

# Sercel Borehole Seismic Solutions S.A.I.D. 2018 Paris

April 5th, 2018



Ahead of the Curve<sup>SM</sup>

# Agenda

- // Industry Needs
- // Current State of Technology
- // Next Step of Technology Evolution



# Industry Needs

- // Overall and sustainable reduction of the service cost
- // Reduction of rig & well shutdown time
- // Reducing the cost of the source
- // Increasing data quality
- // Decreasing turn around time for processing
- // Democratization of the borehole seismic measurement

# Industry Needs - Cost

// Lowering the cost of equipment / trace

// Improving reliability

// Enable use of standard and sub-standard wireline units

// Optimization of the surveys offshore by increased number of levels

// Streamlining synchronisation with the source and surface seismic to cut down time and source cost

# Receivers – Universal, Any Well Type

- // Up to 205°C / 400°F for digital and 260°C / 500 °F for analog
- // Up to 35 kpsi
- // From 2" to 26" well diameter both in open and cased hole
- // Onshore / Offshore
- // Any deviation – up to 70 degrees deviation on wireline; tractors, pipe conveyed or pump down for horizontal wells
- // Conventional wireline from 1 to 7 conductors
- // H2S/Sour Service Capable



# Receivers – Universal, Any Survey Type

- // Any VSP from Zero Offset to large 3D with up to 160 3C receivers
- // Microseismic, with excellent sensitivity, and 3C
- // Telemetry rates with up to 120 3C levels at 2 ms real-time & more on FO telemetry
- // Intertool spacing from 1 meter to 500 meters
- // Array up to 3000 meters
- // Spread array capability
- // Cross well
- // Multiwell acquisition
- // Synchronized acquisition with surface seismic





# Cutting Time & Increasing Safety

## // Quick Rig Up Clamp (MaxiWave и GeoWave II)

- Quick deployment operations
- Safer conditions for the personnel
- System stays powered up during deployment for early fault detection



# Flexibility of Deployment

- // Wireline (up to 4,2 Mbits/s on copper, and >10 Mbits/s on fiber)
- // Cemented (1)
- // On Tubing (onshore / offshore / subsea) (2)
- // Behind Casing (3)
- // Under Tubing on Wireline (4)





# Borehole Acquisition Systems

## Permanent



STPG

## Wavelab II



## Wireline



GeoWave® II



SlimWave®



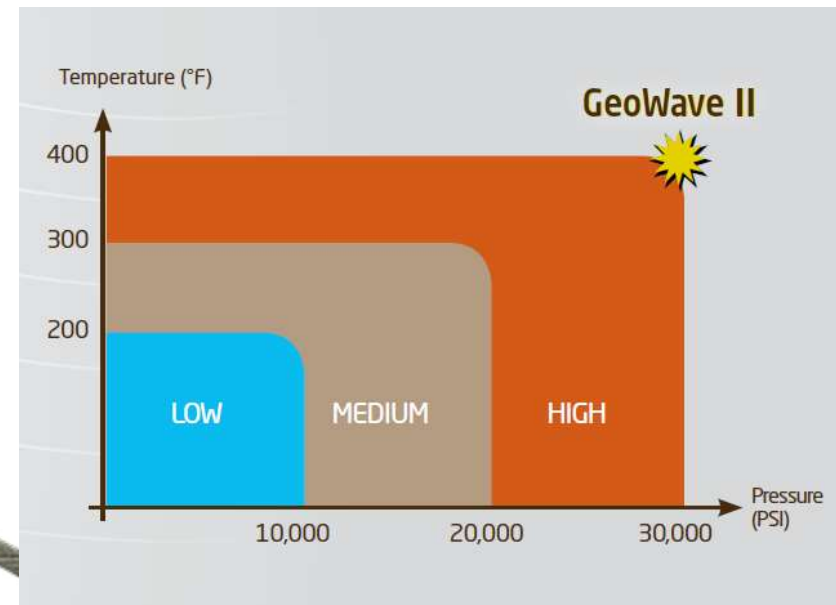
MaxiWave®

# GeoWave® II : Extending Your Frontiers

// The only digital tool on the market capable of continuous acquisition at :

**400°F (205°C) & 30 000 psi (2070 bar)**

**120 Levels (3 components) & 3000 m antenna aperture**



# GeoWave® II

## // Any Well type

- From 3" to 22" well diameter both in open and cased hole
- Deviated well compliant – compatible with downhole tractors for deviated & horizontal wells
- Works on any wireline from 3 to 7 conductors

