




1

Silixa – Introduction


About Silixa

- Established in 2007
- 80 specialists in science, engineering
- backed by 3 major investors.


2009



2010




2012



What we do

- Fiber Optic Monitoring Solutions
- Engineer and Manufacture DAS and DTS interrogators
- Constellation Engineered Fiber – Carina™ iDAS


Our industry footprint



- Offices
- Oil & Gas
- Environmental & Infrastructure
- Mining

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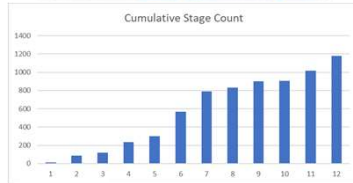
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Silixa Experience and Track Record

Permanent Installations 2015 - 2019



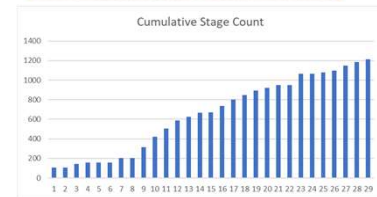
Research Project



Tactical Callout

- >3500 frac stages monitored cross-well strain
- >1500 frac stages monitored frac allocations
- >1000 stages monitored with microseismic

Xwellxpress 2018 - 2020



3

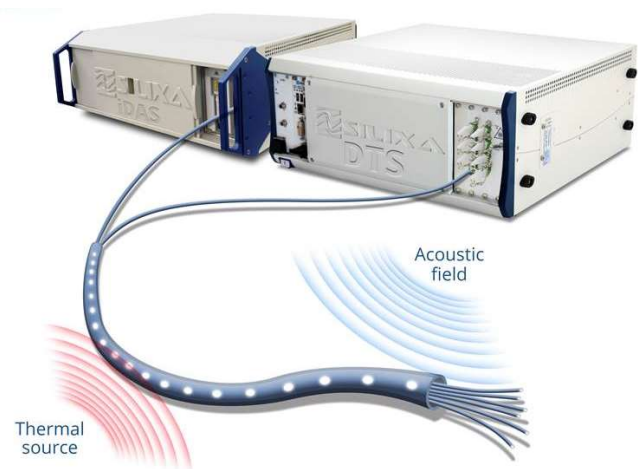
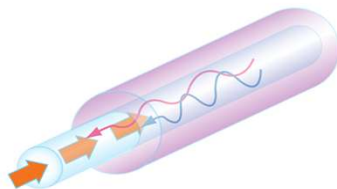
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Distributed Sensing – DTS and DAS

Loss mechanisms are useful!

- Rayleigh Scattering: scattering caused by microscopic density and refractive index variations (DAS)
- Raman Scattering: the interaction of light photons at molecular energy levels (DTS)
- Light enters optical fibers, scatters in the glass and returns. The further away the source of scatter, the less light comes back to the detector



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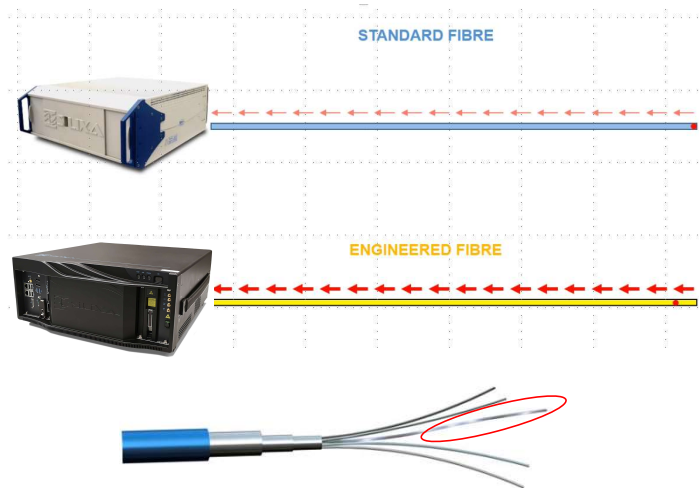
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Next Generation - Engineered Fiber Optic Sensing – Carina®

- DAS SNR is largely governed by how much light can be usefully collected from the optical fiber
- We want low loss fiber – to achieve *long range*, but high scattered fiber – to get *more signal*
- This apparent contradiction is overcome by engineering bright scatter centers along the fiber without introducing significant excess loss in the forward propagating scattered light
- Typically, 20dB (100x) more light is generated than from standard fiber



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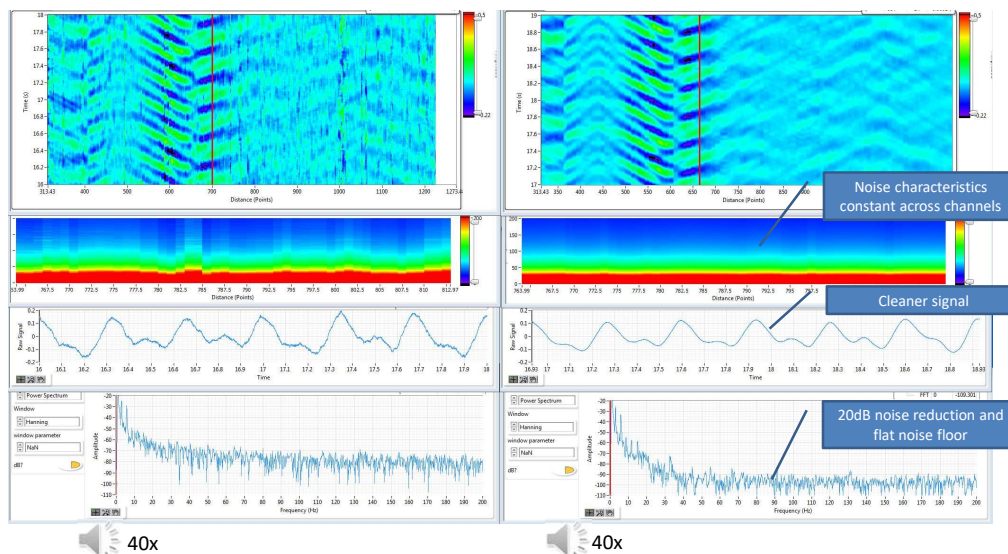
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Engineered Fibre Optic Sensing – Improved Single to Noise



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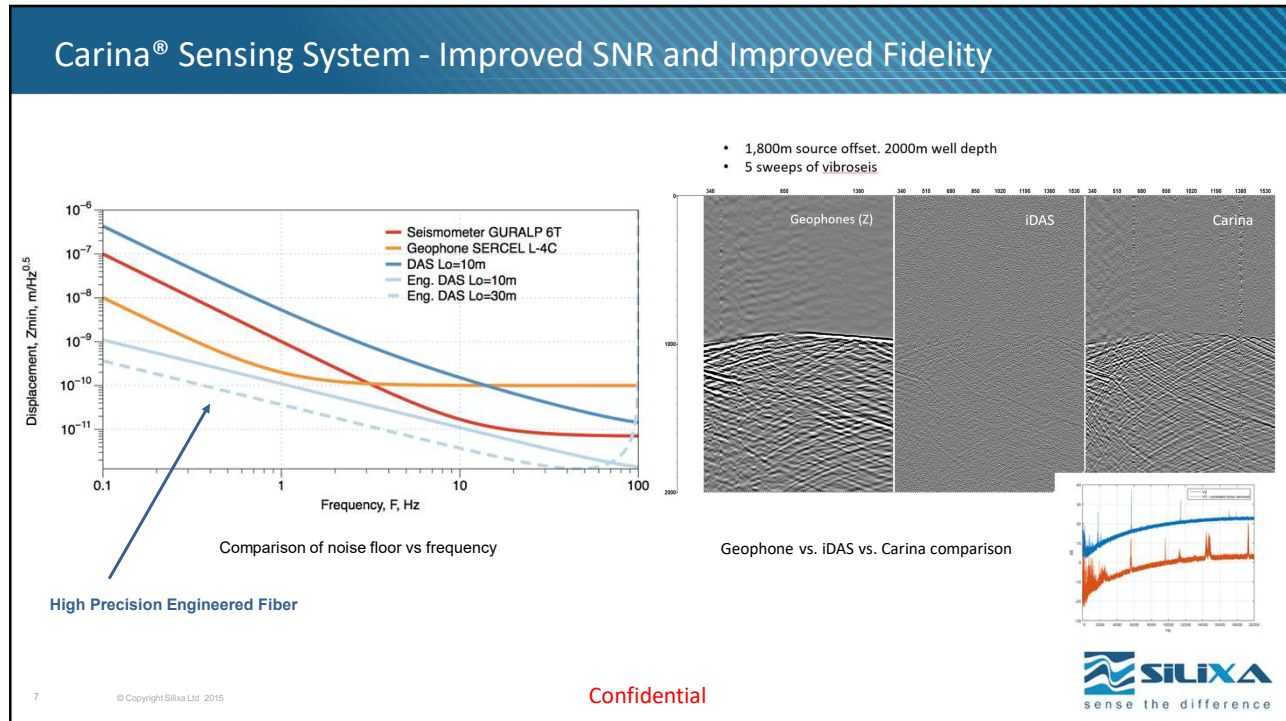
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Data collection courtesy Aqistore Project: PTRC/GSC/LBNL/JOGMEC



