

Well Seismic Tools

Description

Two Well Seismic Tools (WST and WST-3) are available for use in the Ocean Drilling Program. Each tool uses an identical tool body with the primary difference being the number of geophones included in the tool. The WST utilizes a single geophone while the WST-3 utilizes a 3-geophone array to acquire data in the x , y and z axes. The WST or WST-3 is clamped against the borehole wall at intervals of approximately 50m, and an air gun located on the *JOIDES Resolution* or support vessel is fired five to seven times at each station. The resulting waveforms are stacked and a traveltime is determined from the median of the first breaks in each trace. These check shot experiments attempt to reproduce the seismic reflection profiling by simulating a similar geometry and source frequency.

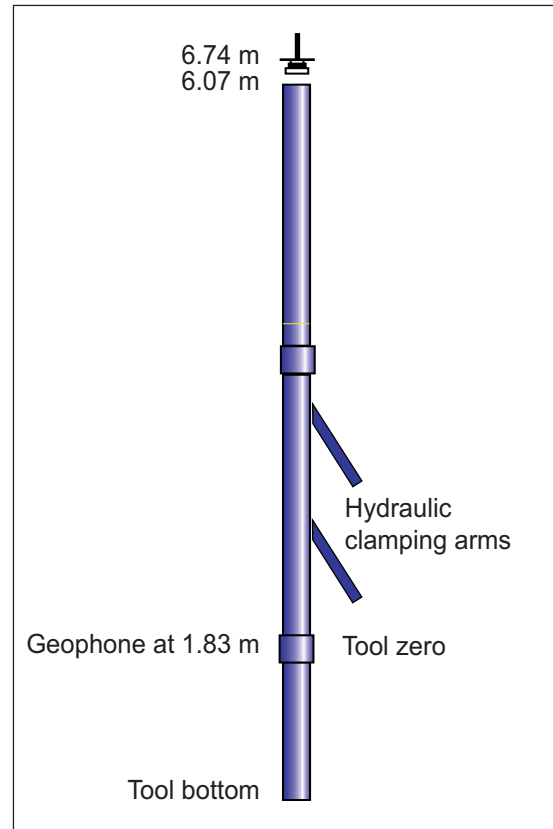
Applications

The WST and WST-3 can make check shots to produce depth-traveltime pairs to calibrate the sonic logs and determine accurate drilling depths and their relative position with respect to targets on the seismic reflection profiles. In addition, offset VSP data acquired by the WST-3 is useful for:

- ◆ Providing seismic interval velocities which can be compared to the rock sequence intersected by the borehole
- ◆ Placing the borehole results in their proper setting with respect to the seismically defined structure of the oceanic crust and mantle
- ◆ Correlating borehole lithology with the up-going seismic reflected wavefield
- ◆ Predicting structure and lithology changes below the drill hole
- ◆ Estimating physical properties of rock on seismic scales by studying particle motion and downhole seismic attenuation

Deployment Notes

The WST can be used only for checkshot surveys while the WST-3 can be used for check shots and offset vertical seismic profile experiments. A remote seismic source is required for an offset survey while a traditional check shot