## // Any Survey type

- Any VSP from Zero Offset to large 3D
- Microseismic, Cross well
- Multiwell acquisition
- Synchronized acquisition with surface spread



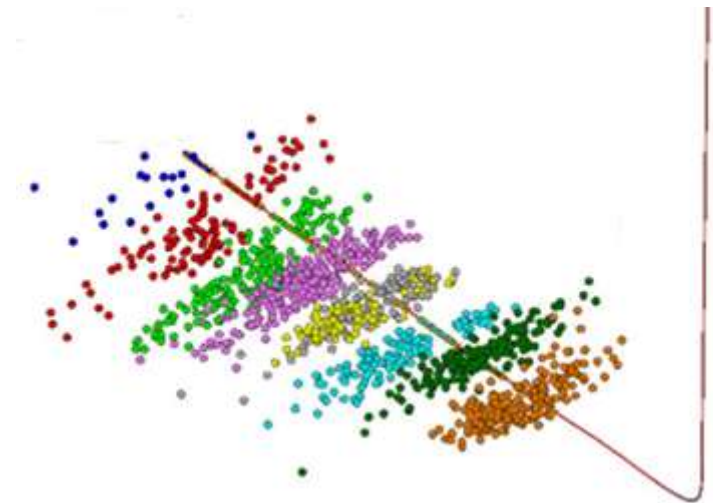
# SlimWave<sup>®</sup> : Monitoring & Slimhole access

## // Ultra slim design

- For wells form 2¼" to 13"
- Access to slim holes, live pressurizes wells
- Deployment through tubing

## // Enhanced flexibility

- Standard single or quad geophone configuration
- Tractor compatible
- Compatible with Sercel GRC Pressure and temperature gauge
- Hermetically sealed option available
- Wide choice of conveyance
  - Heptacable
  - 3 or 4 conductor
  - Coax or monocable
  - Wireline tractor



# SlimWave®

- // Cemented (1)
- // On Tubing (2)
- // Behind Casing (3)
- // Under Tubing on Wireline (4)
- // Wireline
- // Real-time Pressure & temperature



# MaxiWave<sup>®</sup> : Large Seismic Surveys

## // High Productivity

- Up to 100 levels @ 1 ms
- Proprietary deployment system for rapid rig-up
- Full system testing during deployment
- Largest industry track record for 3D operations

## // Enhanced flexibility

- Level by-pass mode in case of failure
- Fail safe spring
- Motorized locking arm
- Standard wireline conveyance

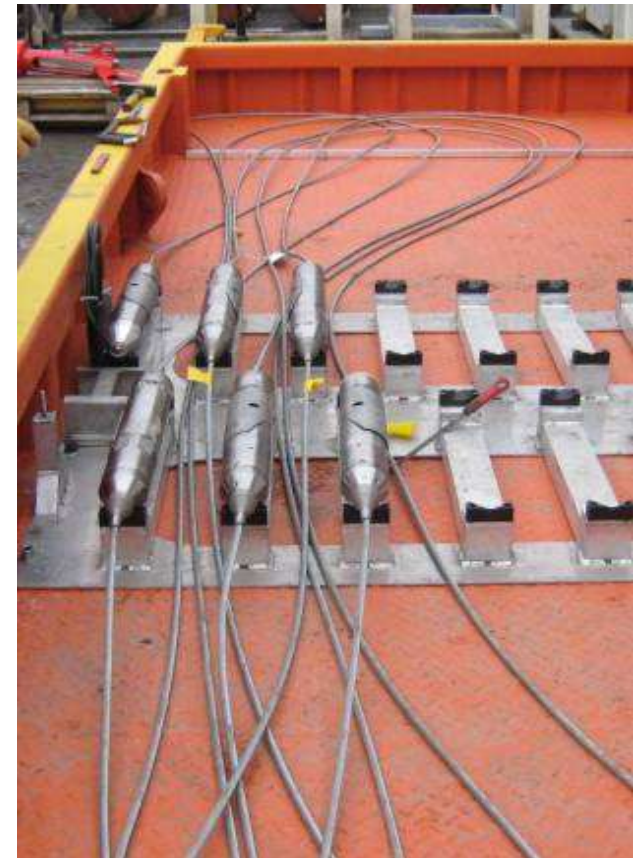




# MaxiWave®

## // Proprietary deployment tool:

- Transportation and Storage
- Excessive rig up / rig down deployment times
- System check
- Performance monitoring during deployment
- Maintenance



# Increasing Quality

- // Continuous improvement of electronics, and sensors reliability
- // Shielding electronics against aggressive well environment to extend the life duration
- // Use of groups of geophones to increase sensitivity for microseismic and far offset VSP
- // Increasing field quality control capabilities

