Vertical Seismic Profiles

HIGH-RESOLUTION ATTRIBUTES FOR RESERVOIR CHARACTERIZATION

Halliburton Borehole Seismic Services (BHS) can help enhance reservoir characterization with customized, reliable high-resolution data and attributes provided by Zero-Offset Vertical Seismic Profiles (VSP).

THE COMPLETE PACKAGE

Halliburton uses the latest technology in data acquisition coupled with advanced VSP software to provide quality images of the borehole and its vicinity. From presurvey plan design, to data acquisition, processing, and interpretation, our fully trained professionals work with you from start to finish to optimize the value on every project.

ZERO-OFFSET VSPs

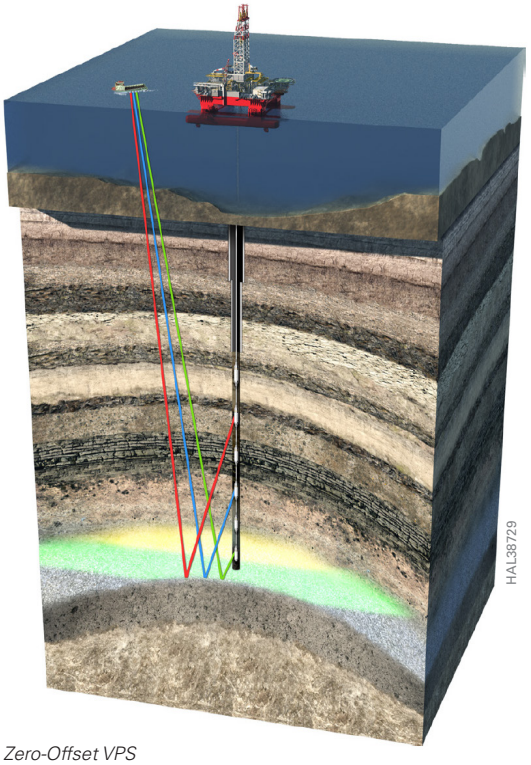
Providing precise velocity information, as well as true seismic wavelet well-tie with phase, frequency, and time/depth, a Zero-Offset VSP is the only tool that can identify events (target, over pressure, casing point, base salt, etc.) "ahead of the bit."

The processed Zero-Offset VSP is multiple free; therefore, it can delineate seismic multiples, as well as validate and calibrate surface seismic data.

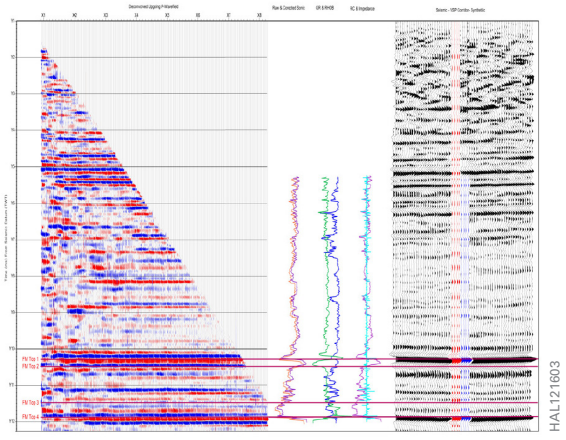
Depending on the wellbore deviation and application, the source is positioned differently. For a straight or slightly deviated well, the source is positioned near the wellhead, and data is collected at a geophone increment of ~50 ft (15 m). If the wellbore is deviated by more than 10 degrees, it is recommended to move the source over the geophone to remain normal incident. Again, data should be collected at a geophone increment of ~50 ft (15 m). In some instances in a deviated wellbore or around complex structures, the source may remain near the wellhead, resulting in a high-resolution subsurface image under and away from the wellbore.

APPLICATIONS

- Near-well corridor stack true wavelet well-tie to surface seismic for both compressional and shear-wave fields
- "Q" studies of acoustic energy attenuation
- Accurate time/depth correlation
- Acoustic-log calibration and accurate synthetic seismograms
- Prediction "ahead of the bit"
- Improved velocity analysis for surface-seismic processing
- Imaging in deviated wellbores and complex structures



Zero-Offset VPS



Zero-Offset VSP Imaging *(Courtesy of Anadarko)*

BENEFITS

- Improved velocity analysis for surface-seismic processing
- P&S Average, Interval, and RMS Velocity data
- Higher vertical resolution/frequency than surface seismic
- Imaging in deviated wellbores and complex structures
- Prediction "ahead of the bit"
- True seismic wavelet well-tie to validate and calibrate surface seismic using phase, frequency, time/depth, and multiple identification
- Wellbore-position verification placing the drill bit on the seismic section
- Calibrated acoustic log to improve correlation of log-derived synthetic seismogram
- Provides Q (Transmission loss) estimation for surface-seismic processing enhancement

DATA PROCESSING SOFTWARE

Halliburton iBHS™ next-generation data processing software incorporates advanced proprietary processing techniques to address the basic to the most complex reservoir imaging challenges.

PRESURVEY MODELING

As a key to a successful survey, Halliburton BHS provides accurate 2D and 3D presurvey modeling to optimize parameters for data acquisition.

DATA ACQUISITION

To obtain an accurate and comprehensive geological picture of the well, field, or reservoir, Halliburton BHS combines industry-leading borehole seismic energy sources and downhole array technologies with experienced, dedicated experts worldwide to provide operators with improved data quality while reducing rig time.

SEISMIC RECORDING SYSTEM

Avalon and Sercel PC-based systems provide digital and analog recording with full QC capabilities, and interface with vibrator electronics and digital airgun source controllers. This technology helps ensure optimization of sources and frequency bandwidth, and enables users to monitor S/N ratio, first-arrival picks, and critical velocity data.

ENERGY SOURCES FOR MARINE AND LAND APPLICATIONS

Halliburton BHS provides the full range of auxiliary equipment including compressors, airgun array 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 advanced vibrator electronics to deliver repeatable and reliable broadband 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-, dual- and quad-receiver package configurations with a high locking force-to-weight ratio. BHS tools can be deployed via wireline, pumpdown, tool-pusher logging (TPL) and tractors.

Tool Specifications

Tool Array	Maximum Number of Sondes	Length in. (mm)	Diameter in. (mm)	Maximum Pressure psi (MPa)	Maximum Temperature °F (°C)	Weight lb (kg)
ASR-HP	2	35 (889)	3 (76)	25,000 (172)	400 (204)	38 (17.2)
Geochain™ 60	60	35 (889)	3 (76)	25,000 (172)	356 (180)	38 (17.2)
GeochainX™ 60	60	35 (889)	3 (76)	25,000 (172)	385 (195)	38 (17.2)
ASR-EHT	2	35 (889)	3 (76)	25,000 (172)	435 (224)	38 (17.2)
GeochainSlim™ 100	100	45 (1,143)	1 11/16 (43)	20,000 (138)	356 (180)	10 (4.5)
ASR-EHP	2	35 (889)	3¼ (83)	30,000 (297)	400 (204)	51 (23.1)
Geochain™ EHP 60	60	35 (889)	3¼ (83)	30,000 (297)	356 (180)	51 (23.1)
GeochainX™ EHP 60	60	35 (889)	3¼ (83)	30,000 (297)	385 (195)	51 (23.1)
ASR-EHT-EHP	2	35 (889)	3¼ (83)	30,000 (297)	435 (224)	51 (23.1)
MaxiWave®	100	17 (432)	3½ (89)	17,400 (120)	275 (135)	17.6 (8.0)

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

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MaxiWave® is a registered trademark of Sercel.