Downhole Sand Ingress Detection Using Fibre-Optic Distributed Acoustic Sensors (DAS)

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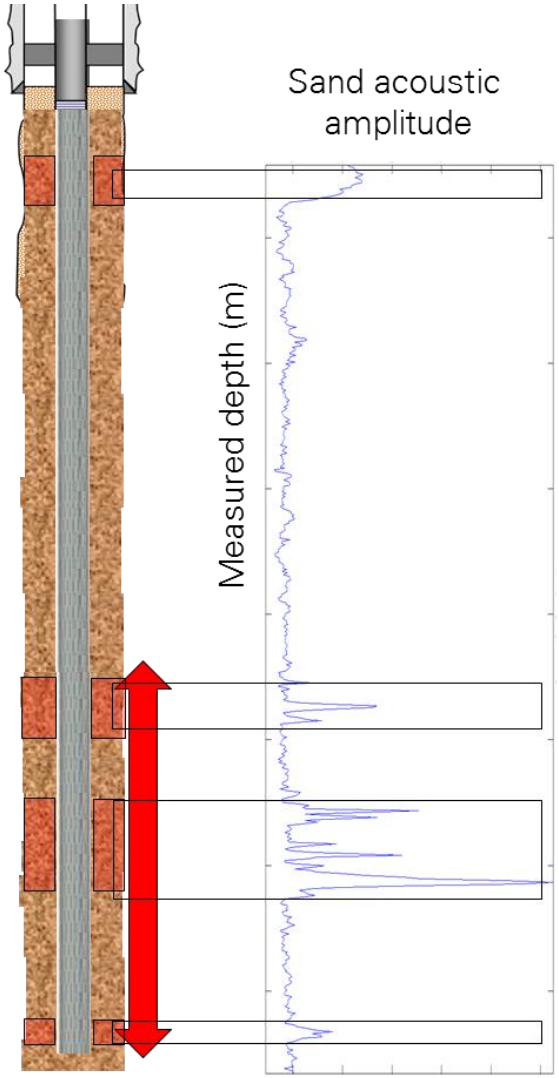
Downhole Sand Monitoring – the business need



Challenge:

- Ineffective sand control completions can lead to excessive sand production
- Precise sanding interval unknown

Current response:

- Well choked back to reduce sand production
- Plugs installed to shut off sand intervals

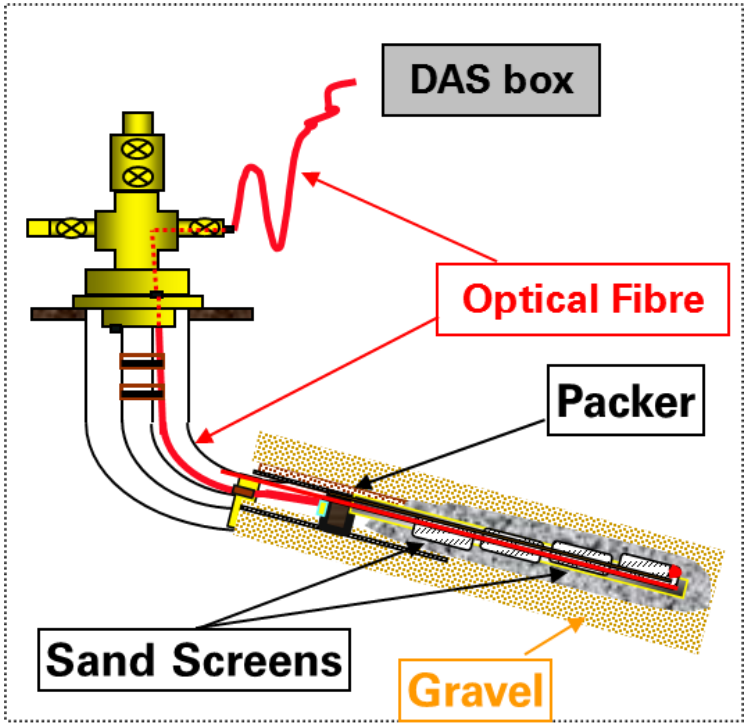
Consequence:

- Deferred oil production
- Non-sanding reservoir intervals also shut off.
- Continued sanding if plug placement is not accurate
- Loss of well integrity

Solution:

- Use in-well fibre optic cables for DAS
- Develop digital signal processing techniques using DAS to identify sand ingress
- Creation of DAS sand log to enable targeted remediation

What is DAS? How is it installed?



