fishbones

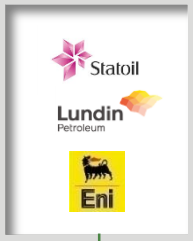
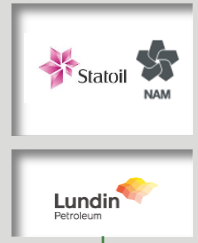
Multilateral Stimulation Technology

Connect your reservoir with simplicity, accuracy and efficiency

Winner OTC 2015
Spotlight on New Technology

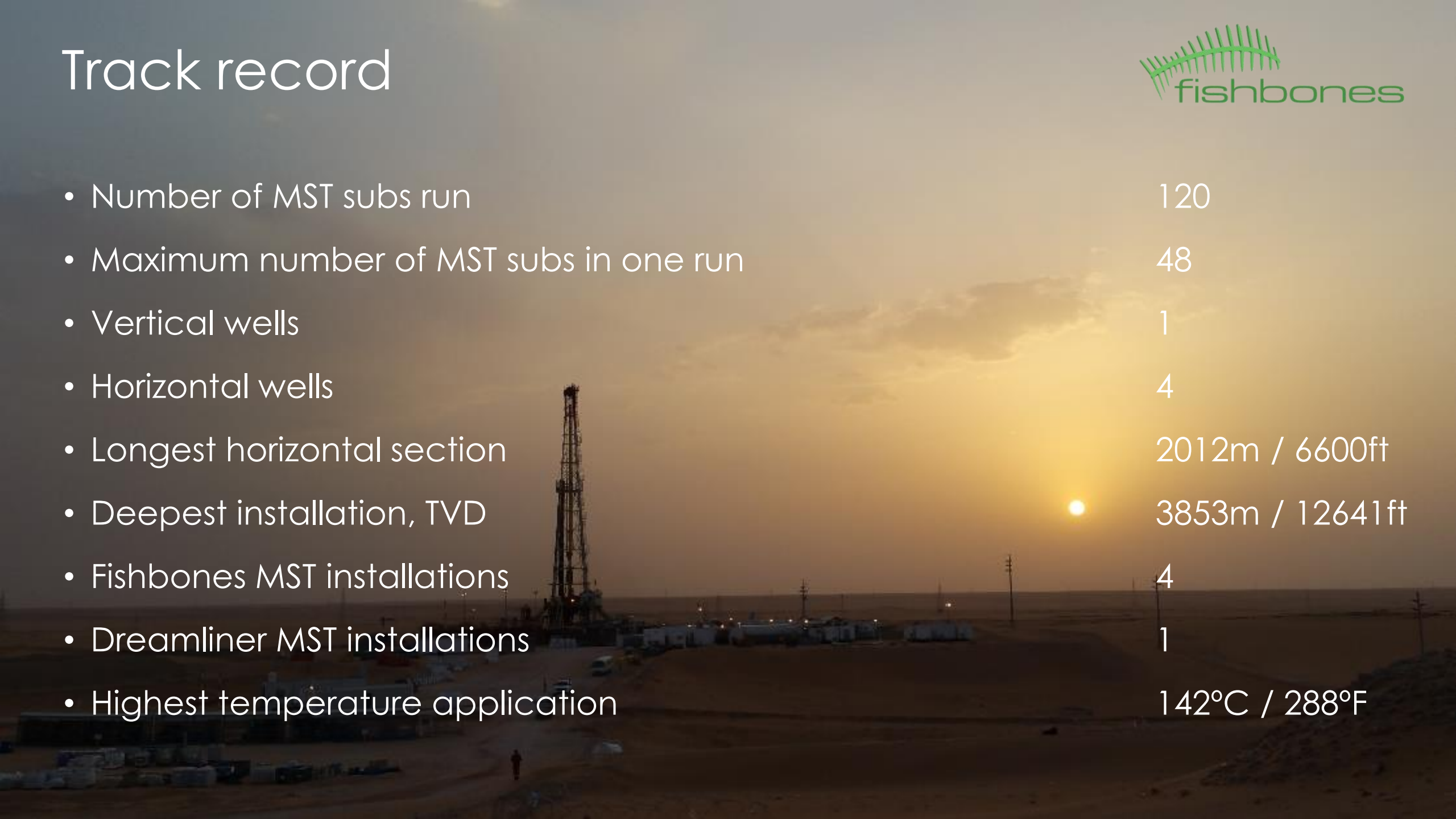
Winner ONS 2014
SME Innovation award

Fishbones development timeline

2009	2012	2013	2014	2015	Today
								
Fishbones for Carbonates	Fishbones full scale tests	JIP- Fishbones for Hard rock, 5.5" Dreamliner	