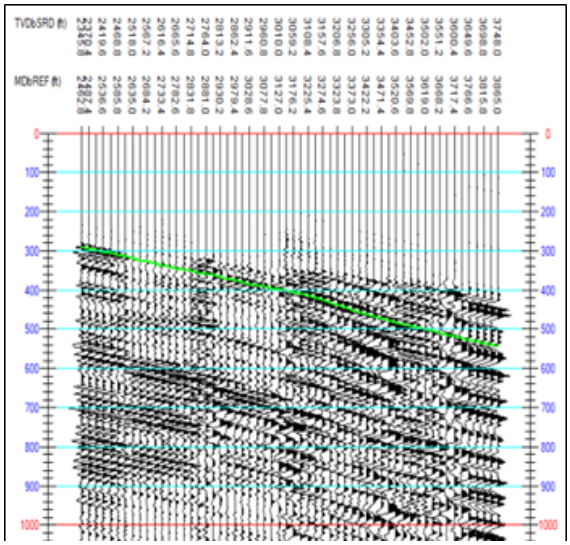
# **Shear Velocity Analysis** From Challenging Near-Offset VSP Survey Used to Understand Subsurface Mechanical Properties



The P-S converted wavefield where the green line shows the times picked.

## Objectives

- Process the zero offset vertical seismic profile (ZVSP) data and estimate the shear velocity (Ps) from already acquired zero offset VSP data.

## Our Approach

- In an offshore well, Weatherford experts deployed the SlimWave™ tool to conduct a ZVSP survey. This involved deploying four arrays of three-component geophones in the borehole and an air gun source at the surface.
- The vertical seismic profiles with the source located near the wellhead (zero offset VSP) are a useful tool for 1D study of compressional waves (Pp) and shear waves (Ps).
- The mode conversion in the subsurface generates shear waves with sufficient amplitude and it can be identified and picked for velocity analysis.
- A Hodogram analysis was performed to obtain the shear velocity and maximize shear wave energy, and the reorientation of horizontal X and Y components into horizontal maximum (HR) (or radial component) and horizontal minimum (HT) (or transverse component) was performed.

**LOCATION**
Middle East

**WELL TYPE**
Offshore, development

**HOLE SIZE**
8-1/2 in.

**CASING SIZE**
13-3/8 in. at 2,995 ft (912 m)

**MEASURED DEPTH**
3,865 ft (1,178 m)

**PRODUCTS/SERVICES**

- Wireline services
- Reservoir evaluation system (RES) (6 stations)
- Compact gamma ray (MCG)
- Compact microimager (CMI)
- Compact cross-dipole sonic (CXD)
- Compact array induction tool (MAI)
- Dual laterolog (MDL)
- Compact microresistivity (MMR) tool
- Focused magnetic resonance (FMR) tool
- Compact formation pressure tester (MFT) (30 Points)



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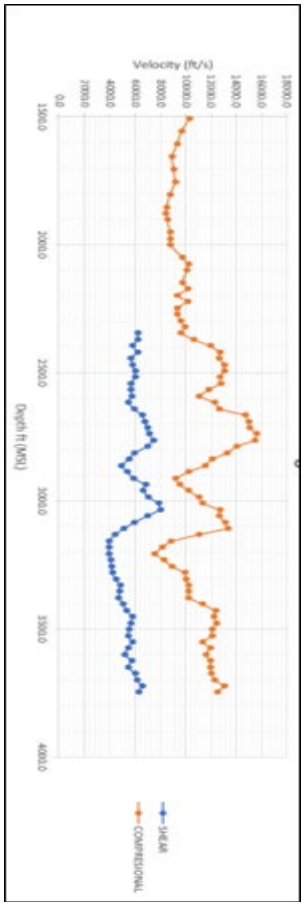
## Our Approach (continued)

- Weatherford experts then used the HR data with the vertical component data (Z) to estimate the down going shear wavefield by using a parametric wavefield separation.
- The shear moveout was picked and measured the lateral displacement of shear wave arrivals on the shear wavefield seismic data. Good correlation was observed between the compressional and shear velocities.

## Value to Customer

- Weatherford's VSP shear processing provided a shear velocity (Ps) profile from zero offset VSP data and its non-rig related product as well as its additional product of zero offset VSP.
- The shear velocity profile helped geophysicists and geologists understand the subsurface mechanical properties of the earth by using shear velocity along with compressional velocity.
- With this data, the customer was able to calibrate the shear slowness to generate the shear synthetic seismogram to study the geological structure around the borehole.




The compressional and estimated shear wave velocity (Ps) comparison.