Fibre is the sensor

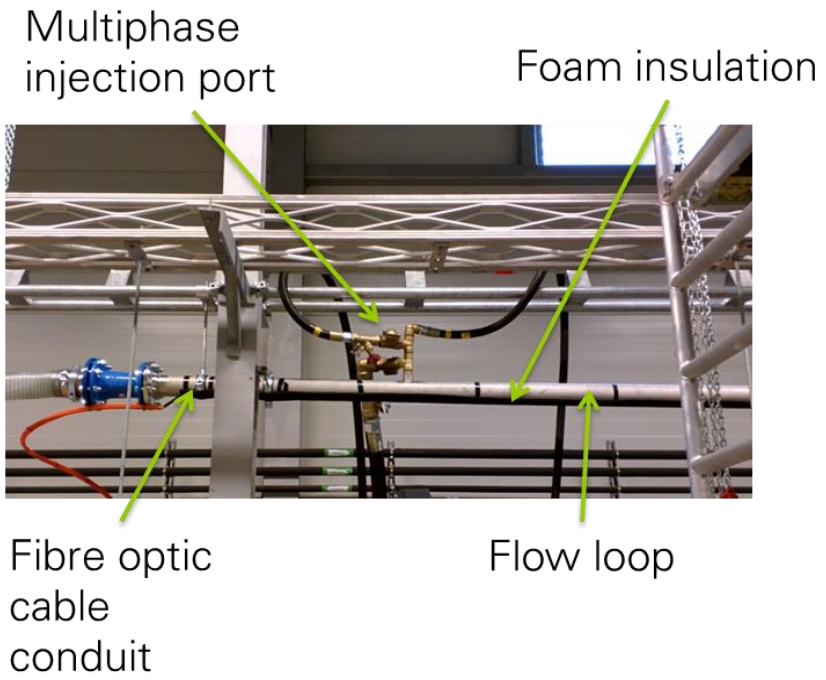
Permanent fibre installation example:

Fibre optics in control line

Ref: SPE 95419

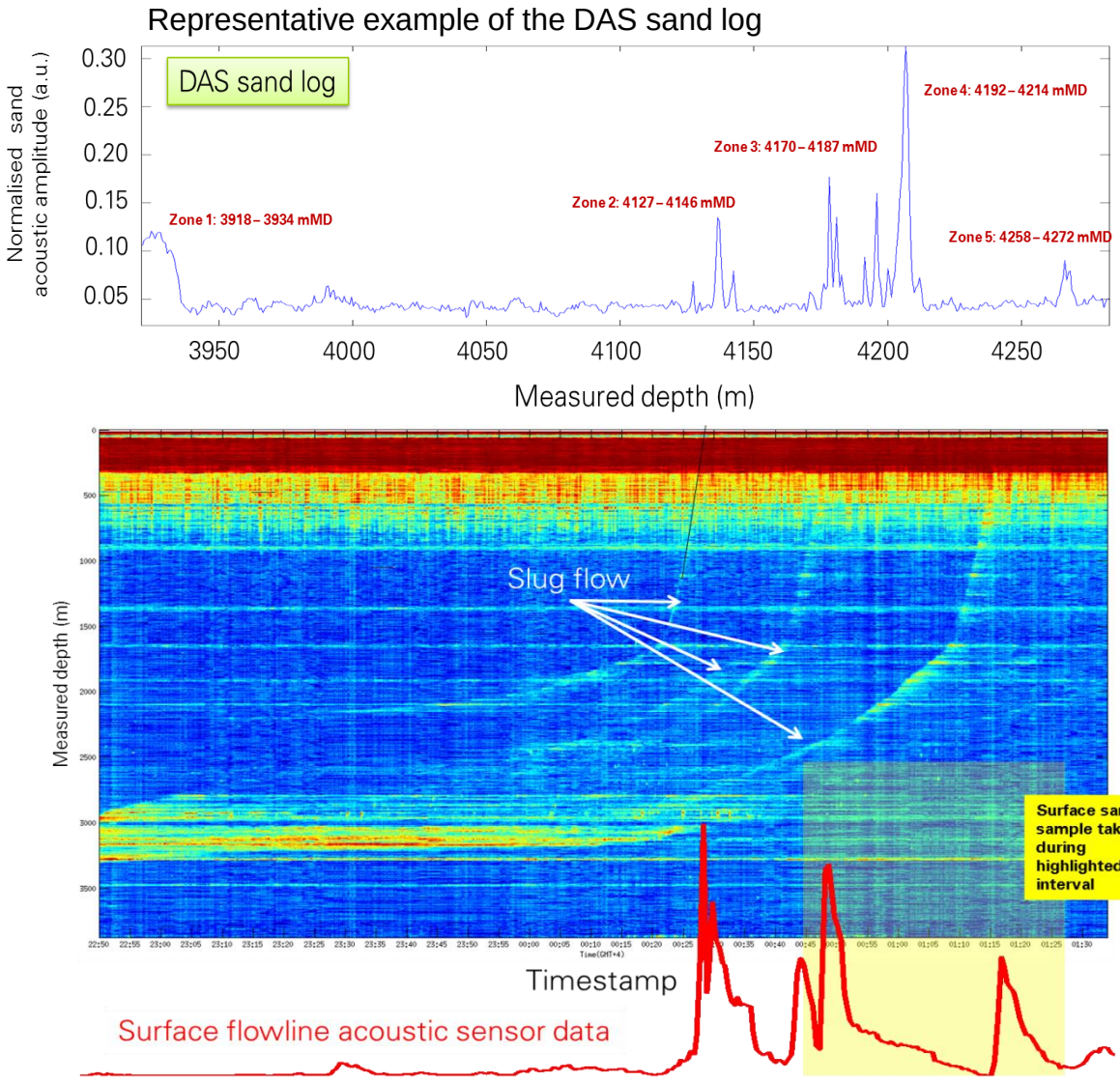
Fibre can be deployed in a number of other ways, such as on wireline

