

# 3D Reverse Salt Proximity

## HIGH-RESOLUTION 3D REVERSE SALT FLANK PROXIMITY

Halliburton Borehole Seismic Services (BHS) provides high-quality 3D Reverse Salt Proximity surveys to help minimize potential risks associated with salt cavern storage by defining the salt flank in 3D space.

### 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.

### 3D REVERSE SALT PROXIMITY SURVEYS

Halliburton 3D Reverse Salt Proximity methods can help operators minimize risks associated with salt cavern storage by determining the distance between the wellbore and the edge of the salt dome so that once leached, the cavern will hold its integrity.

With 3D Reverse Salt Proximity surveys, the wellbore is drilled into the salt body, and the source is offset away from the salt, with multiple source points in multiple directions. The source offset distance is optimized to produce mode-converted shear waves at the salt-sediment interface.

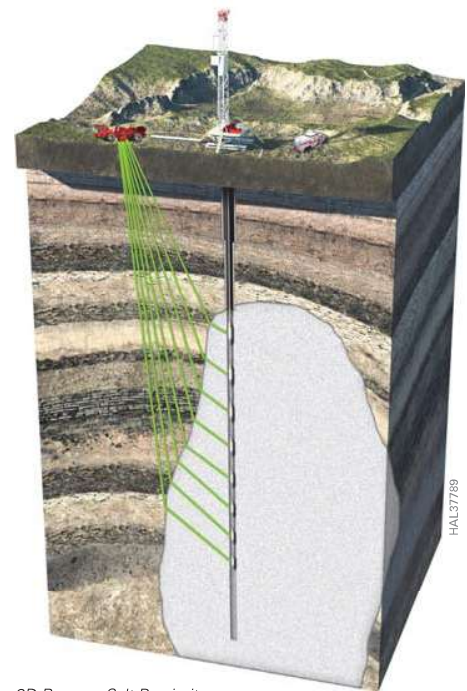
These surveys require orientation of the 3-component quad geophone pack, which should be spaced at approximately 50 ft (15 m) to capture the wavefield angle arrivals and provide an accurate 3D depiction of the salt flank.

### APPLICATIONS

- » Maps salt flank in 3D space using salt entry points
- » Confirms the surface-seismic salt interpretation
- » Provides an indication of sediment truncation position
- » Helps define massive salt bodies for liquid-storage purposes

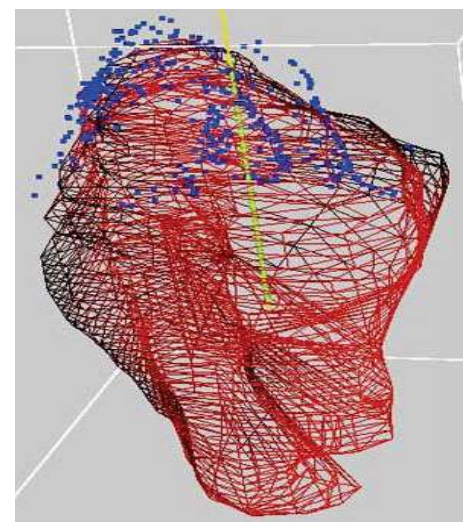
### BENEFITS

- » Simple and robust methodology
- » Provides an accurate 3D depiction of the salt flank using X, Y, Z salt entry points in 3D space
- » Reduces potential risks and environmental issues associated with a possible breach of the salt flank
- » Reduces potentially substantial costs associated with locating a new cavern for storage
- » Assists in providing assurances and redundancy of the salt flank interpretation
- » The quad-pack receiver's increased fidelity and signal-to-noise ratio provides higher resolution and better data quality
- » Complies with governmental regulations



3D Reverse Salt Proximity

HAL37789



3D Reverse Salt Proximity Entry Points

HAL37963

**DATA PROCESSING SOFTWARE**

Halliburton iBHST<sup>™</sup> 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 source and downhole array technologies with experienced, dedicated experts worldwide to provide operators with improved data quality while reducing rig time.

**SEISMIC RECORDING SYSTEMS**

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.

Optional aligned rigid interconnects can be used between multiple tools to allow a single gyro azimuth reading to be applied to all receivers in the tool string.

**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 <sup>™</sup> 60	60	35 (889)	3 (76)	25,000 (172)	356 (180)	38 (17.2)
GeochainX <sup>™</sup> 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 <sup>™</sup> 100	100	45 (1,143)	1 <sup>11</sup> / <sub>16</sub> (43)	20,000 (138)	356 (180)	10 (4.5)
ASR-EHP	2	35 (889)	3 <sup>1</sup> / <sub>4</sub> (83)	30,000 (297)	400 (204)	51 (23.1)
Geochain <sup>™</sup> EHP 60	60	35 (889)	3 <sup>1</sup> / <sub>4</sub> (83)	30,000 (297)	356 (180)	51 (23.1)
GeochainX <sup>™</sup> EHP 60	60	35 (889)	3 <sup>1</sup> / <sub>4</sub> (83)	30,000 (297)	385 (195)	51 (23.1)
ASR-EHT-EHP	2	35 (889)	3 <sup>1</sup> / <sub>4</sub> (83)	30,000 (297)	435 (224)	51 (23.1)
MaxiWave <sup>®</sup>	100	17 (432)	3 <sup>1</sup> / <sub>2</sub> (89)	17,400 (120)	275 (135)	17.6 (8.0)

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

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