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XwellXpress – Wireline Deployment

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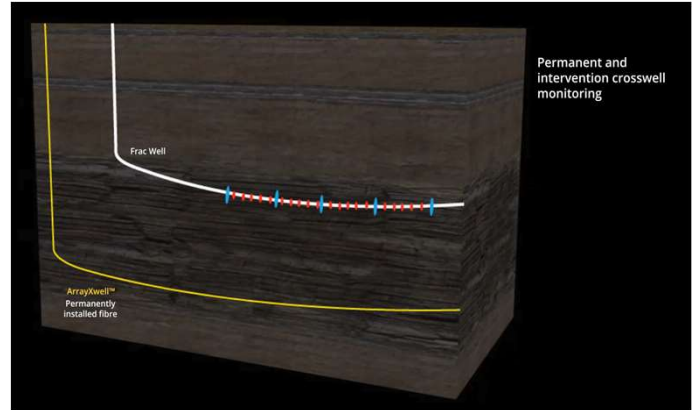
Silixa Carina® XwellXpress™ – Realtime Solutions

Historical Challenges with Permanent FO installations

- Cost of deployment
- Risk of deployment
- Planning cycle
- Time to receive answers

XwellXpress – Wireline Solutions

- Lower equipment and personnel requirements to monitor
- Call-out service
- Cross-well to determine cross-well and reservoir interaction
- Real Time Answers -
 - Frac hits
 - Frac Azimuth
 - Frac Transit time
 - Strain Intensity
 - Well spacing
 - Microseismic SRV



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Carina® XwellXpress – Acquisition Equipment and wellsite setup

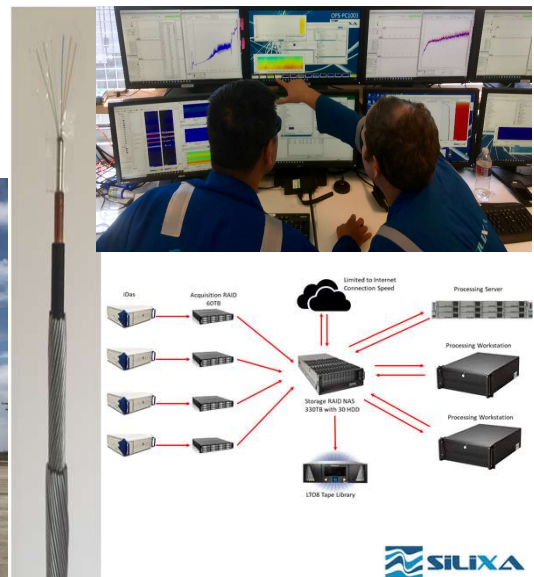
Silixa Monitoring Cell

- Wellsite Acquisition Unit
- Wireline Deployment Unit
- Field Acquisition Personnel
- Real Time Processing and Answer Products



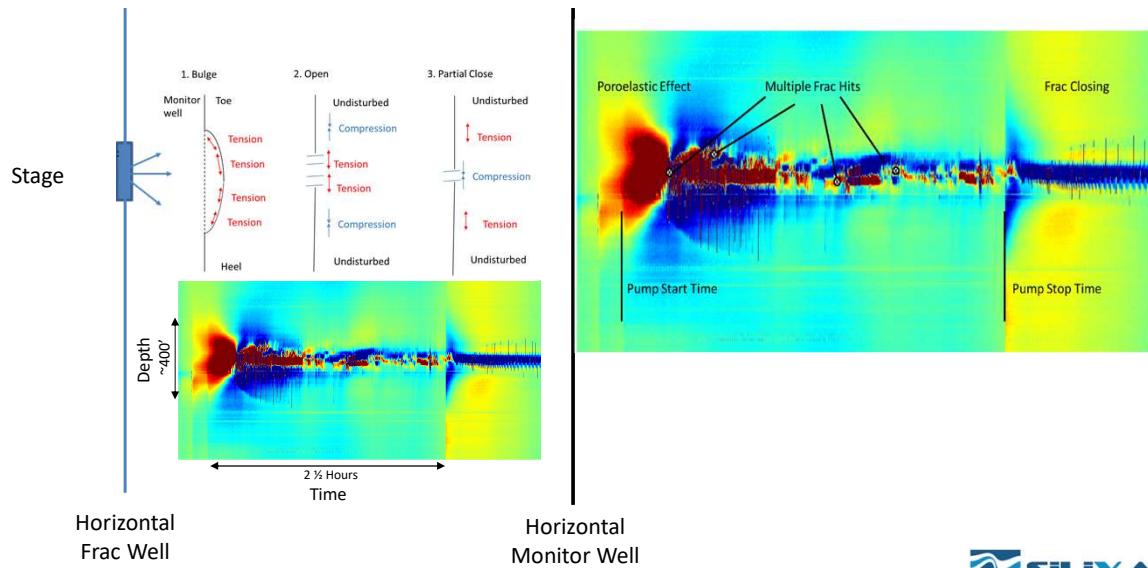
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Carina® XwellXpress™ - Crosswell Strain Concept



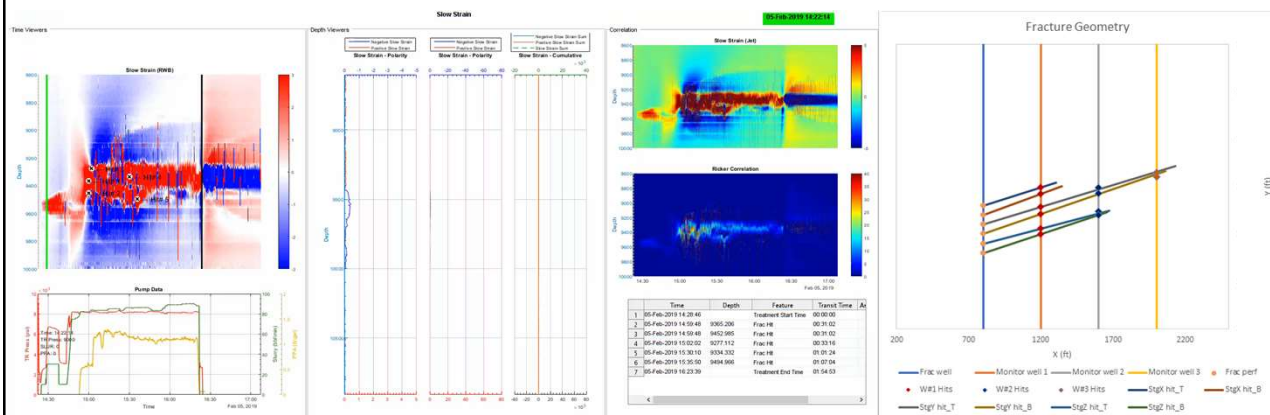
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Carina® XwellXpress Frac Hit Identification

