Integrated Distributed Optical Fibre Sensing System

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Silixa in summary

We are the global leading provider of **fiber-powered data solutions** that solve the **most critical measurement challenges** in the **Alternative Energy, Mining, Environmental & Earth Sciences, Infrastructure and Oil & Gas sectors**

Our suite of **integrated distributed fiber optic technologies** provides **dense array data sets of the highest fidelity.**

Our **dedicated teams**, with **sector-matched expertise and highly diverse skillsets**, deliver **world class real-time data solutions**. These enable our clients to gain **actionable insight** into their assets and systems to **increase efficiency, prevent loss, reduce operational costs and extend lifespans**.

We hear more, We see more

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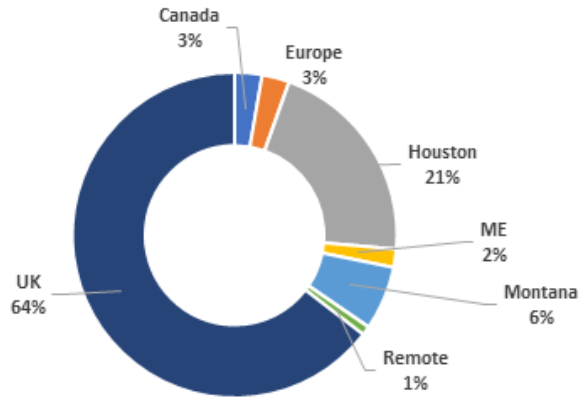
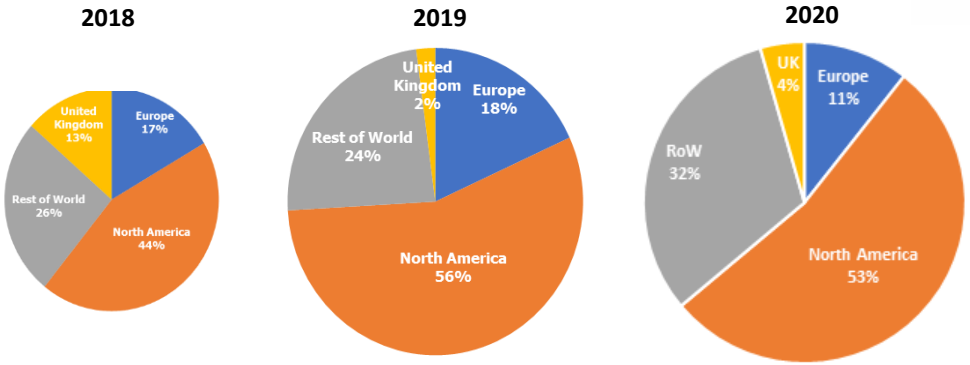
Activities Geographically Diversified Across the Globe