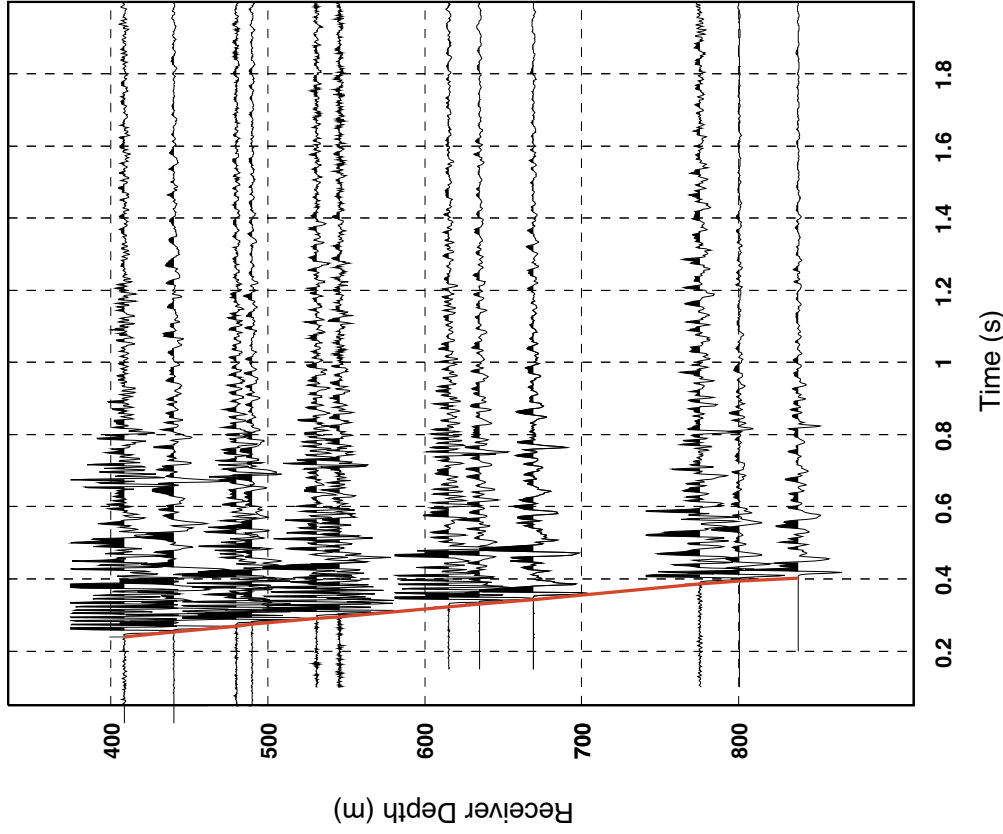
Schematic illustration of the Well Seismic Tool.

survey can be completed with existing equipment on the *JOIDES Resolution*. For a check shot, a 120 in³ air gun is suspended by buoys at a depth of 3 mbsl, offset 48.5m from the hole on the portside.

The WST/WST-3 is always the last tool run and it is always run alone. At each selected station, a seismic shot is produced at the sea surface using either air or water guns provided by TAMU. Schlumberger provides a blast hydrophone for synchronizing the gun pulse with the system timer.

The WST-3 and other downhole seismic tools are sensitive to pipe noise and ringing of pipe following a shot. Efforts should be made to reduce pipe noise at each station. If time and resources permit, a drill string packer may be deployed to dampen the banging motion of the pipe against the borehole. It is always prudent to leave at least 50 to 75 meters of distance between the tool and the bottom of pipe.

WST/WST-3 - Air Gun
(stacked waveforms)



The WST and WST-3 acquire acoustic wave travel time data for each geophone. The waveforms for each station are typically stacked vertically to create a "time-depth" curve with the first arrivals highlighted as in the figure above.

Specifications

Mechanical	
Diameter:	3.625 in.
Weight:	310 lbs (141 kg)
Length:	6.07 m
Temperature rating:	175° C
Pressure rating:	20,000 psi
Minimum hole diameter:	5 in. (127 mm) with "short" arms
Maximum hole diameter:	19 in. (483 mm) with "long" arms
Maximum logging speed:	Stationary
Sensors	
Geophone type:	SM4 (gimbaled, one per axis)
Geophone frequency:	10 Hz
Damping:	60 dB
Sensitivity per axis:	83 V/m/sec or .80 V/in./sec at 25° C
Low-cut frequency:	0.2 Hz
Low-cut slope:	18 dB/octave
High-cut frequency:	250 Hz for 1 ms or 125 Hz for 2 and 4 ms
High-cut slope:	36 dB/octave
Digitization:	Downhole
Sampling rate:	1, 2, or 4 msec (selectable)
ADC resolution:	11 bit
Autoranger steps:	Five 6 dB steps
Preamplifier gain:	40 - 106 dB by 6 dB steps for each axis
Dynamic range per waveform:	90 dB
Total dynamic range:	156 dB
Input noise level:	2 μ V
Anti-aliasing filters:	330 Hz / 24 dB per octave
Data format:	16 bit FP (12 bits mantissa, 4 bits exponent)