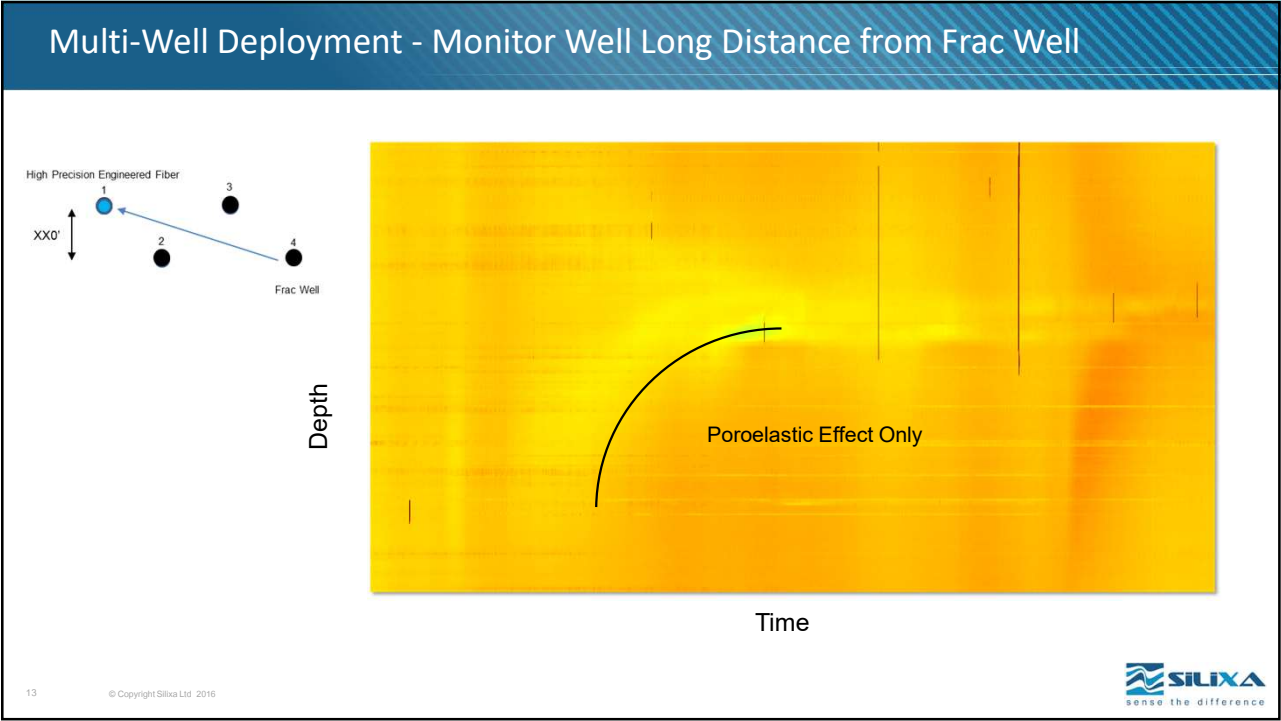


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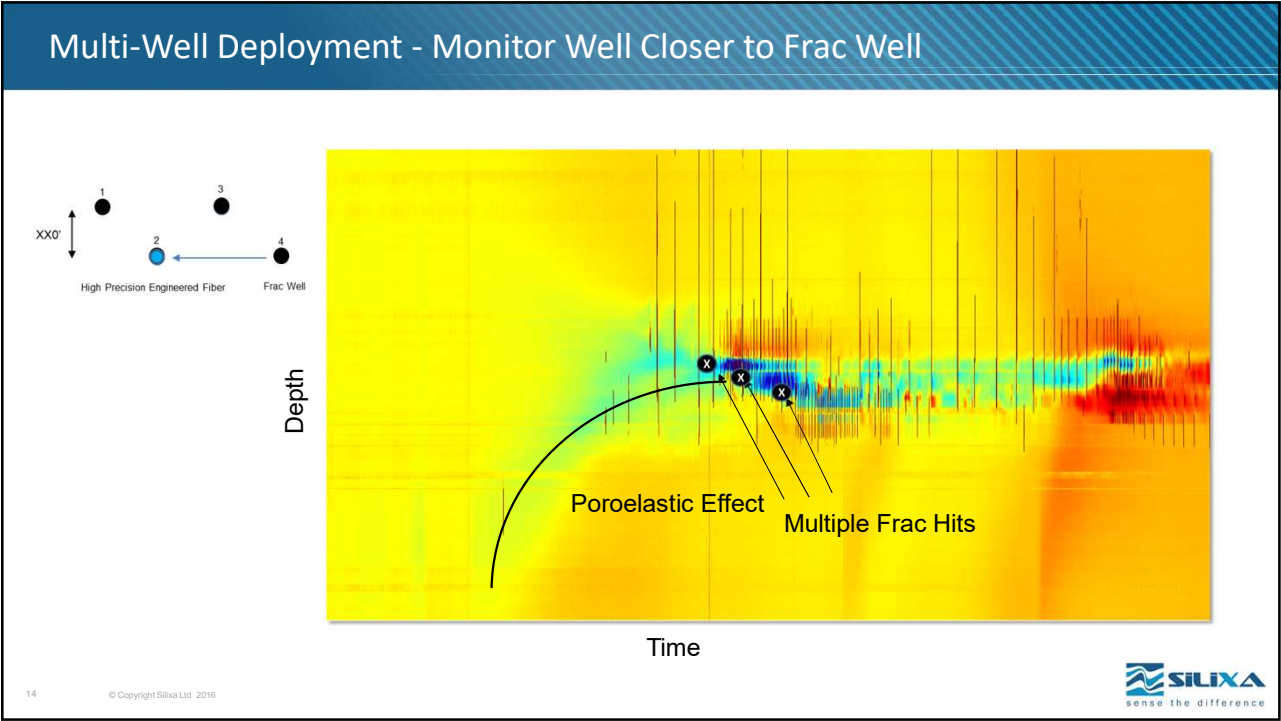
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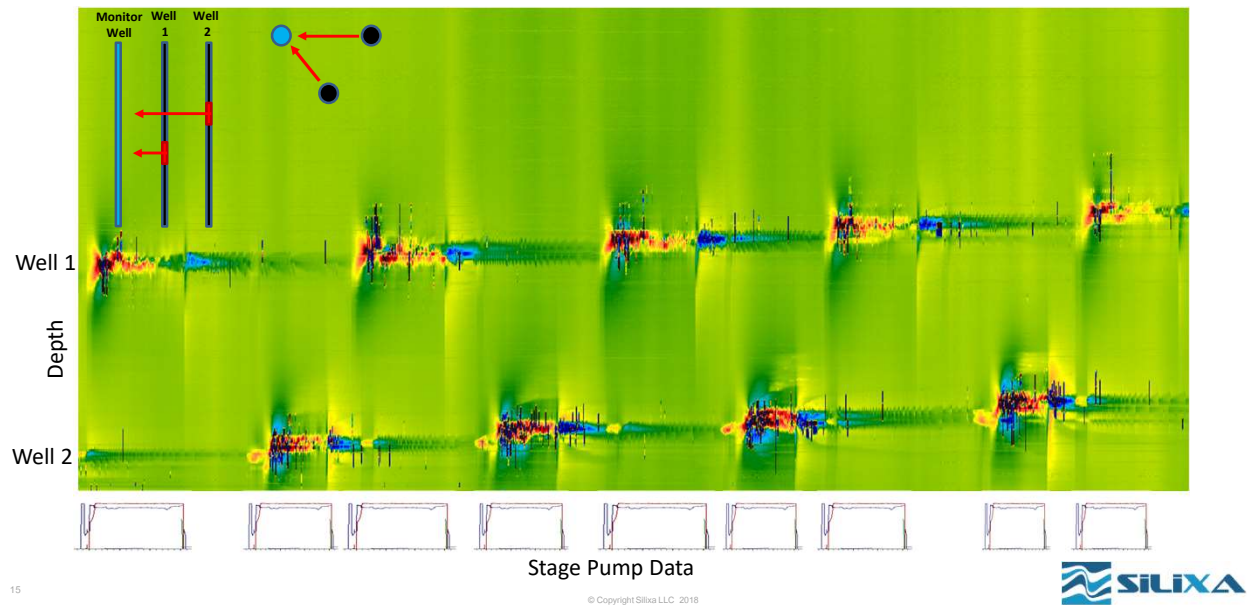


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Carina® XwellXpress™ - Map View Strain Multi-Stage Plot

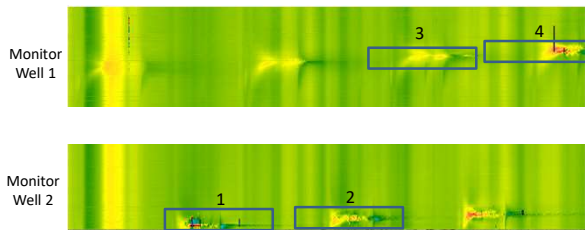


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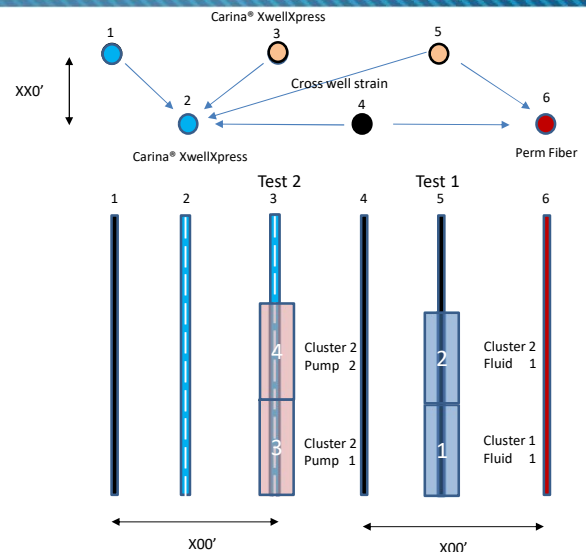
Carina® XwellXpress - Allows Flexibility in Project Designs - Concept