Employee Location



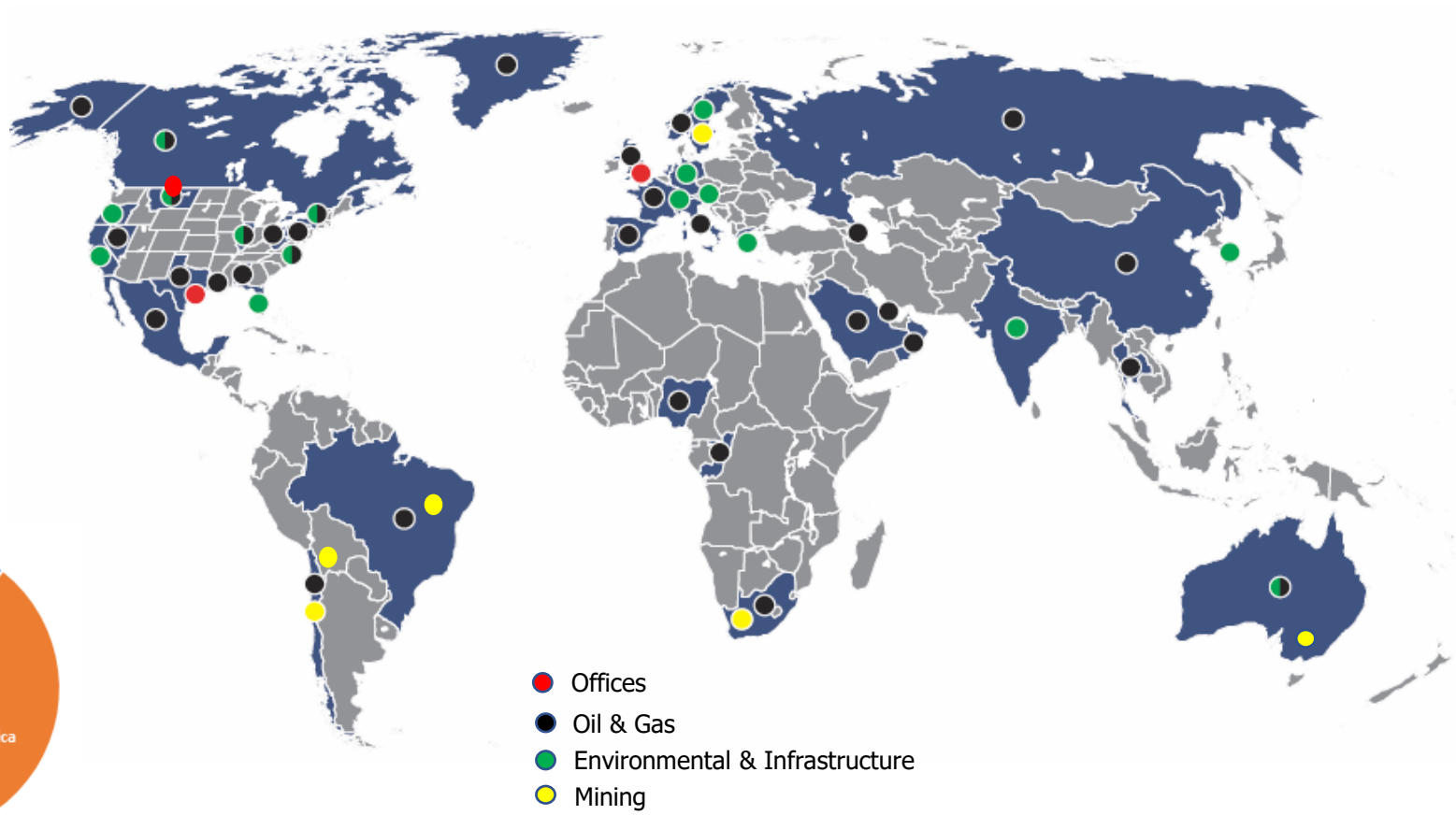
Global Revenues



+107% YoY

+10% YoY

Operational Footprint



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2009 Chevron

2010 LIME ROCK PARTNERS

2012 equinor

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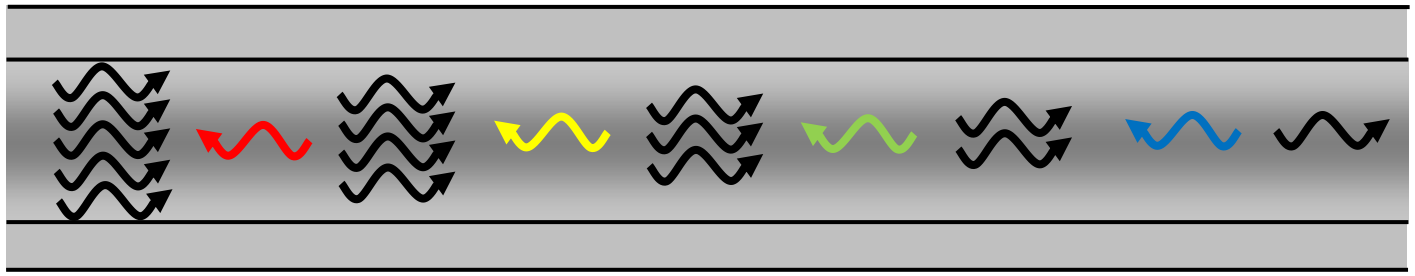