# Getting Extra Value

- // Combining VSP and Microseismic Monitoring
- // Combination with surface seismic & microseismic
- // Recording Pressure & Temperature during monitoring
- // Combining VSP and borehole gravity
- // Combining VSP and EM
- // Better combination of the different methods results to increase borehole seismic value

# Next Step

// Better value per receiver (Quality & Cost of Ownership)

// Better Sensors: Higher Sensitivity, Larger Spectrum,  
Sensor Orientation

// More receivers and better telemetry rates

// Faster deployment

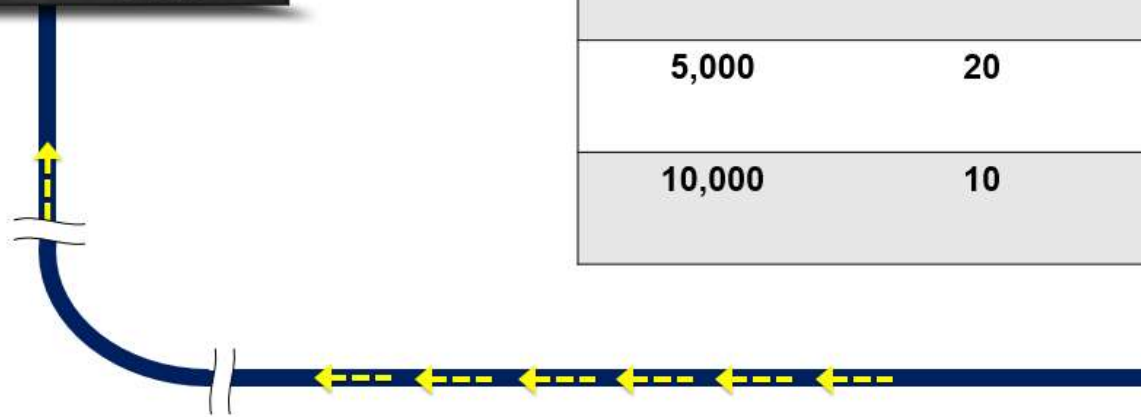
// More measurements, better downhole sources

// And by the way, what about DAS?

# DAS: How it works

## How it works

### Distributed Acoustic Sensor (DAS)



Fibre Length (m)	Max PRF (kHz)	Max Bandwidth (kHz)
2,500	40	20
5,000	20	10
10,000	10	5

# DAS vs. Electronics

// DAS enables increased length of array and number of channels

// DAS enables 4D, in particular in extreme environments

// The primary issues stay overall sensitivity, 1C, directional sensitivity, coupling and depth control

// So, who will win in this Cold War?



# Value

// In the competition, we should not forget the final value.  
Use both, and mix both to increase overall value

// DAS is enabler for 4D

// DAS Above should become the standard for deep offshore 3D, and gradually for onshore

// DAS on wireline, if necessary complemented by a geophone system, should democratize the borehole seismic

# Sercel DAS: Types of Compatible Fibers

// Compatible both with single mode fiber and multi-mode fibers for the following deployments

- ✓ Cemented behind casing
- ✓ On tubing TEC
- ✓ Buried
- ✓ FO wirelines & slicklines
- ✓ Hybrid wirelines (combining electrical and optical)
- ✓ Standard telecom

// Hybrid wirelines enable the hybrid acquisition mixing both electronics 3C sensors and DAS measurement