Design Considerations

1. Cluster Spacing
2. Pump Rate
3. Diversion
4. Well Spacing
5. Fluid Type



Measure - Change - Measure - Validate - Implement



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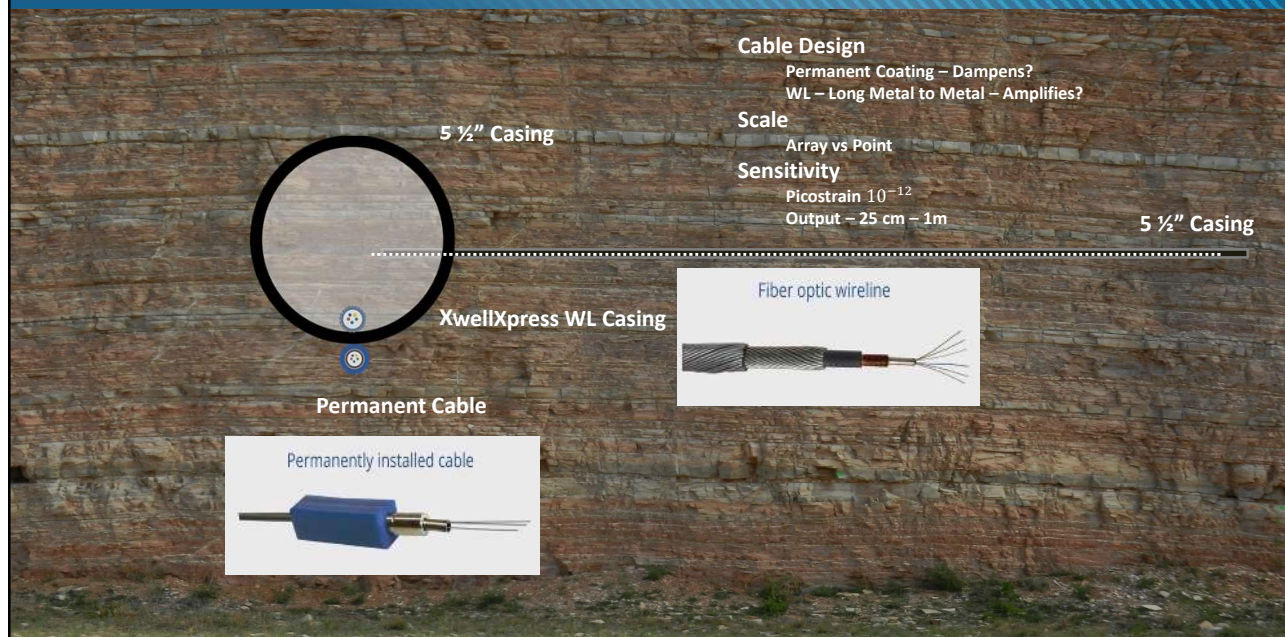
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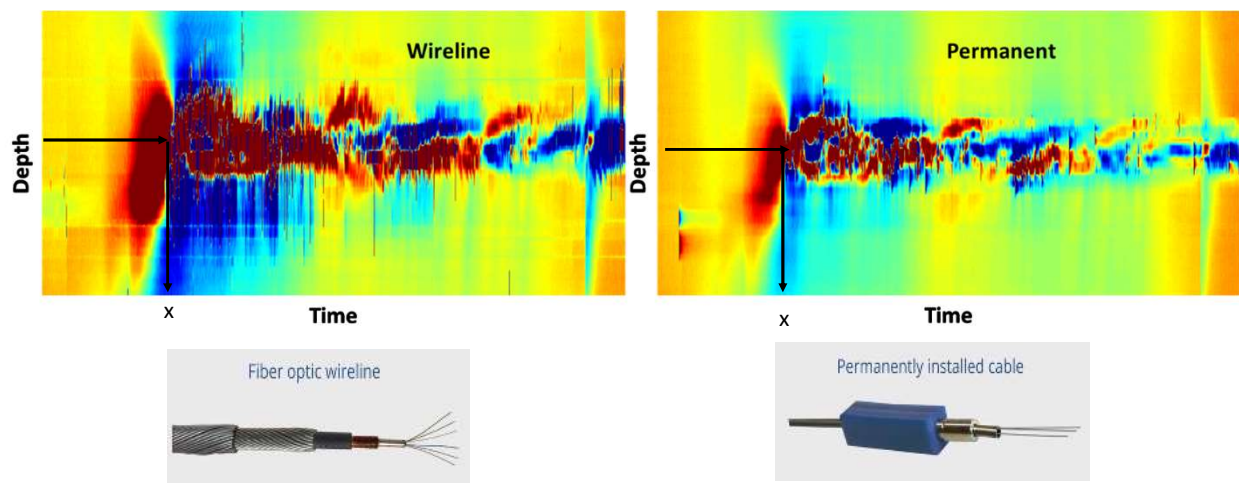
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Will Strain Work With Wireline?



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Carina® XwellXpress™ Strain vs Permanent Installation



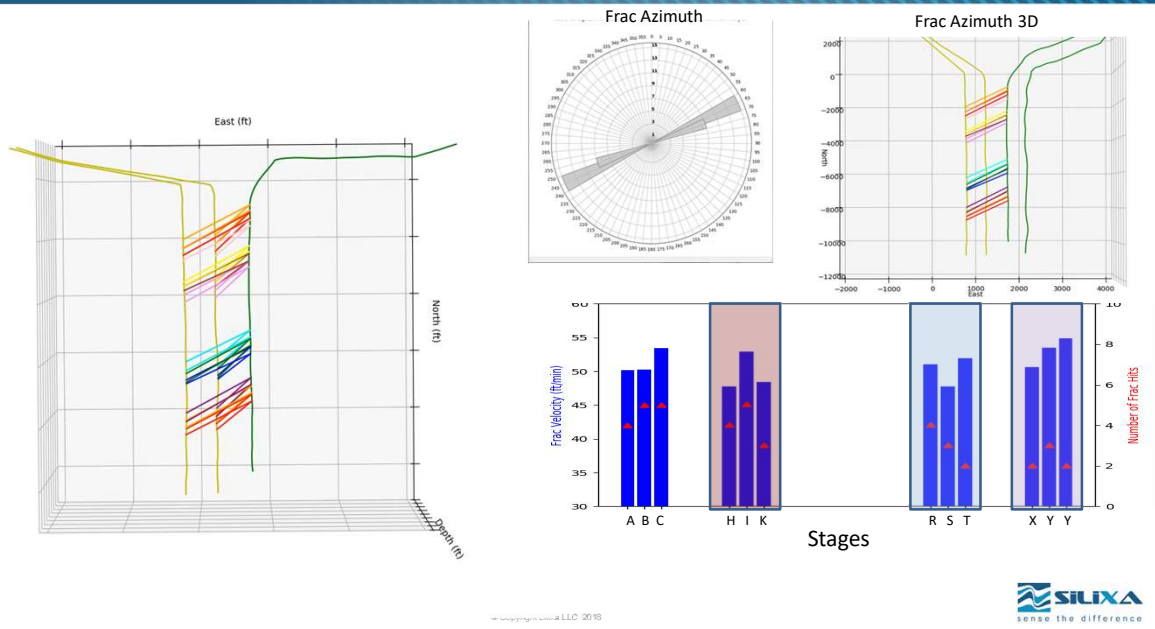
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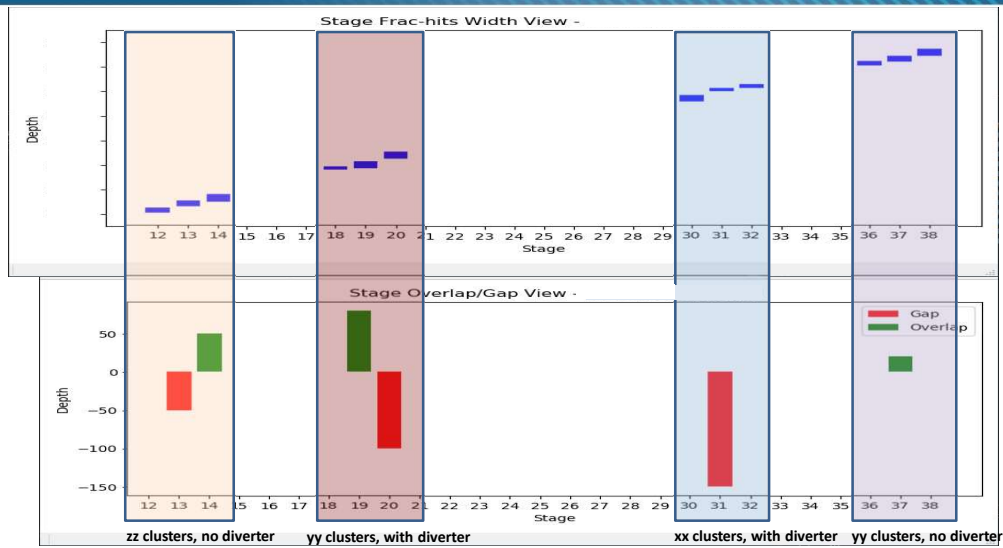
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Statistical Analysis - Frac Azimuth and Frac Velocity