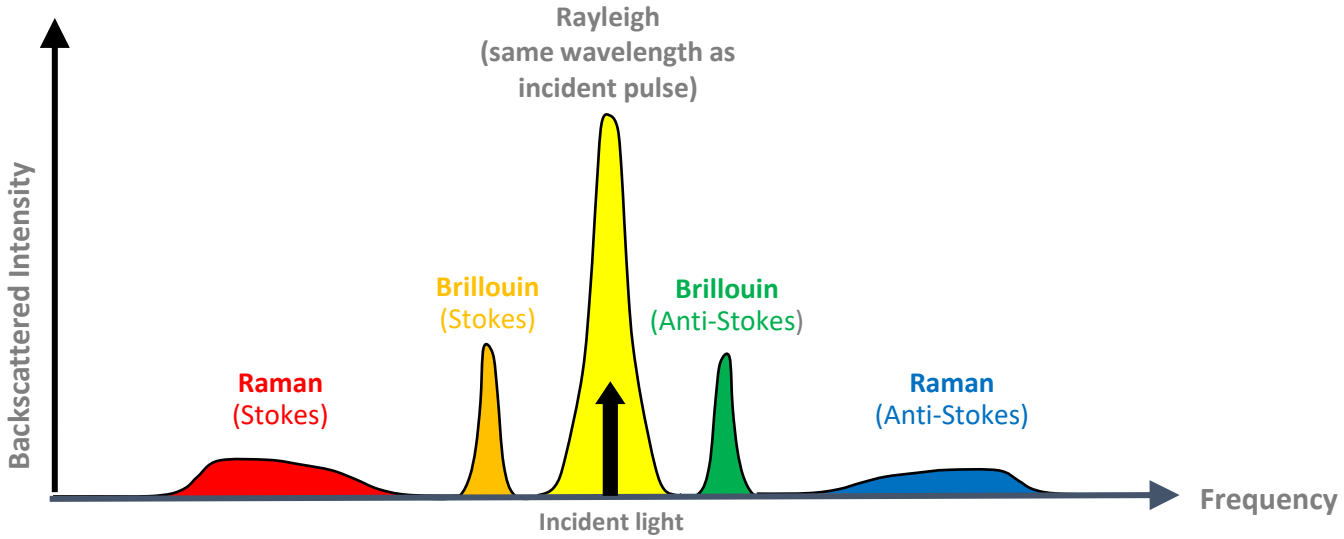
Optical fibre scattering mechanisms





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iDAS

intelligent Distributed Acoustic Sensor

- Simultaneous measurement of acoustic amplitude, phase and frequency
- 40,000 independent measurement points
- *Acoustic phased array detector*

