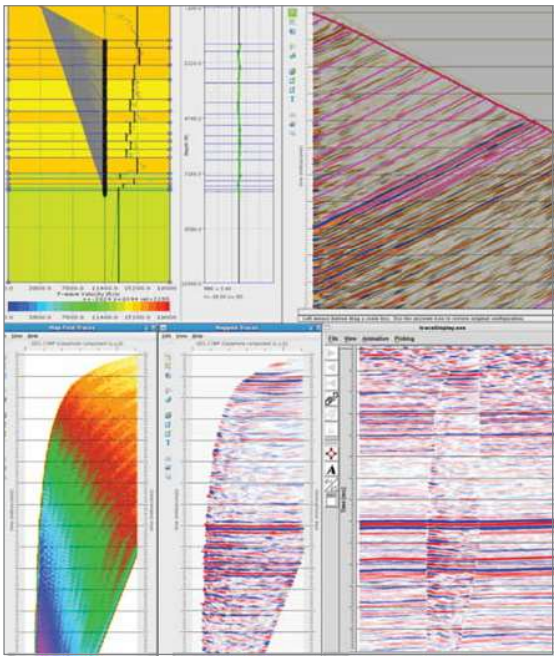
Borehole Seismic Services

IMPROVES RESERVOIR ANALYSIS

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.

Using industry-leading borehole seismic energy sources and downhole array technologies combined with dedicated experts, BHS provides operators with improved data quality while minimizing rig time. Advanced source-and-receiver technology is crucial toward obtaining a more accurate and comprehensive geological picture of the well, field or reservoir. Coupled with advanced VSP processing from presurvey plan design, data acquisition, through to complex data processing and interpretation, our total approach delivers results. From time/depth data to complex imaging, Halliburton BHS provides detailed accuracy in integrating geology with surface-seismic data, and putting the drill bit in the seismic section. For both normal and high-pressure/high-temperature environments, we deliver reliable, high-resolution borehole seismic solutions.



HAL39218

Halliburton iBHS™ Software *(Courtesy of Anadarko)*

APPLICATIONS

Velocity Survey/Check-Shot

- Calibrate surface seismic using:
  - Accurate time/depth information
  - Average, Interval, and RMS Velocities
  - Acoustic log calibration and synthetic seismograms

Zero-Offset Vertical Seismic Profiles

- Validate and calibrate surface-seismic attributes using a true wavelet tie with phase, frequency, time/depth and multiple identification services for:
- Wellbore position verification
  - Prediction beneath bit — Geosteering
  - Q estimation

Far-Offset, Salt Proximity, Walkaway/Walkaround and 3D VSPs

- Complex high-resolution 2D and 3D P- and S-wave anisotropic imaging to determine reservoir boundaries, fault identification, salt flank and presalt imaging
- Q estimation and AVO calibration to enhance surface-seismic resolution
- HTI and VTI anisotropy measurements
- Fracture detection and fracture intensity
- Time-lapse 4D studies, fluid movement mapping
- Rock property and pore-pressure assessment
- 3D salt proximity survey

BENEFITS

- Reduces uncertainties
- Maximizes recovery
- Minimizes risks
- Increases reserves

BOREHOLE SEISMIC DATA PROCESSING SOFTWARE

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

BOREHOLE SEISMIC SERVICES EQUIPMENT

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

Recording Systems

Avalon and Sercel PC-based systems provide digital and analog recording with full QC capabilities, and interface with vibrator electronics and digitial 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.

On-site quick-look seismic processing software optimized for borehole seismic data generates quality control displays and preliminary processed results during or shortly after data acquisition.

HAL36499

Recording Unit HAL36498

Energy Sources

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,

Tuned Airgun Array HAL36502

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.

Vibrator Unit HAL36503

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.

Geochain™ Tools HAL36504

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)

Geochain™, GeochainSlim™ and GeochainX™ are trademarks of Avalon Sciences Ltd.
MaxiWave® is a registered trademark of Sercel.

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