Determining the “acoustic fingerprint” of sand ingress using DAS: Flow loop experimentation



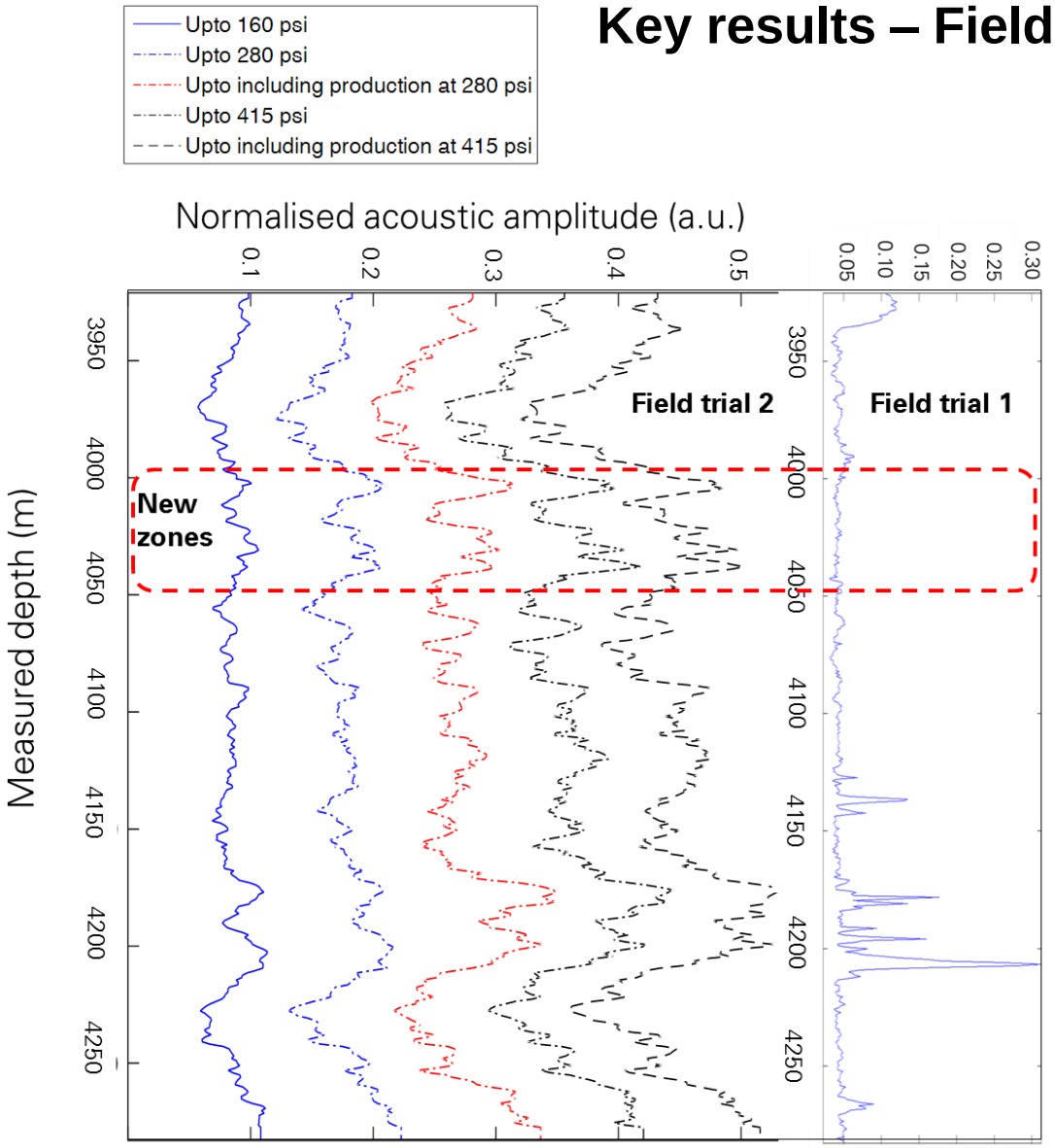
Flow loop experimentation used to study and distinguish sand ingress “signals” from fluid noise