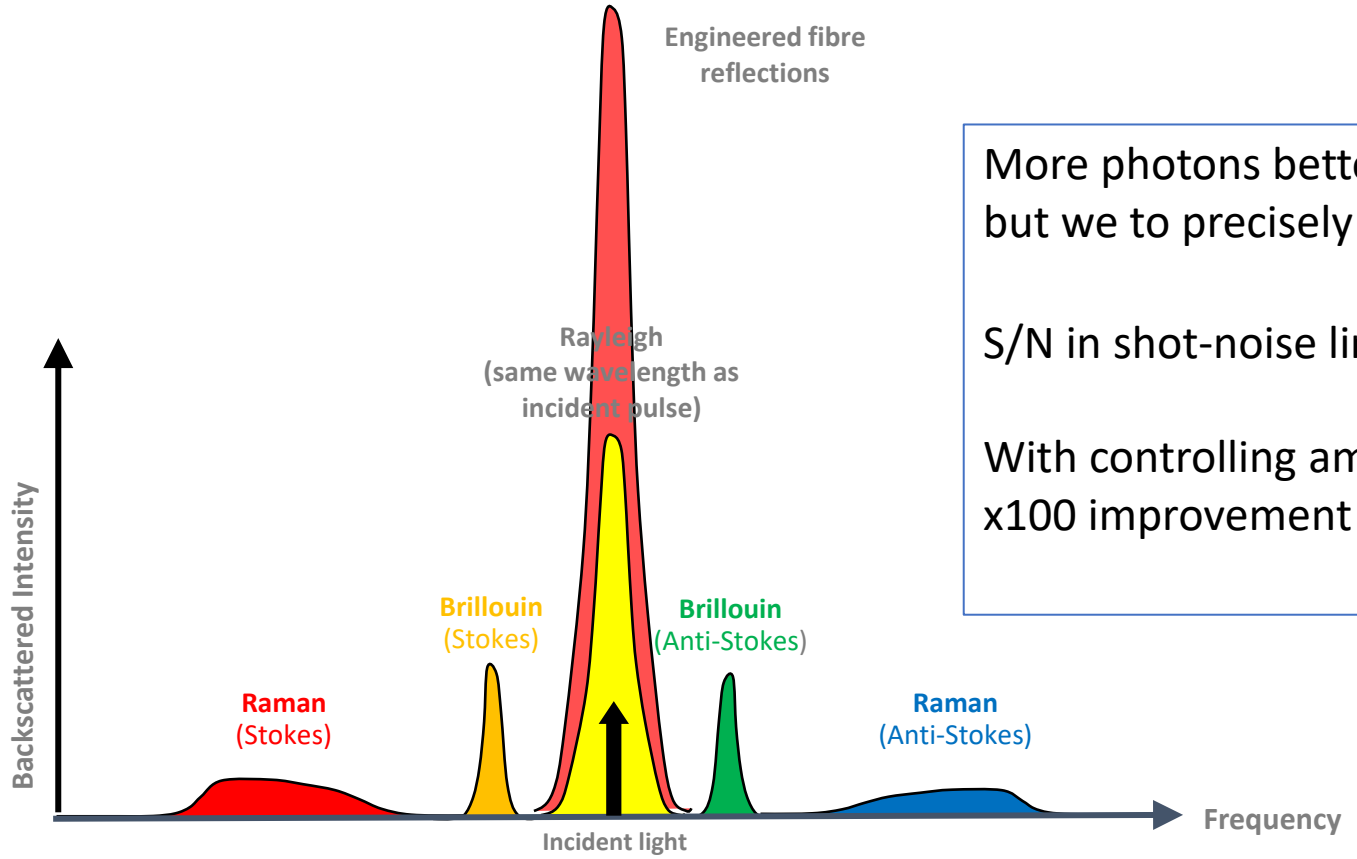
Acoustic field

Optical fibre

Laser pulse propagating through the fibre

Backscattered light returning to iDAS

Engineered optical fibre



More photons better Signal-to-noise ratio but we to precisely control the phase

S/N in shot-noise limit $\longrightarrow \sqrt{N}$

With controlling amplitude and phase we get x100 improvement in signal-to-noise ratio

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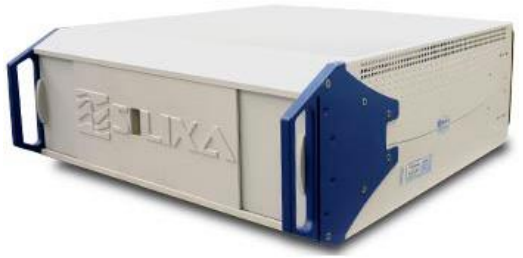
Silixa Technology

- **Temperature - ULTIMA™** and **XT** provide measurements to an accuracy of 0.01°C and a class-leading spatial resolution of 30cm, over a wide operating temperature range.
- **Acoustics - iDAS™** technology enables high-quality digital recording of acoustic waves at every metre along many kilometres of optical fibre cable.
- **Carina ™–** Engineered Optical Fibre Sensing System enabled with **Constellation ™ fibre**
- **DSS - Distributed Strain Sensor**
- **FibreRuler**