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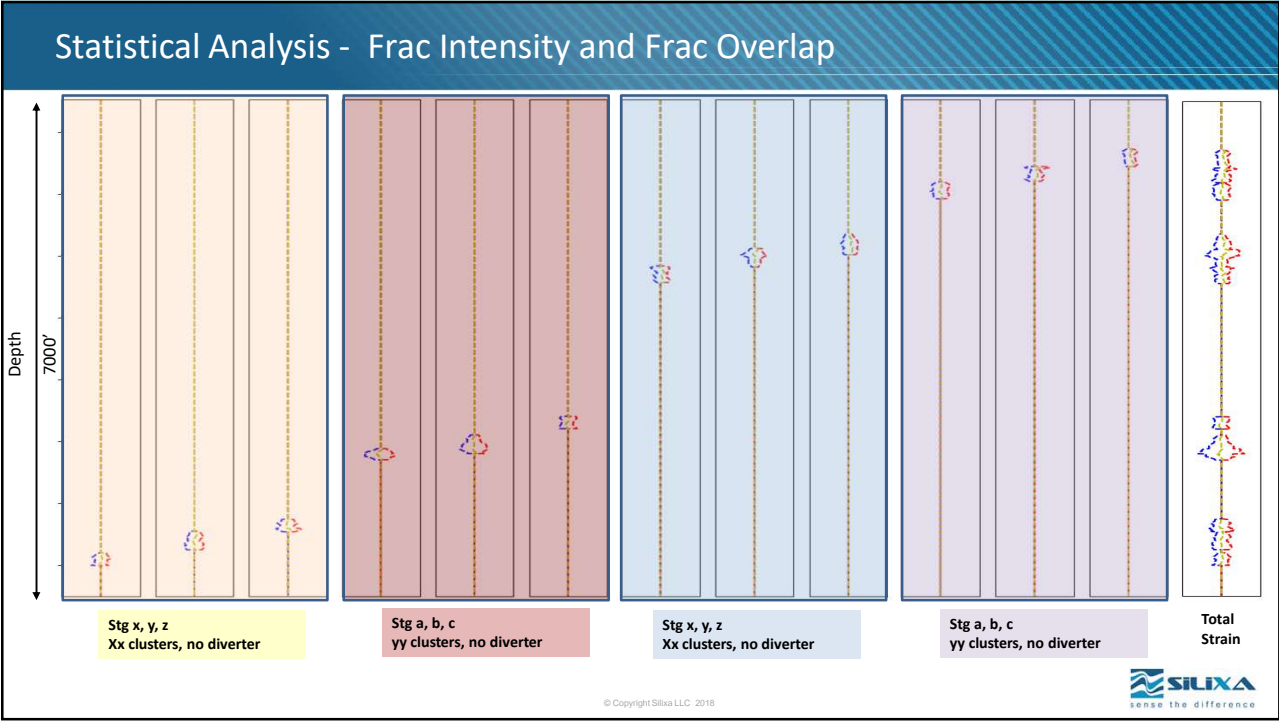
XwellXpress- Frac Overlap



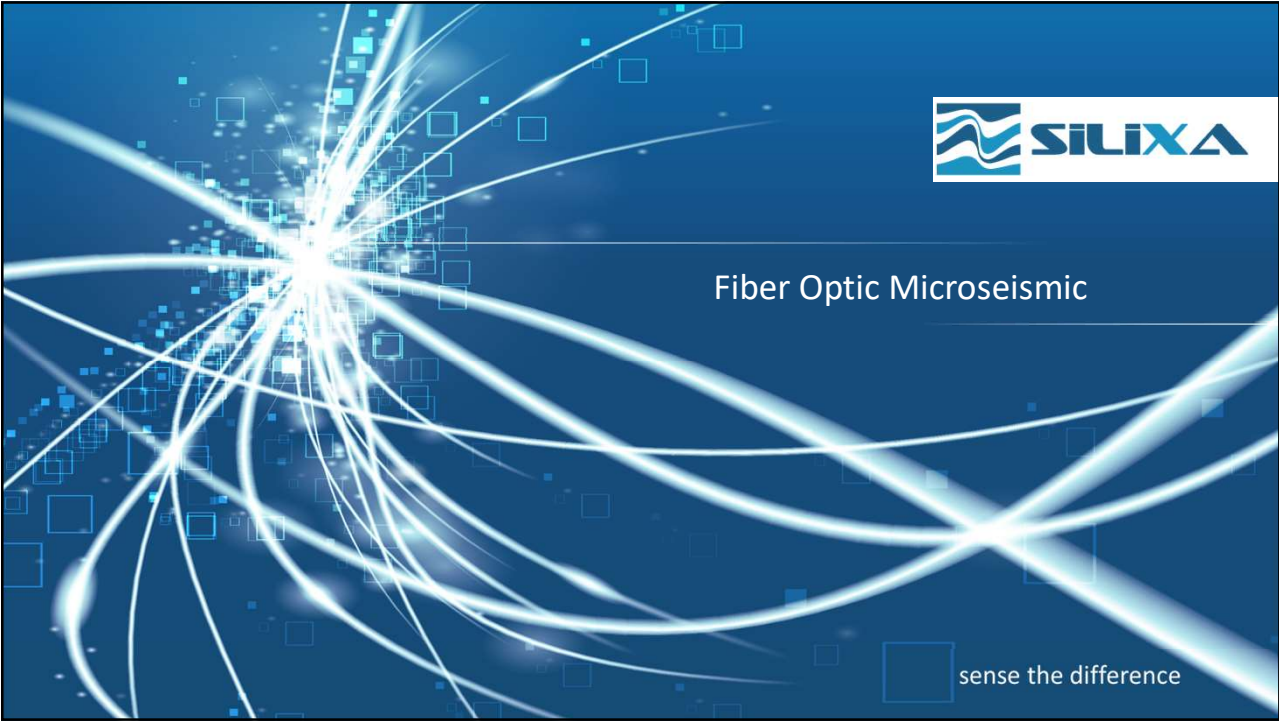
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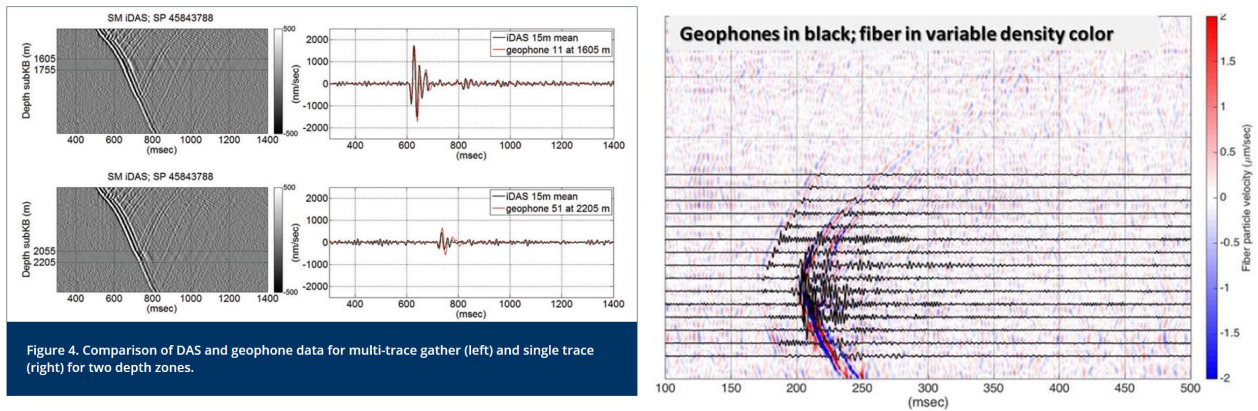


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Seismic Dataset Comparison Geophones with Fiber Optic Array



Simultaneous Acquisition of Distributed Acoustic Sensing VSP with Multi-mode and Single-mode Fiber Optic Cables and 3C-Geophones at the Aquistore CO₂ Storage Site, *D Miller, et al, CSEG Recorder 2016*