Key results – Field trial 1



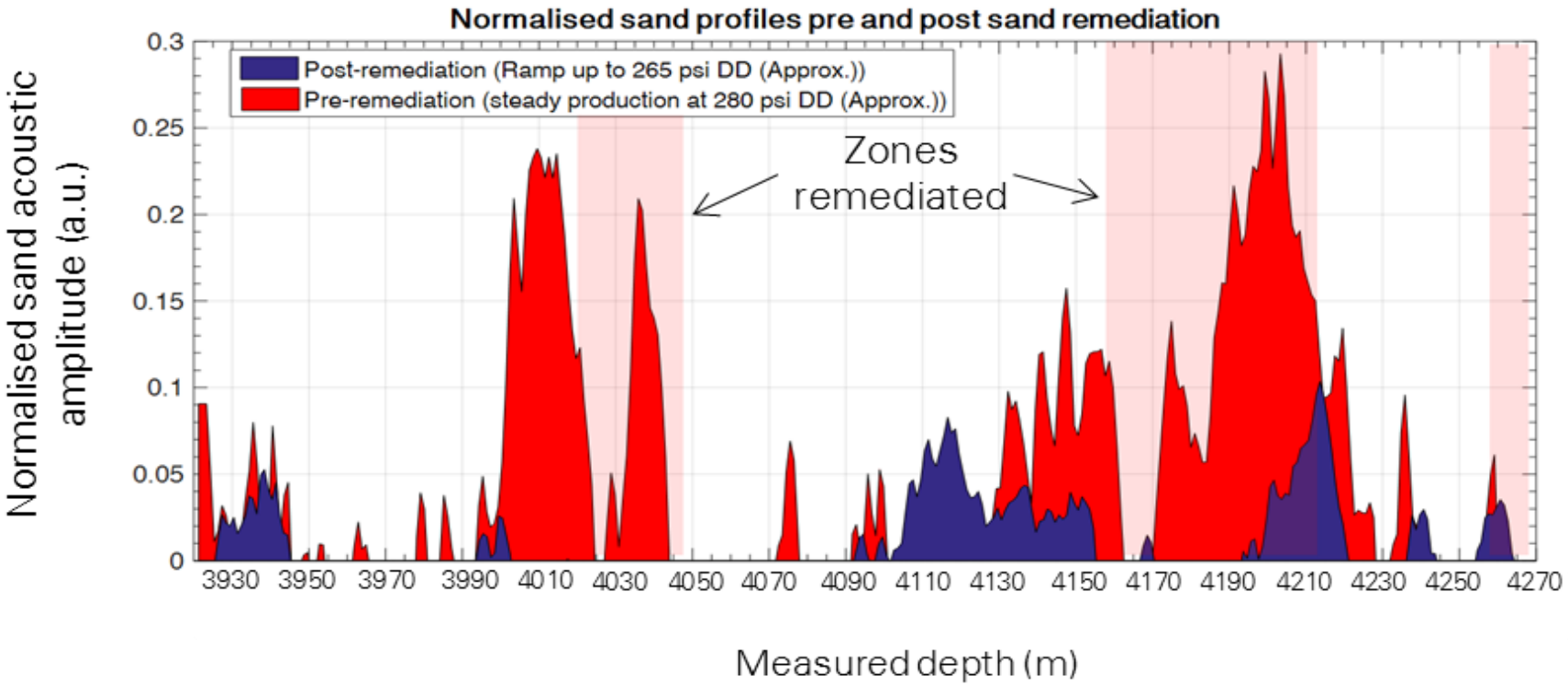
- Signal processing methodology for sand ingress signal extraction works
- Multiple sand ingress zones
- DAS can monitor sand transport from ingress to surface
- Good correlation observed with surface and sub-surface data
- DAS “sand log” generated