Ultima DTS

XT - DTS



iDAS

Carina

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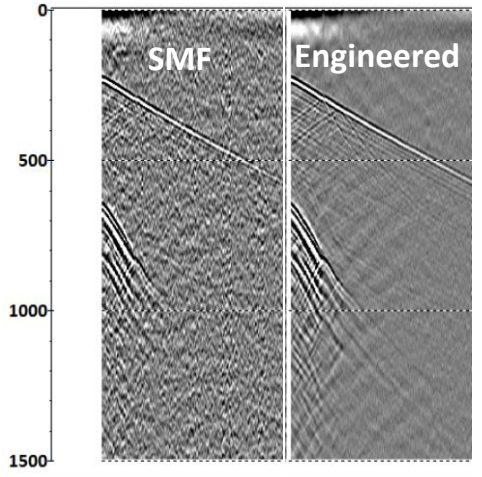
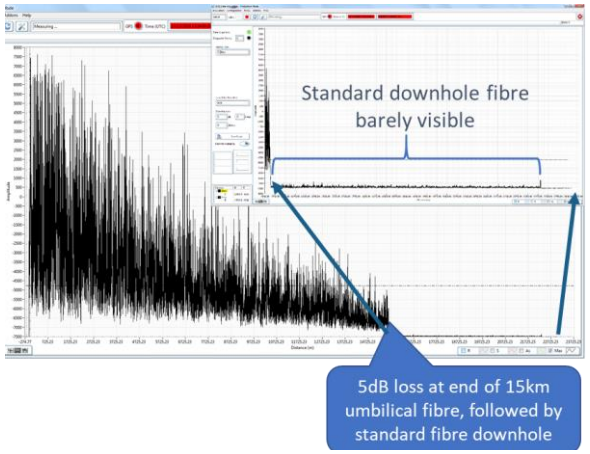
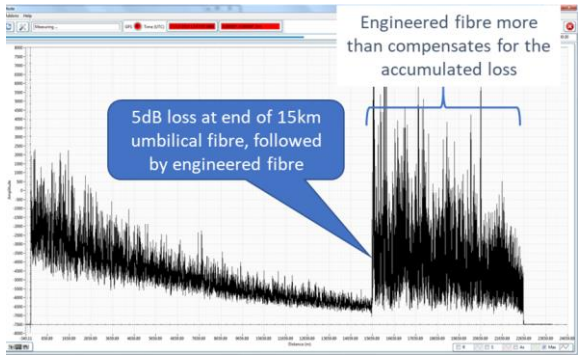
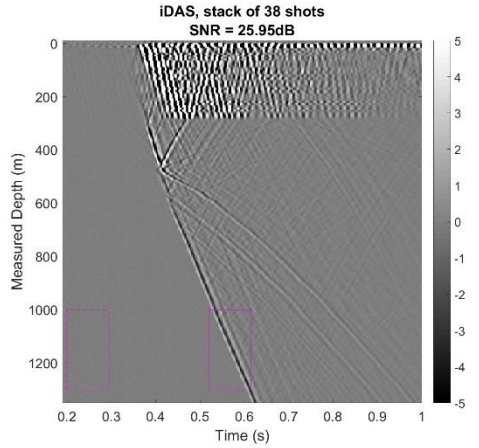
Engineered Constellation Fibre Advantages

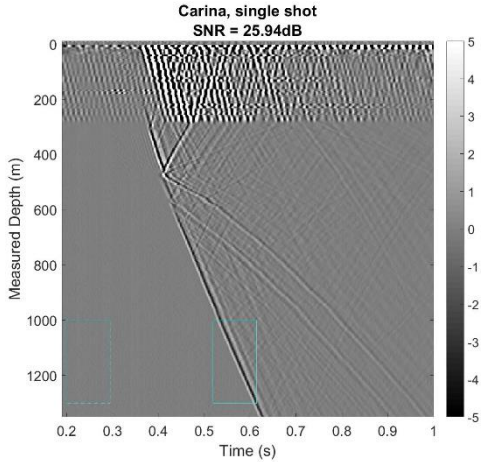
- Higher signal to noise
- Lower source energy/fewer shots
- Increased loss tolerance
- Wider dynamic range
- Control – optimized performance where needed
- High-performance low frequency response











Tom Parker, Silixa; “Advanced Geophysical Measurements Using an Engineered Fibre Optic Acoustic Sensor”; EAGE, London; June 2019