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Silixa Real-Time Microseismic

Track Record and Experience

First project - 2017

13 projects > 850 stages mapped

Microseismic Attributes and Workflow

Velocity Model - 1D smoothed and blocked (with dip)

Grid Search Method, Grid 30' x 30'

Auto Event Detection and Location (all possible locations)

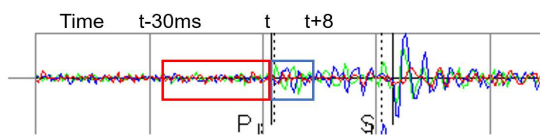
Output in SEG-Y (750 ms)

Waveform stacking every 10 channels

Ray trace with VTI Anisotropy (best fit analysis)

Event Quality based on SNR

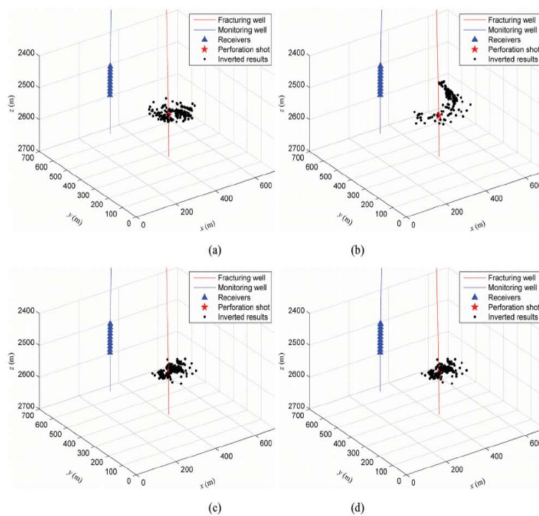
Real-time, Location Map updated ~ 10 seconds



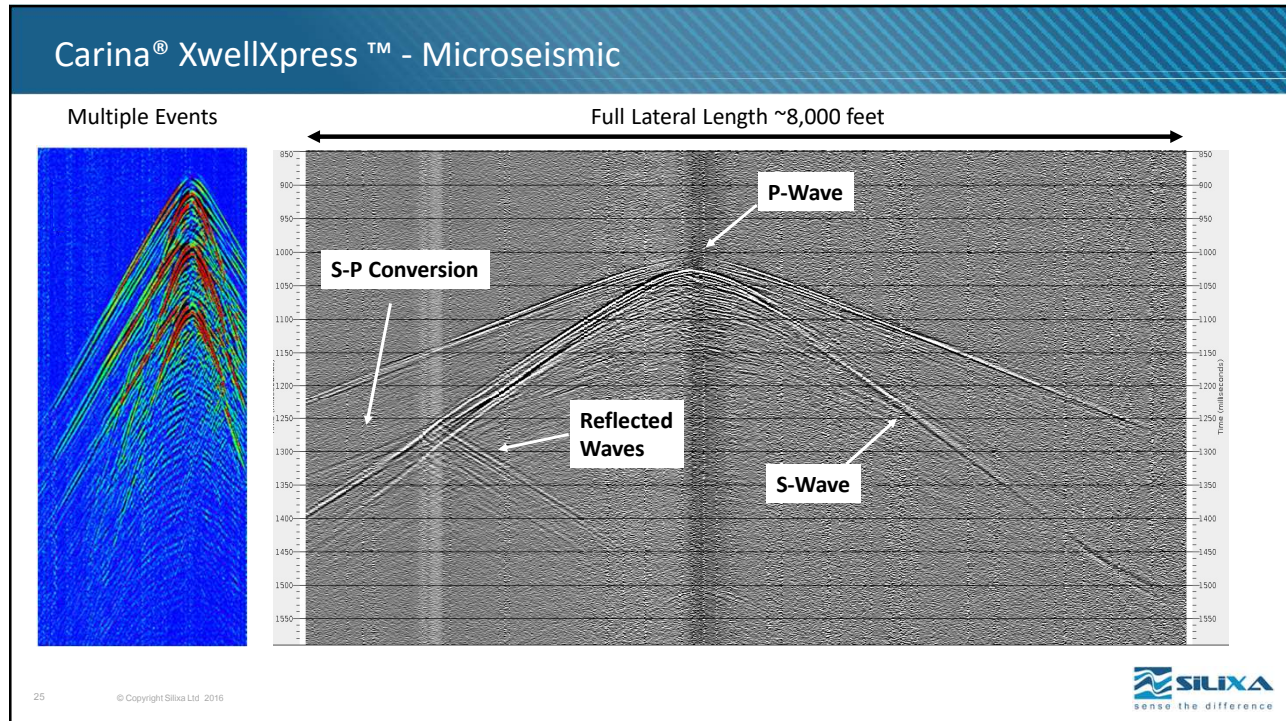
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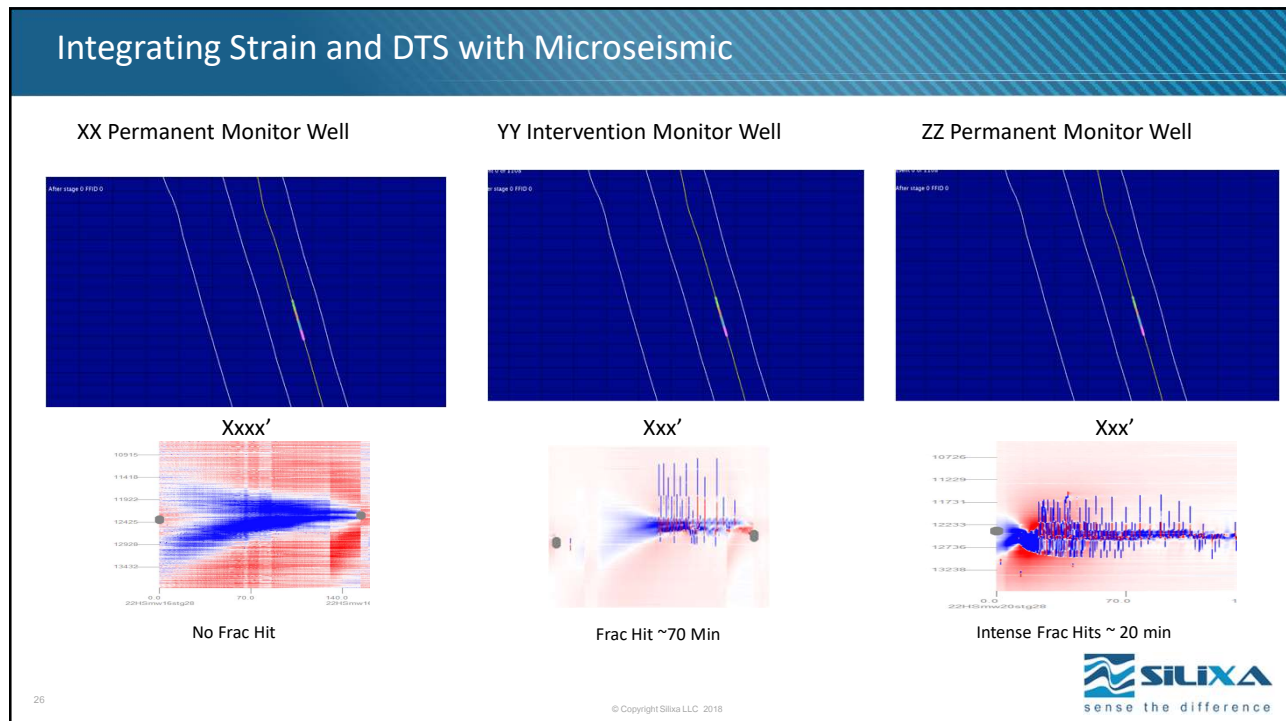
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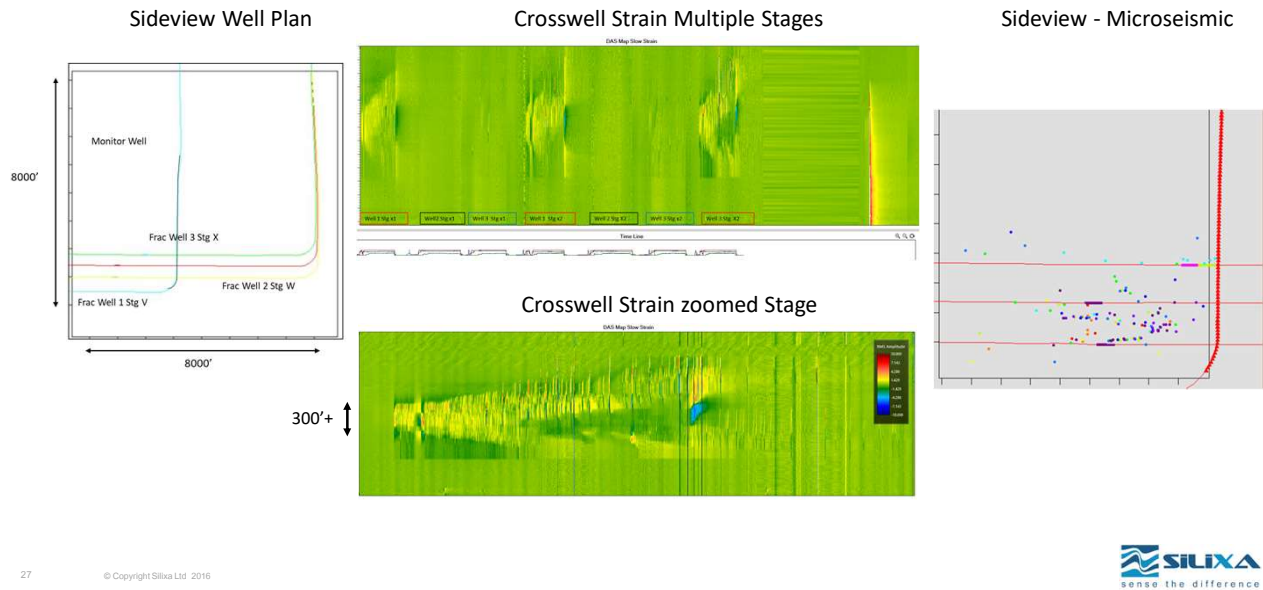