First Fishbones installation (CBM)	1st well JCR* Fishbones pilot well program (Carbonate)	First Middle East order	JIPs - 4.5" Dreamliner and Extreme hard rock	First Dreamliner installation (Sandstone)	Several installations being planned worldwide
Jetting	Jetting	Drilling	Jetting	Jetting	Jetting	Drilling	Drilling	

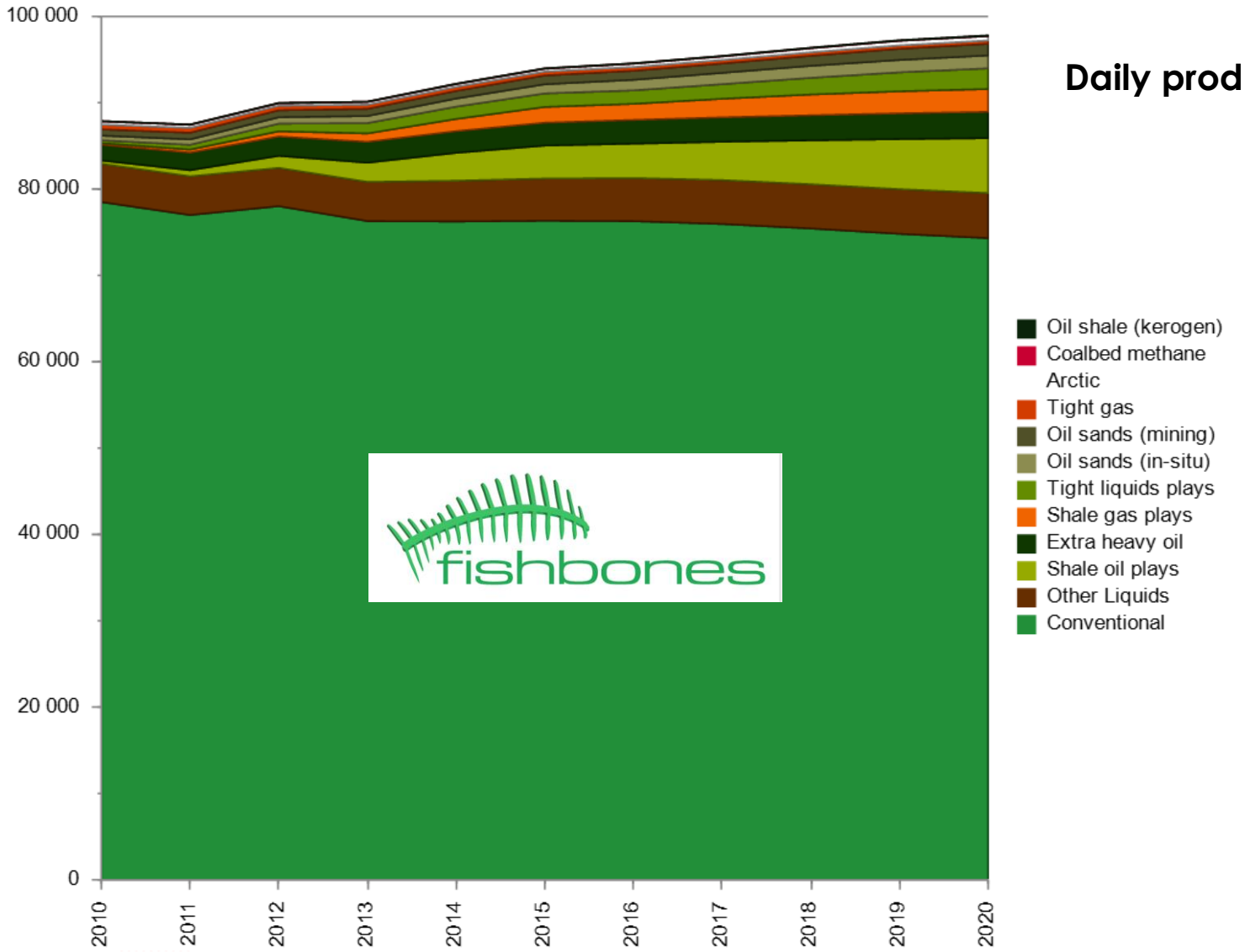
JCR (Joint Chalk Research group) – BP, ConocoPhillips, the Danish North Sea Fund, Dong, Hess, Maersk, Shell, Statoil and Total