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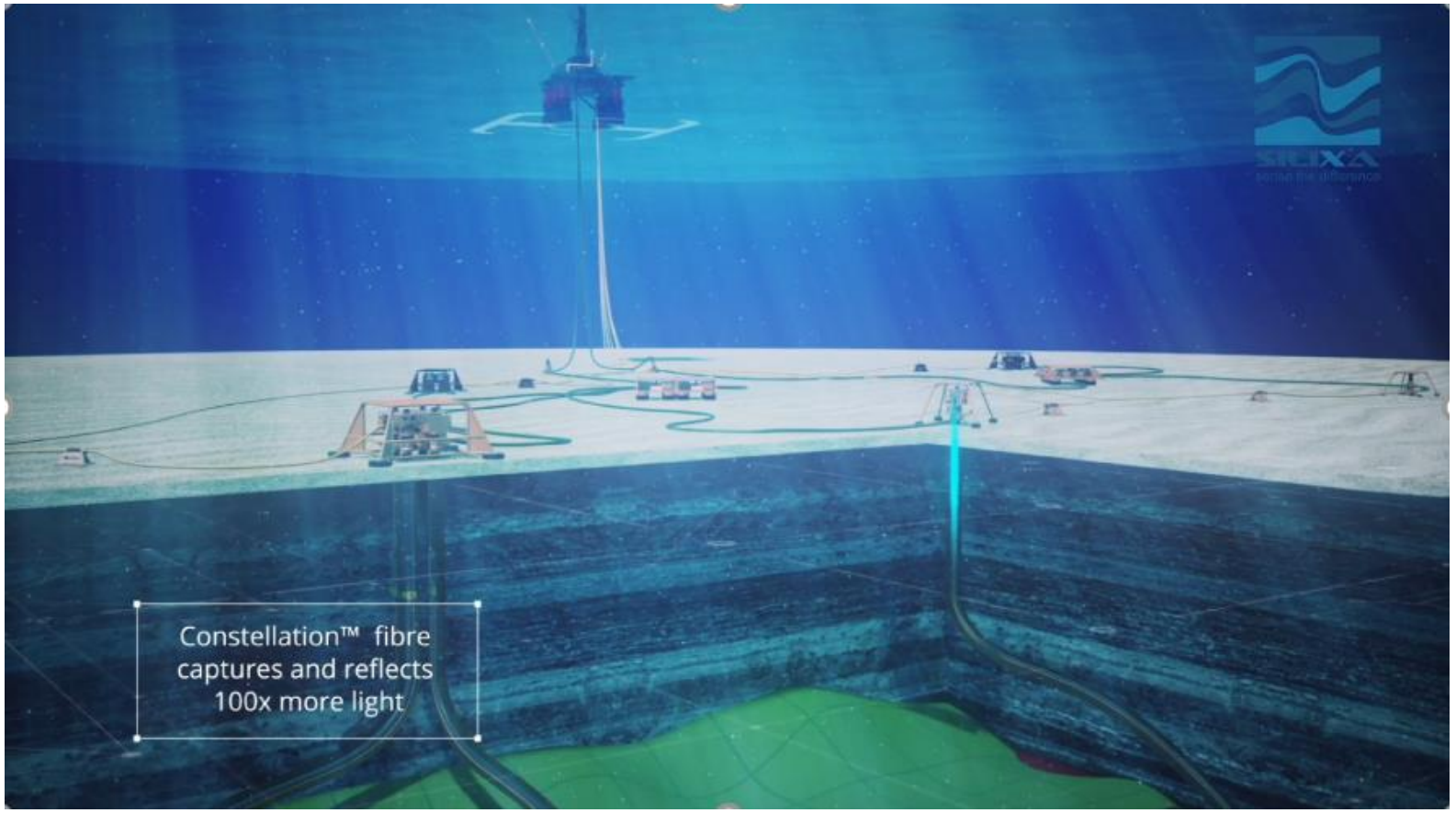
Carina® Subsea 4D Deepwater Pre-Salt Permanent Reservoir Monitoring