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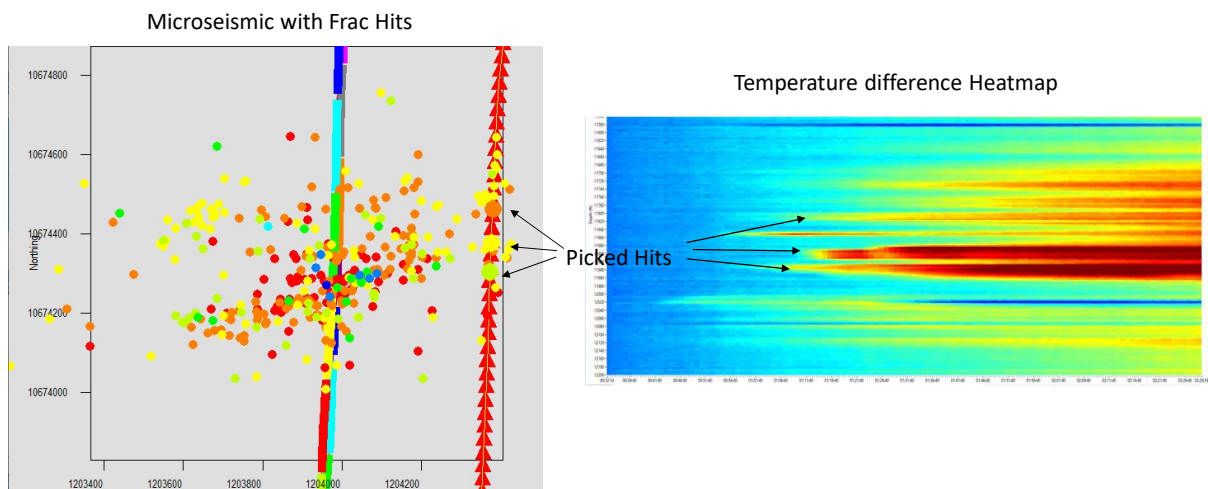
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Carina® XwellXpress™ - Vertical Deployed Wireline



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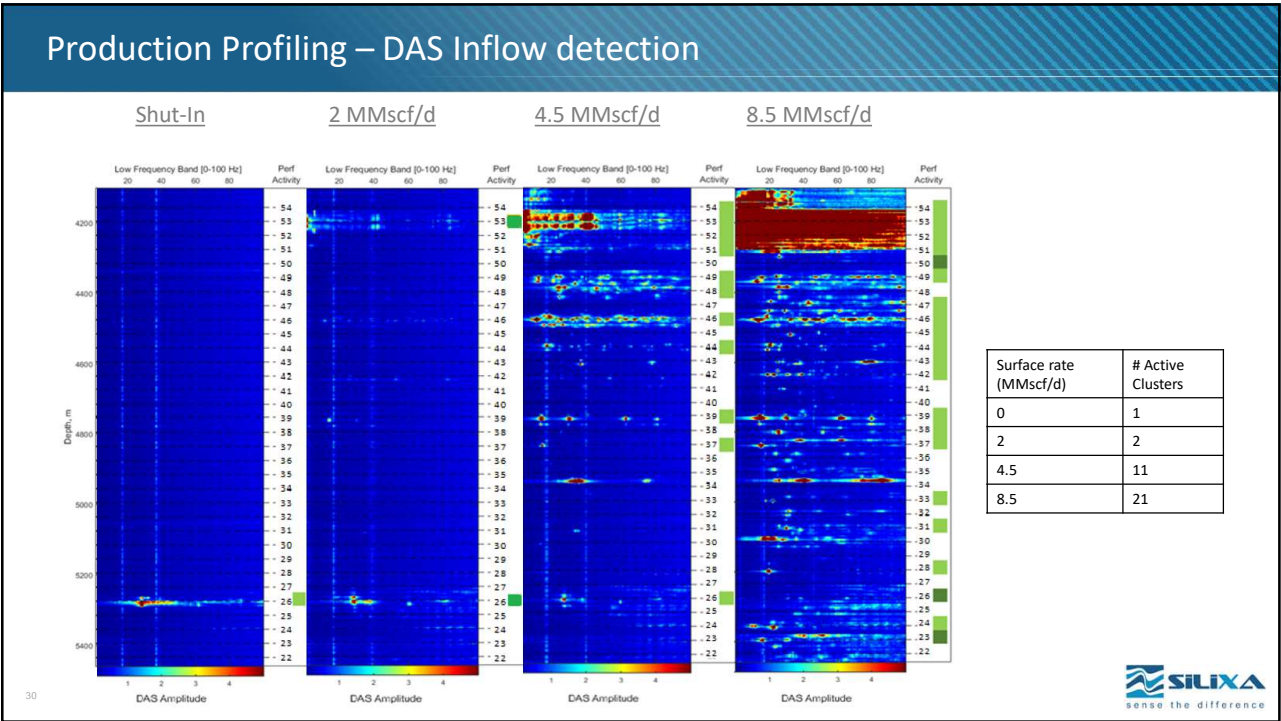
Integrating Microseismic with Strain and DTS



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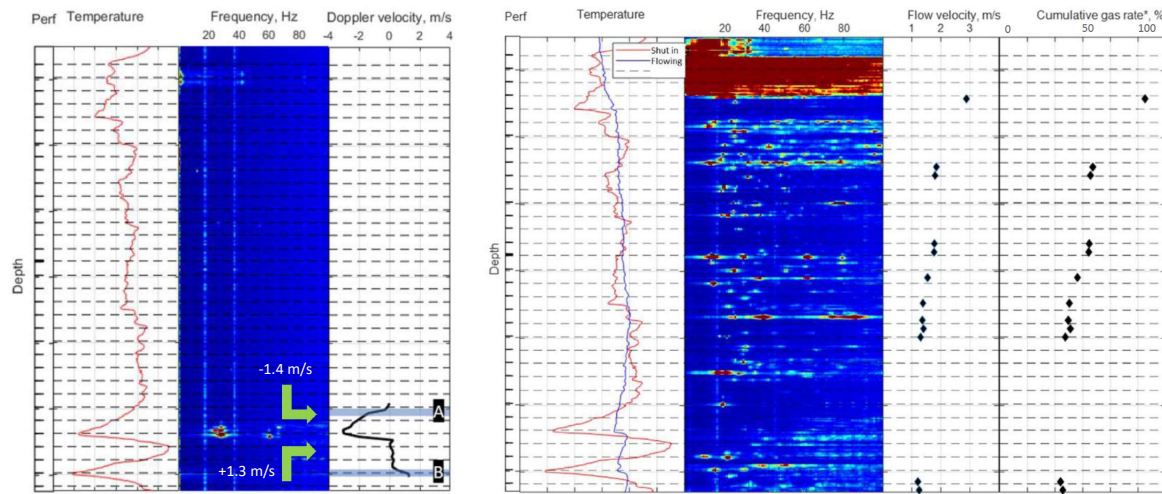


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Production Profiling – DAS Shut-In and Flow Analysis



- Doppler Analysis during shut-in identified crossflow

- Speed of Sound (SOS) Quantitative Flow Analysis
- Downhole flow velocities converted to volumetric rate using well dimensions, bottom hole flowing pressure and formation volume factor