Track record



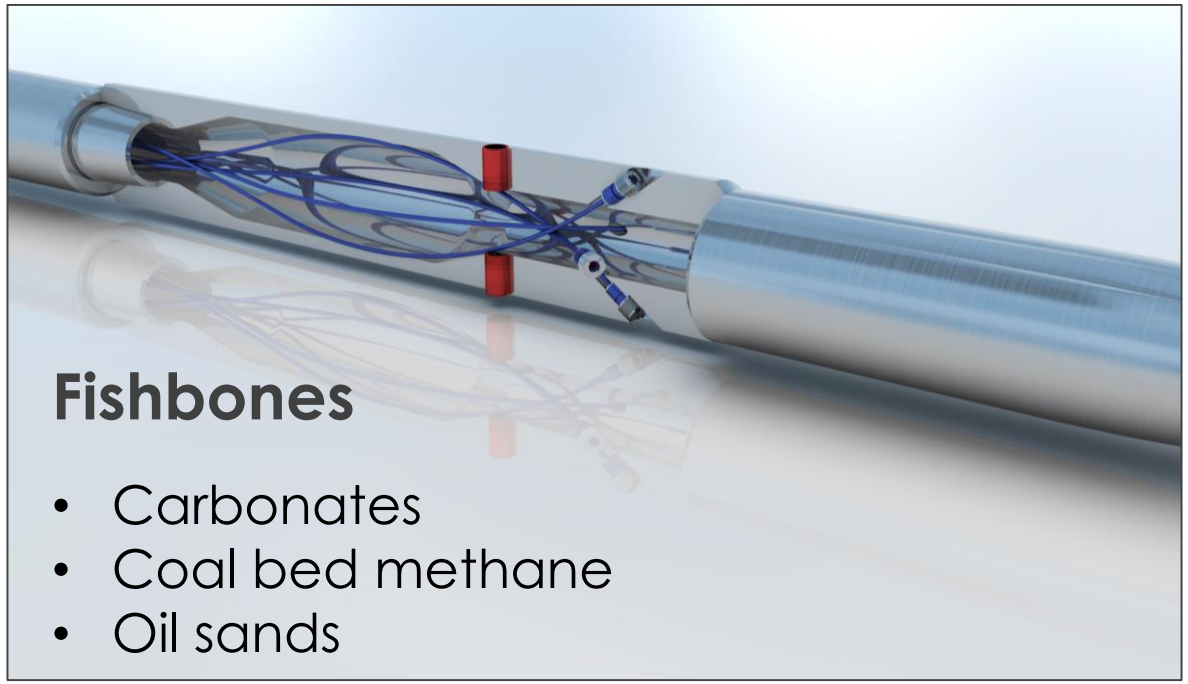
• Number of MST subs run	120
• Maximum number of MST subs in one run	48
• Vertical wells	1
• Horizontal wells	4
• Longest horizontal section	2012m / 6600ft
• Deepest installation, TVD	3853m / 12641ft
• Fishbones MST installations	4
• Dreamliner MST installations	1
• Highest temperature application	142°C / 288°F