- Creates a step change in the cost of acquiring data from long tie-back pre-salt repeat seismic for reservoir management.
- Constellation™ “engineered” fibres deliver 100x SNR overcoming connector losses & seismic attenuation in salt layer
- bp Atlantis Gulf of Mexico 1st Subsea installation of DAS
- 2,200m water depth
- 15km tieback, optical interogators on semi-sub platform
- Well accessed through existing optical fibre in umbilicals

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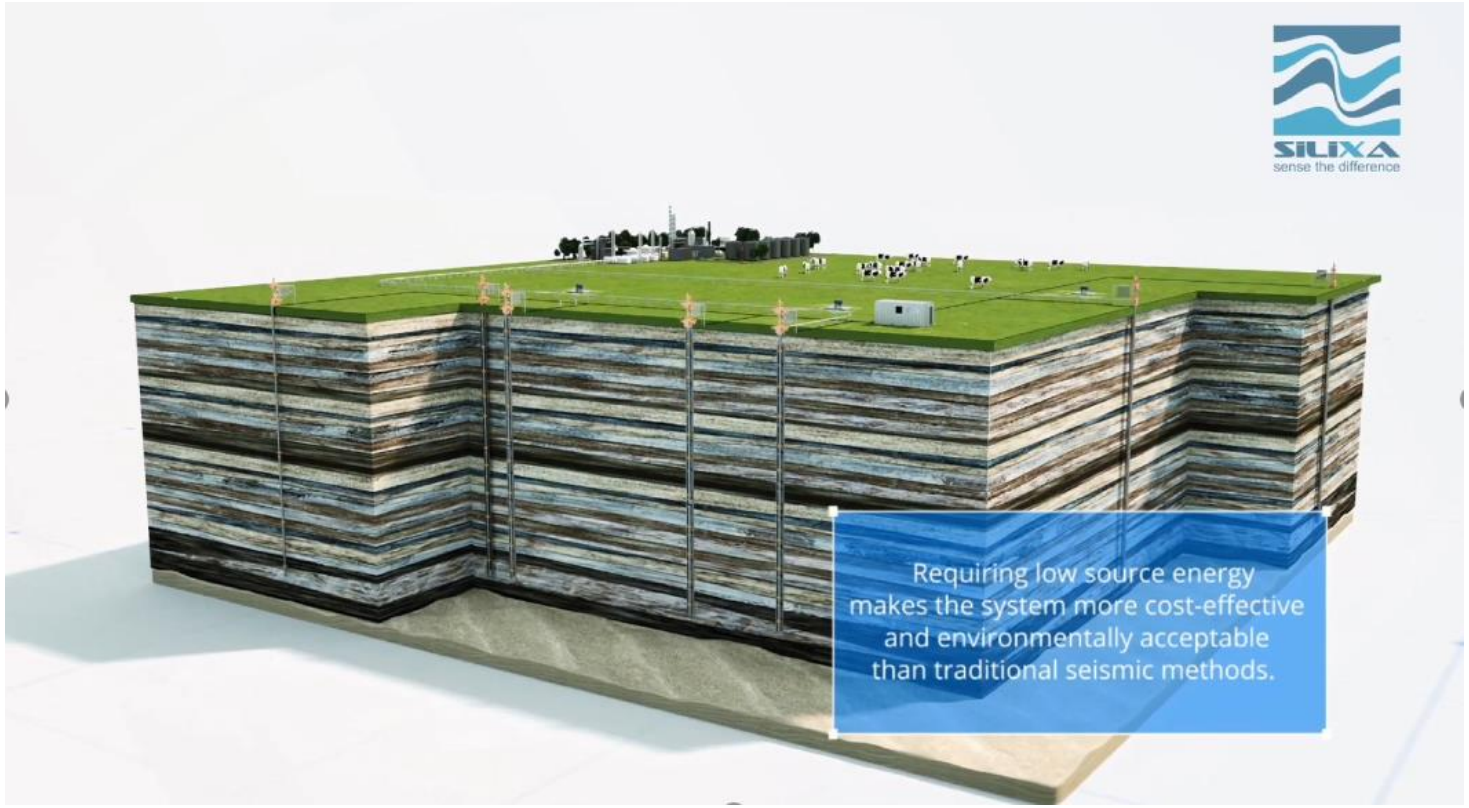
Carina® CarbonSecure™ Seismic Monitoring of CO_2 Geological Storage