Key results – Field trial 2



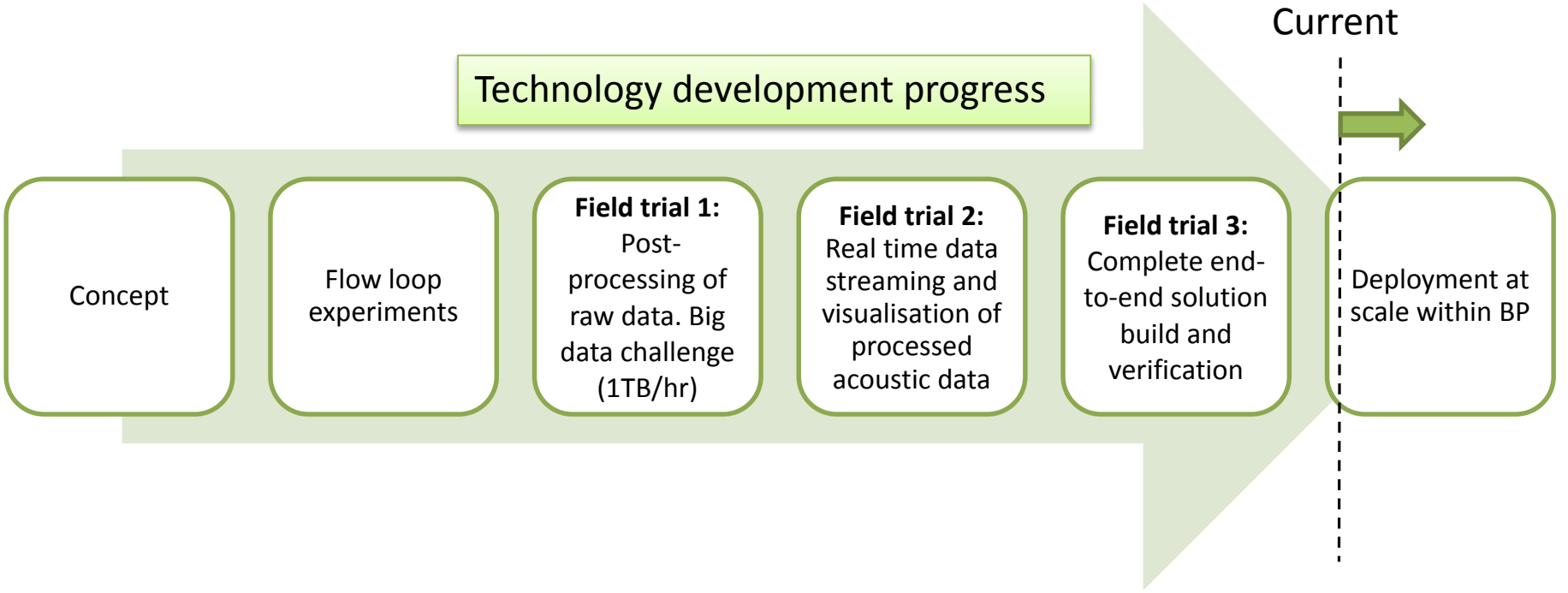
- Field trial 2: conducted six months after first field trial
- Well ramped up in steps
- Cumulative sand logs constructed to observe temporal behaviour of sand ingress
- More zones are seen to produce sand at higher drawdowns

Key results – Field trial 3



- DAS sand logs used to remediate the sanding zones using mechanical patch technology
- Well brought into production post remediation
- Results both on DAS and surface measurements show substantial reduction in the overall sand production (by over 70%) post sand shut off
- Corresponding increase in oil rate: over 2000 barrels per day

Summary and conclusion



- New downhole, real-time sand detection technology developed using DAS as primary sensor feed
- Data processed at source to generate sand logs in real time, overcoming the big-data problem.
- Technology currently used for:
  - Targeted remediation to increase hydrocarbon production
  - Optimal drawdown control to manage sand related risks during well ramp up and production operations
  - Sand control equipment reliability monitoring that helps inform future sand control completion equipment designs