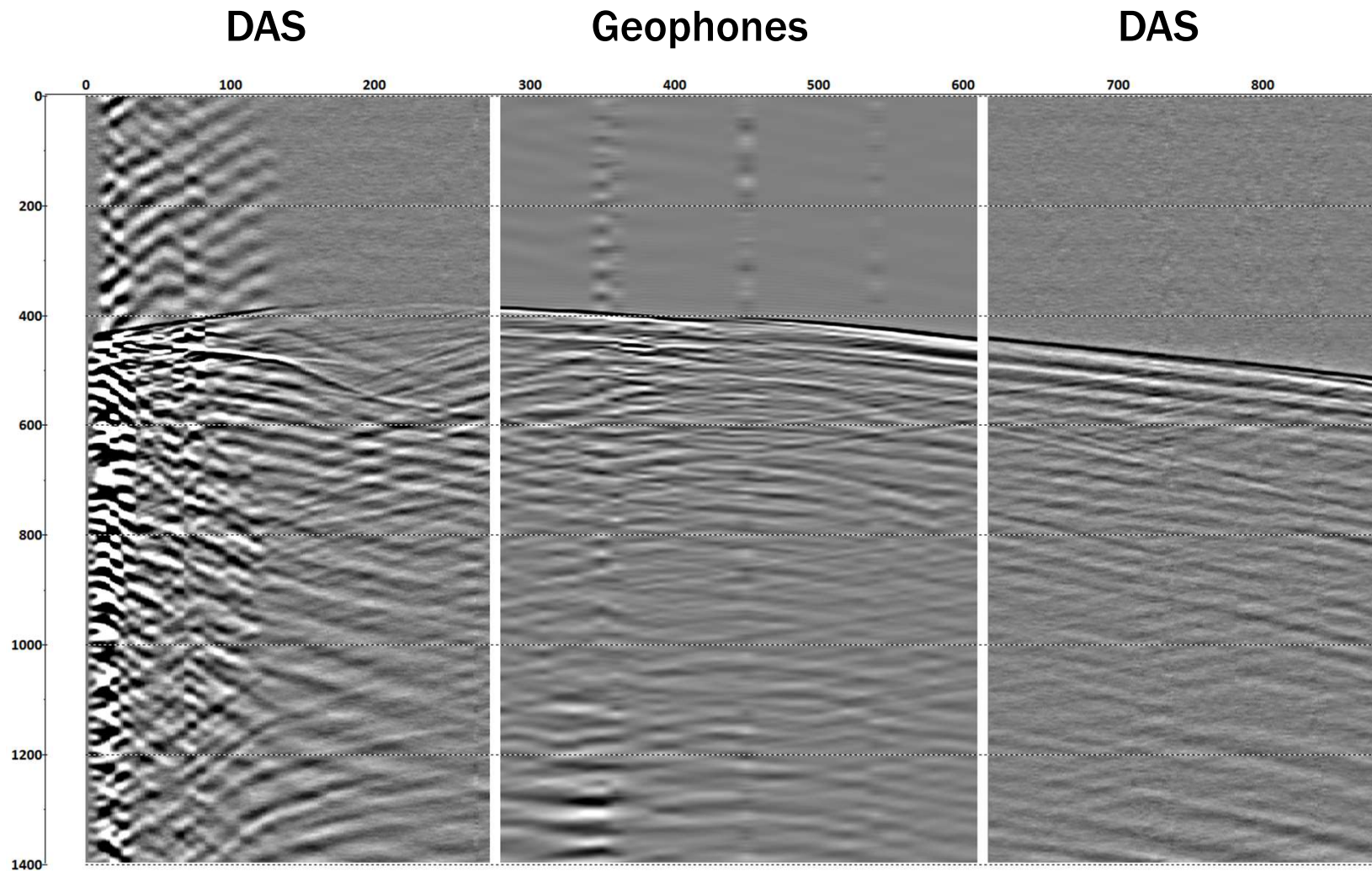
# Key Features – Surface Equipment

- // Low footprint (PC + Interrogator + Source Controller)
- // Ruggedized package
- // No fancy air & vibration control (standard conditions for surface equipment)
- // Compatibility with any type of source
- // Real-time SEG-Y generation, GPS time stamp
- // Access to raw DAS data for detailed analysis
- // Possibility to optimize data stream (stream over network useful part of monitoring while storing all of the raw data)

# HELIOS Interrogator Specifications

- // Gauge Length : selectable (minimum 1 m)
- // Pulse lengths : 3, 5, 10, 20, 50 m
- // Spatial sampling rate : 0.67 m
- // Min. detection frequency : 1 Hz
- // Max. detection frequency : 20 kHz in standard mode and 6.67 kHz in phase recovery mode (at 2.5 km of cable length)
- // Frequency response
  - ❖ 5 km cable: 10 kHz (standard) and 3.3 kHz (phase recovery mode)
  - ❖ 20 km cable: 2.5 kHz and 833 Hz (phase recovery mode)
  - ❖ 40 km cable: 1.25 kHz and 417 Hz (phase recovery mode)

# Far Offset VSP



# Hybrid Systems

- // DAS Above, Along and Below Electronic System
- // 3C capability
- // Sensitivity to enable quality microseismic acquisition
- // Solution for the depth control
- // Solution for DAS directional sensitivity
- // Calibration for DAS sensitivity by using electronics sensor
- // Quality Coupling of the DAS fiber to the wellbore
- // Conventional electronics cannot resist long at very high temperature – the solution “DAS below” would bring the answer to this problem
- // Conventional array cannot cover the whole well – this solution would provide the answer





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