- Carina ® Sensing System cost effective permanent monitoring solution because of the 100x improvement in SNR requires much smaller seismic sources or <u>just ambient noise!</u>
- Seismic methods suitable for CO_2 monitoring.
- Seismic signals sensitive to changes in CO_2 saturation
- CO_2 injected into the reservoir causes a change in seismic response, travel time & amplitude
- Repeat time-lapsed seismic surveys will identify amplitude differences caused by CO_2 saturation
- Development of CO_2 plume and migration into faults or shallow subsurface can be tracked.

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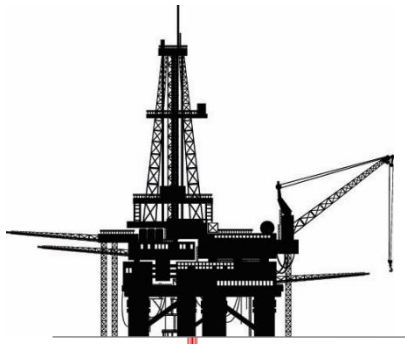
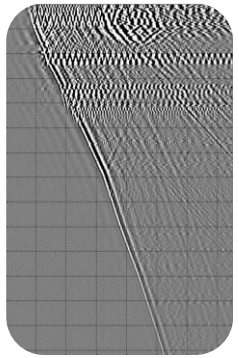
Silixa’s fibre optic vision for wells



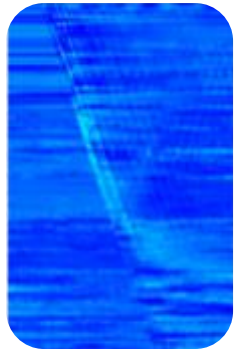
one fibre - life of field - multiple services

Single FO Cable Installation

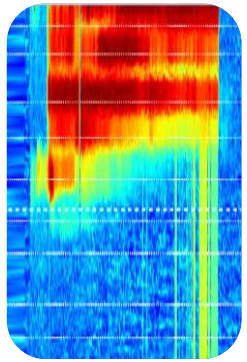
Borehole seismic



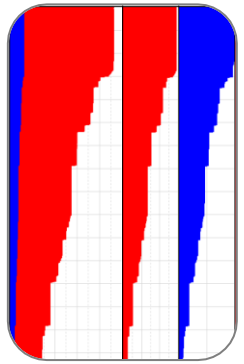
Cement evaluation



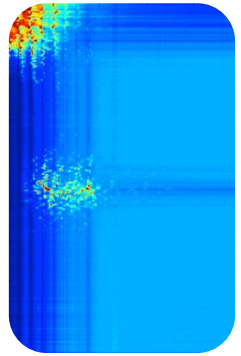
Fracture analysis



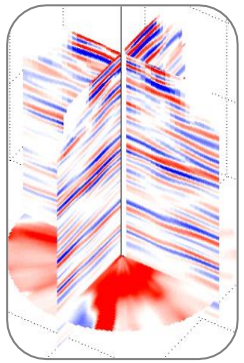
Flow profiling



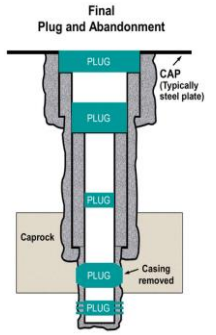
Casing leak, gas lift optimization



Repeat seismic 3D/4D



Well abandonment



DRILLING → COMPLETION → PRODUCT/RESERVOIR MANAGEMENT → WELL ABANDONMENT

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Scope for further improvements and collaborations

- Lasers technology: spectral control, polarisation control, modulation
- Fibres with enhanced properties for sensing applications
- New engineered sensing cables and installation methods
- Low-loss high power optical fibres for remote applications
- Noise reduction in optical receiver chain
- Improved remote amplifications
- Noise reduction in optical-acoustic signal conversion
- New optical signal processing
- Fast data processing and data transmission TB/day/well
- Machine Learning
- Quantum computing

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