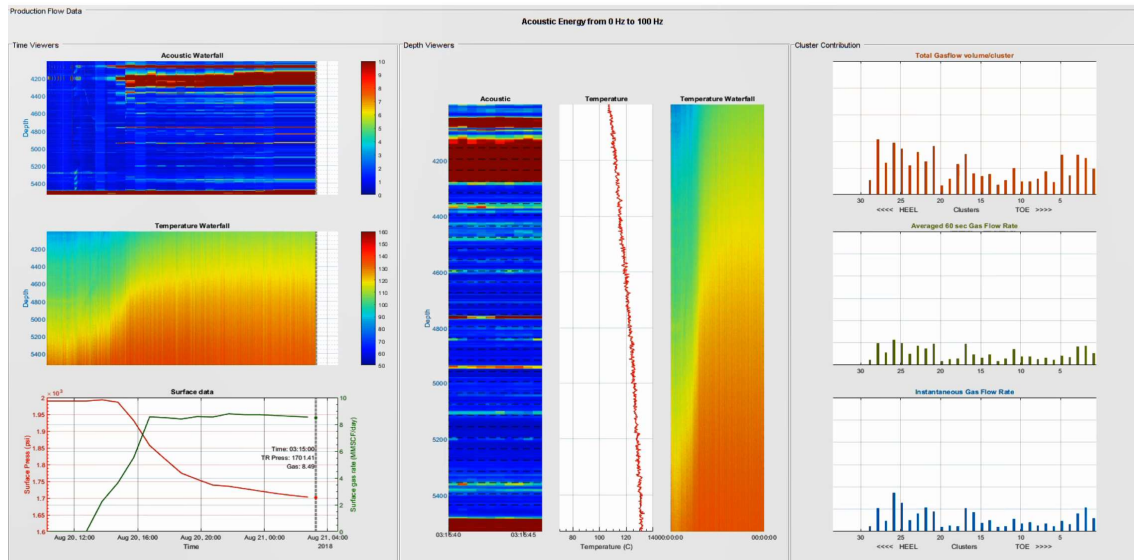


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Production Profiling Dashboard



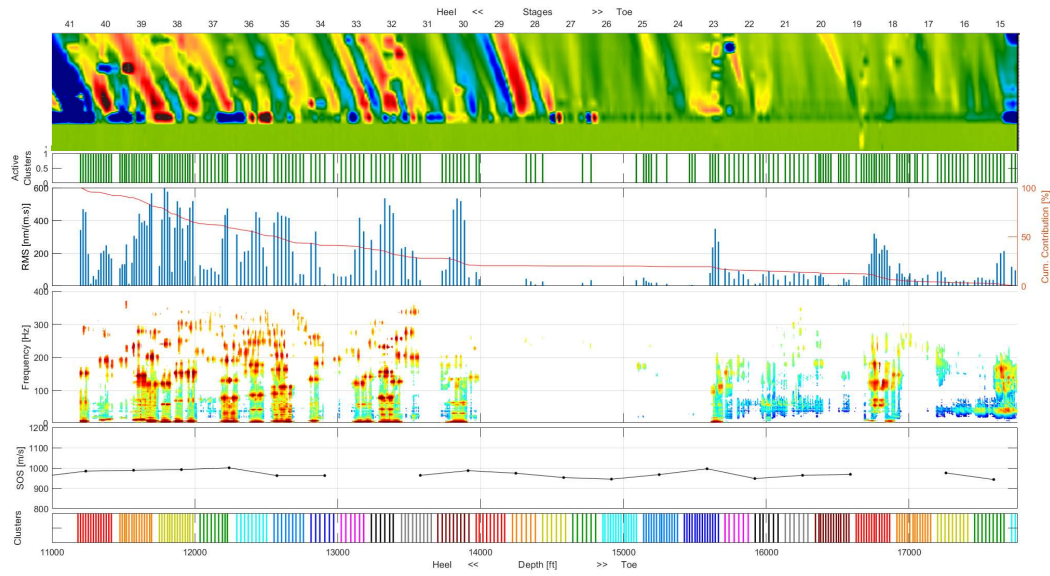
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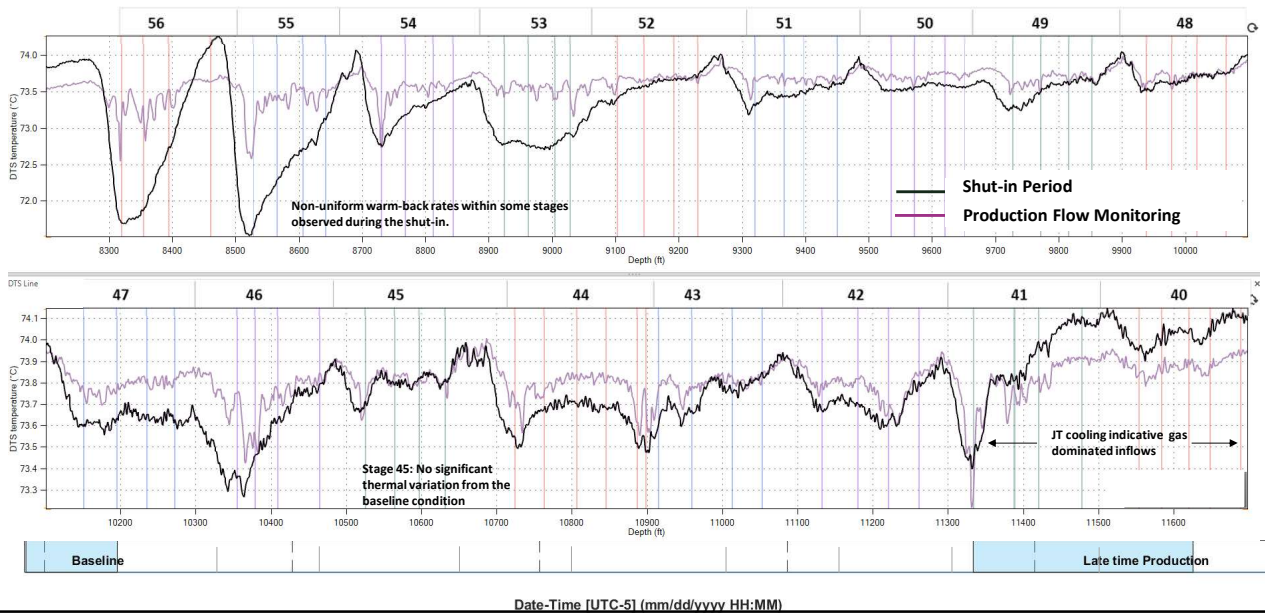
DTS and DAS Production Analysis



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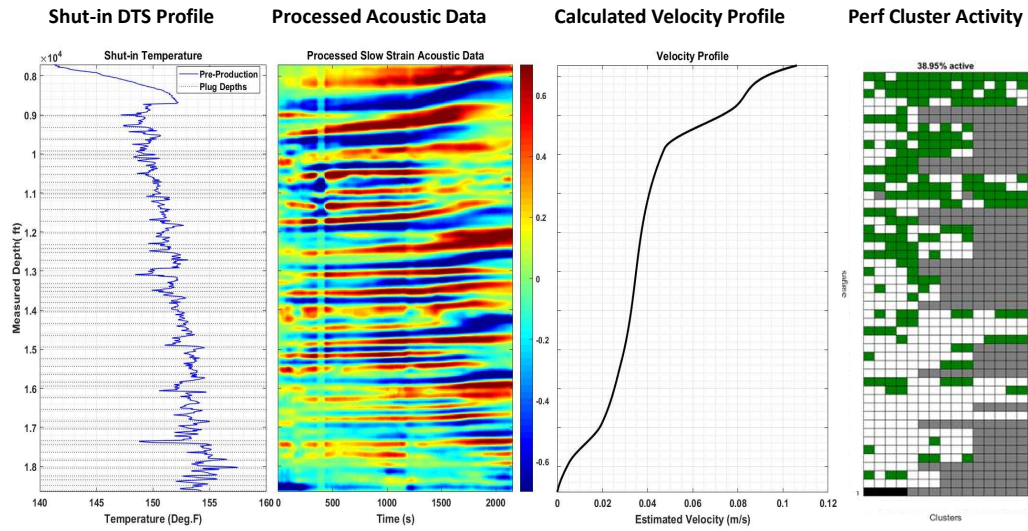
DTS Temperature Traces – Select Stages

Well Dynamics : Temperature changes along the production zone



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Production Profiling iDAS Advanced Processing and Analysis



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Thank You – Questions ?

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