Fishbones' space



Daily production split by liquid source - kbbl/d

Product portfolio



Fishbones

- Carbonates
- Coal bed methane
- Oil sands

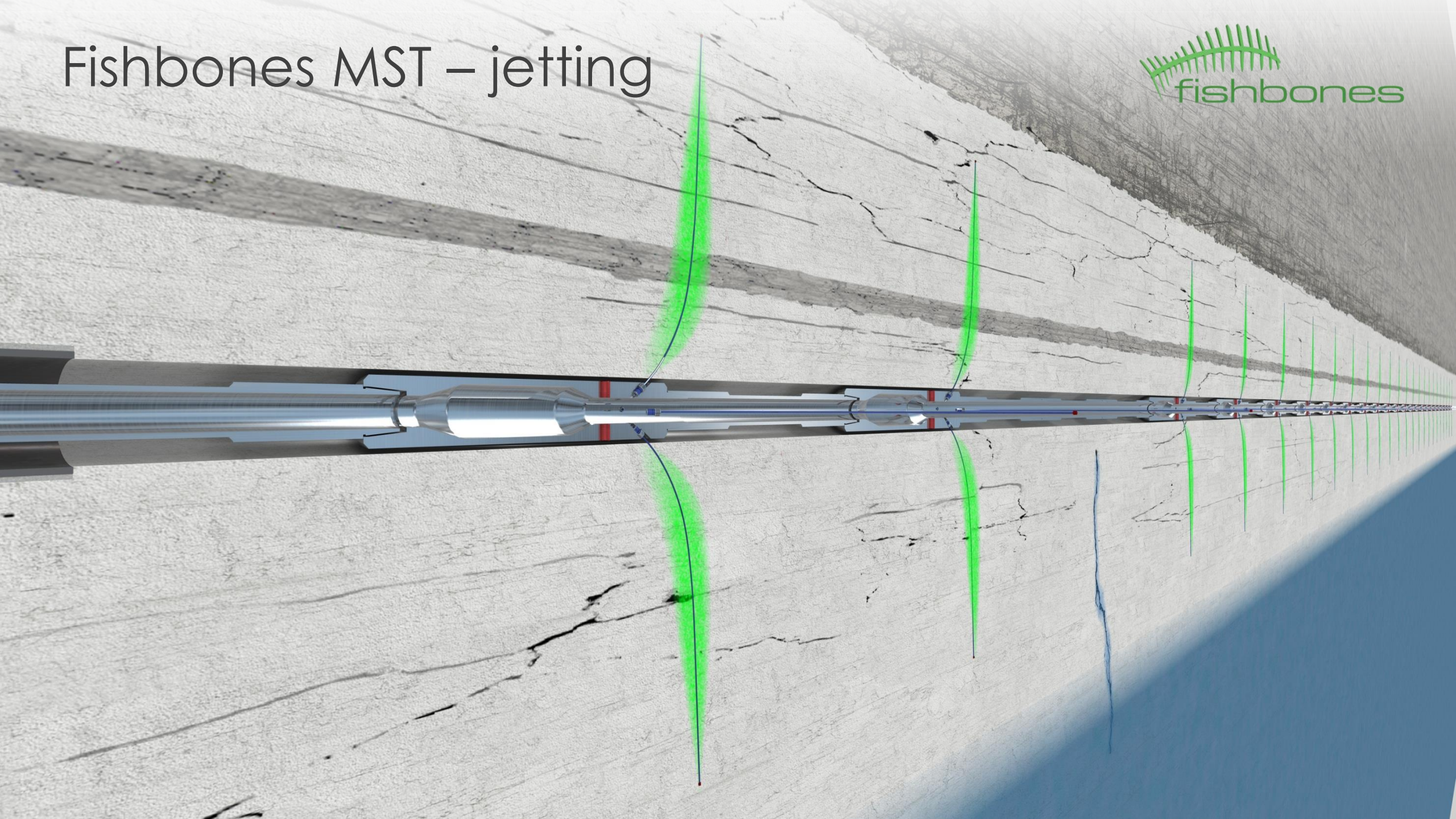
Dreamliner

- Sandstones

Other products:

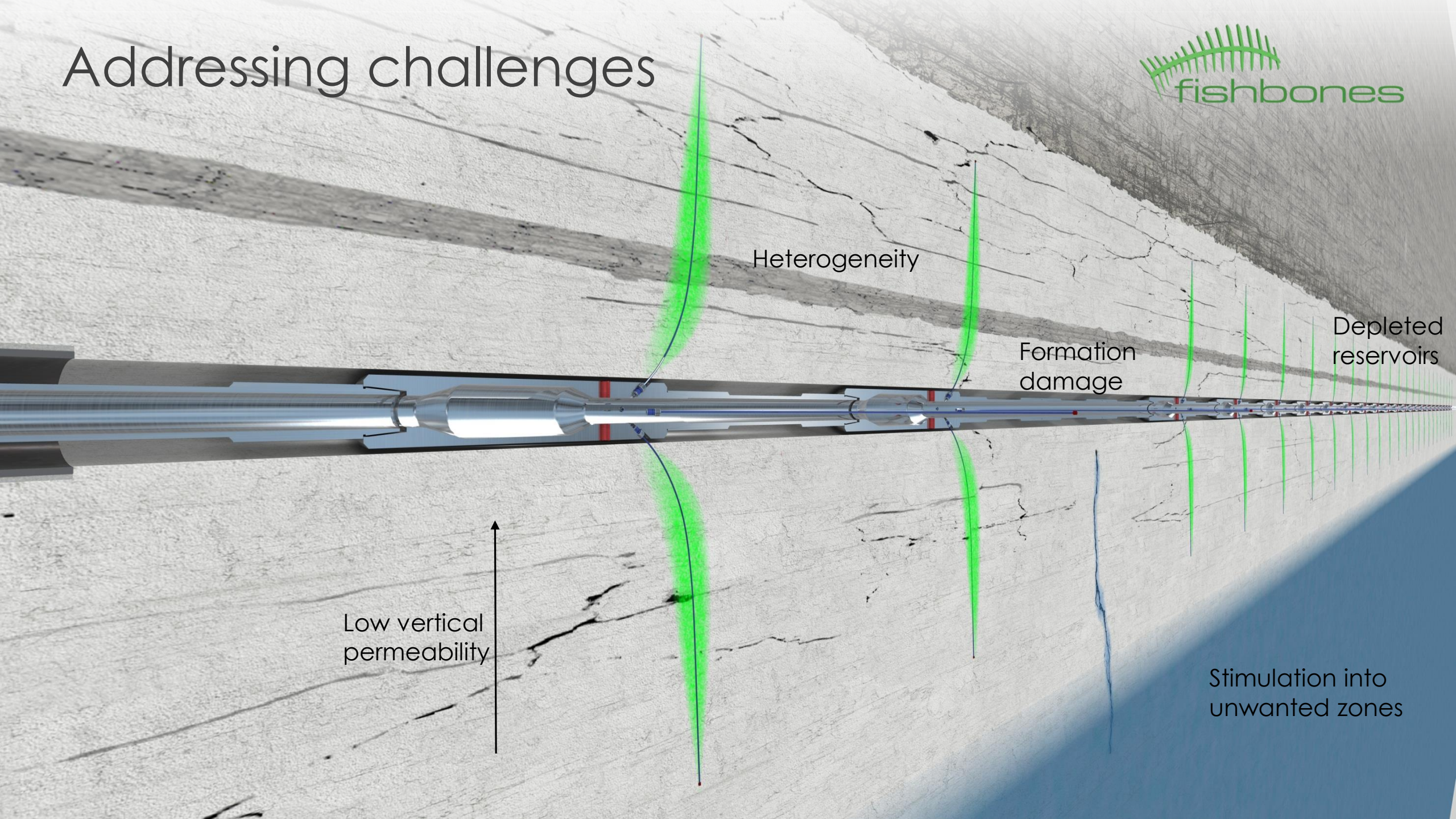
Backbone anchor - Float shoes - Catcher screen - Fishbasket

