



## BOSS: Borehole Optical Seismic System

The 3-C Borehole Optical Seismic System array is a completely new innovation for Avalon Sciences. The system is entirely passive downhole, with sophisticated electronics remaining at the surface in a controlled environment. The high peak temperature rating (260°C) and solid mechanical coupling system will deliver long term deployment, ideal for deep-well subsalt 4D VSP and high resolution fracture/passive monitoring surveys.

### Functionality

The array utilises 3 component optical omni-directional geophones specially developed by Avalon to cope with hostile deep well conditions. These broadband sensors are low noise, extremely sensitive and will work in any orientation from vertical through to horizontal. Sensitivity, noise floor and bandwidth have been optimised to cover both VSP and fracture monitoring.

The system is fully expandable from a small microseismic 1 level system up to 100 stations for large 3D VSPs. The fibreoptic system can also survive more permanent deployment due to metal to metal C-rings throughout, meaning it can be considered for life-of field installations.

### Deployment Options

There are a variety of standard and bespoke deployment options. Satellites can be deployed via optical wireline, using our patent pending non-electrical passive arm clamp design, or alternatively deployed on jointed or coiled tubing. The array can be spaced at just a few meters or at several hundred meters for total well coverage.

### Specifications

### SEMI/PERMANENT MONITORING SOLUTION

	BOSS Specifications
Max No Receivers	100 Satellites (Up-scalable from 16)
Dynamic Range	>100dB
Bandwidth	1-1200Hz
Distortion	<0.01%
Noise Floor	<50ng/vHz
Max Temp	500°F (260°C)
Max Pressure	20,000 psi / 1400 bar
Wireline	Optical Wireline & Interconnects
Surface Panels	BOSS Interrogator
Sensor	3C OMNI directional fibre optic accelerometer
Tool Dimensions*	905mm/35.6" (L) 43mm/1 11/16" (W)
Tool Weight*	6.14 kg /13.5 lbs
Design Lifespan	20+ years

\*No tool arm

### BOSS Main Features

- Passive Fibreoptic Borehole system
- No downhole Electronics
- 500°F (260°C) Operation
- 20,000 psi (1400 bar) pressure rated
- High Sensitivity and recording bandwidth
- Low Noise

## GeoDAS: Combined Geochain-Distributed Acoustic Sensors



### GeoDAS Main Features

- Combined fibre wireline enabling DAS from surface down to top 3C Geochain receiver
- Expands VSP 3-D aperture without compromising depth calibration & resolution
- Retrievable system for short term or semi/permanent operation
- Reduced rig time for instant full well check shot
- Migrate large offset VSP multiples for 3D VSP imaging. Tractor Compatible.

GeoDAS is the next evolutionary application for the versatile Geochain™ borehole seismic system.

When deployed using a combined fibre/conductor wireline, the Geochain-DAS establishes a complete VSP digital seismic solution offering total well coverage from surface without the conventional standalone DAS attributed uncertainties of depth calibration, directionality and noise.

The system is made up of individual satellites of our tried and tested 3-C ASR/GSR borehole geophones arranged below the DAS integrated wireline.

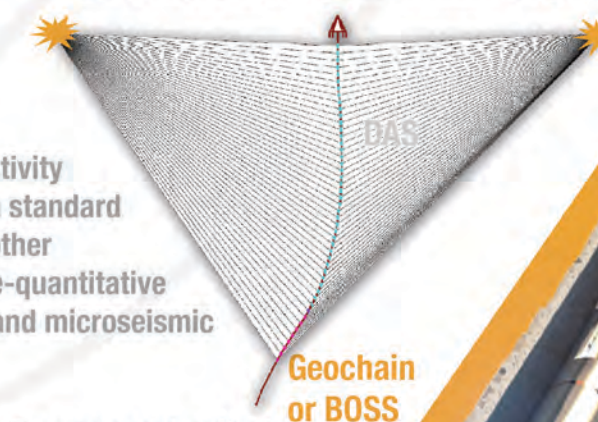
The GeoDAS arrangement has already been deployed commercially in the Gulf of Mexico to acquire full 3DVSP well coverage with minimal rig time.

## SULIS: DAS Interrogator

Sulis is a high-performance rugged, compact, distributed optical fibre sensor interrogator.

Built on novel optics, Sulis provides very high sensitivity distributed measurements of phase changes within standard optical fibres. There is no need for mirrors or any other components in the sensor fibre. Sulis makes phase-quantitative measurements and is well suited to both DAS VSP and microseismic monitoring applications.

Combine Sulis with ASL conventional Geochain™ or 3-component optical BOSS™ systems to realise a massive seismic receiver through the overburden with high resolution 3-component sensors through your reservoir.



Geochain™ 3-C X-Series 195°C rated borehole seismic receiver system with inbuilt high side indicator deployed in lower / lateral well section below DAS wireline cable



## SULIS: DAS Interrogator Specifications

OPTICAL	
Laser Hazard	Class 1m
Fibre type	Single Mode
Fibre loss (dB/km)	<0.2
Max Spurious back-reflection (dB)	-60
Max Range (km)	20
Measurement gauge length (m)	Selectable 5-20
Fibre sampling rate (m)	0.4, 0.8, 1.2
OUTPUT	
Output sample rate (Hz)	100, 1 000, 10 000, 20 000
Recording	Continuous
Max on-board Storage (TB)	1
Time Stamp	GPS derived
Output format	Raw – converted to SEG-Y offline
Display	Real time waterfall indicative display
PERFORMANCE	
Measured Parameter (Radians)	Integrated phase change within gauge length
Measurement Distortion (THD) (%)	<0.1%
Frequency Response (Hz)	0.5-500
Sensitivity (dB re 1 rad VHz)	<-63 @ 3.7km
Measurement Availability (%)	>99 @ 10km
Maximum rate of phase change (radians/sec)	2000 (6km range)
GENERAL	
Operational temperature	5-30°C
Max external vibration level (1-80Hz . m/s <sup>2</sup> )	<0.03
Panel Size	8U
Mass (kg)	<50
Power Requirements	240/120VAC <1kW

### SULIS DAS Main Features

- 20 km receiver length
- 5-20m gauge length
- Real time coherent data
- Wide bandwidth (0.5-500Hz)
- 300°C Max Temperature
- 30,000 psi Pressure Rating
- Interfaces to standard ASL panels for combined 3 component and DAS operation

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## Avalon Sciences Ltd

Avalon Sciences Ltd (ASL) designs and manufactures advanced borehole seismic equipment for Vertical Seismic Profiling (VSP), permanent/passive seismic monitoring, well/reservoir characterisation and hydraulic fracture event detection.

ASL has been at the cutting edge of borehole seismic technology innovation, design and manufacturing for nearly 30 years. A household name in VSP and downhole microseismic equipment, ASL is dedicated to providing the best solution to meet the client needs and the greatest possible customer service and support, both remotely and on-site.

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## BOSS™ & DAS

3C BOREHOLE OPTICAL SEISMIC SYSTEMS  
& DISTRIBUTED ACOUSTIC SENSING



FIBREOPTIC SYSTEMS