Fishbones MST – jetting



Dreamliner MST - drilling

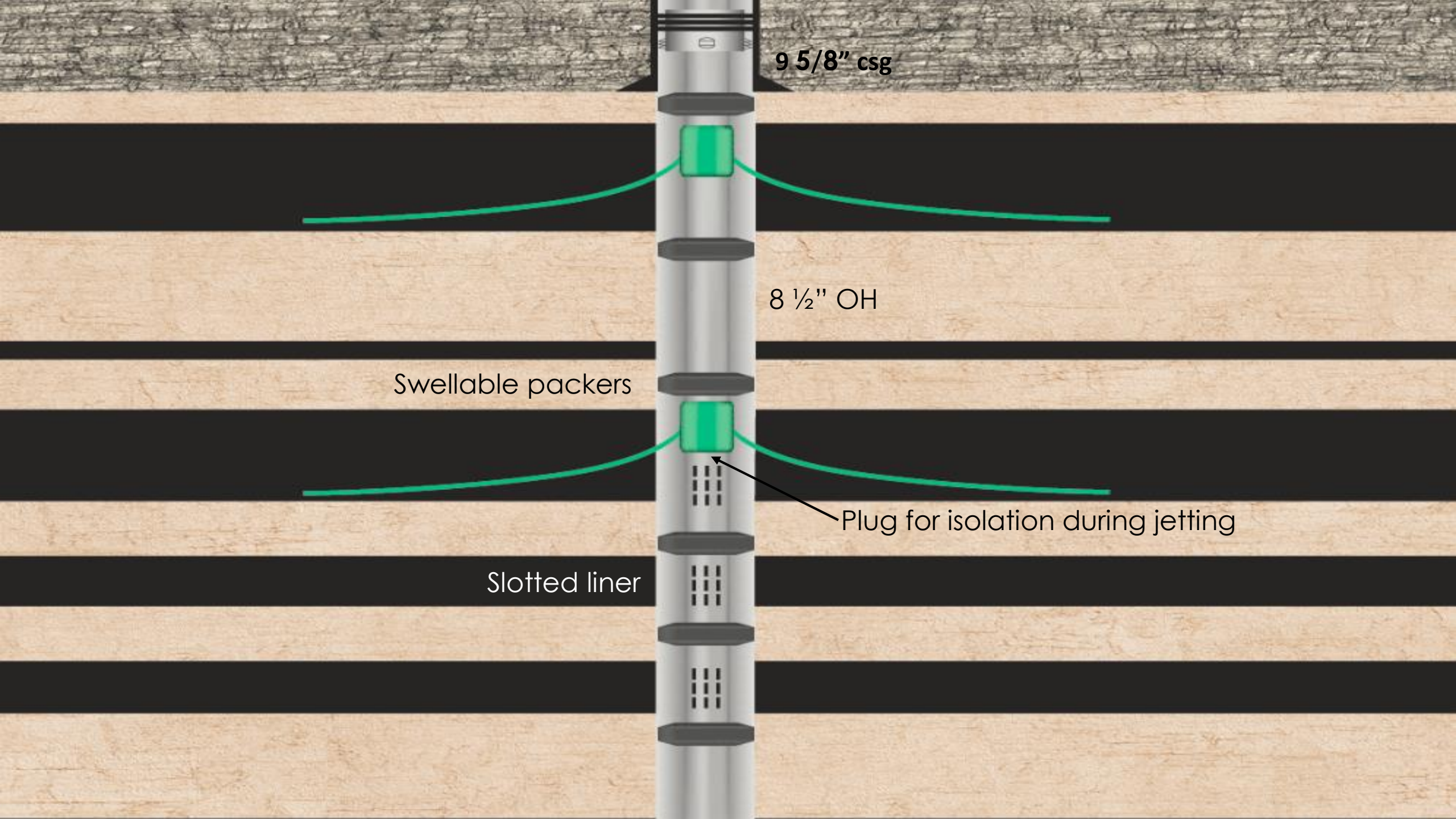
Addressing challenges



Case histories

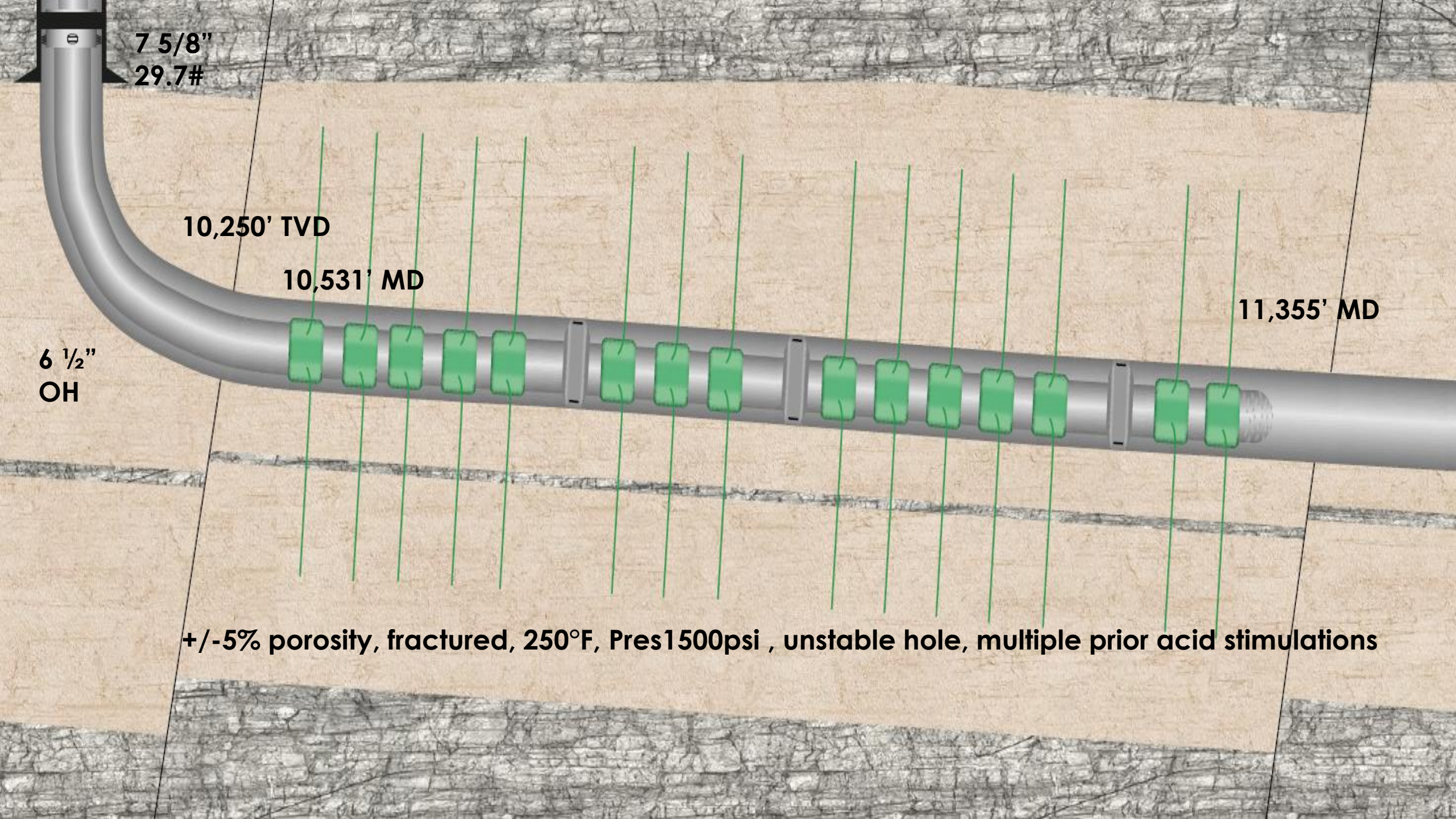
First Fishbones MST installation

- Sumatra island, Indonesia, Nov 2013
- Coal Bed Methane application
  - Water jetting
- Vertical well
- 8.5in hole, 800m / 2620 ft deep
- Two Fishbones subs
- Successful installation
  - Needle extension confirmed
- Initial production rates ~4 times higher than offset well


9 5/8" csg
8 ½" OH
Swellable packers
Plug for isolation during jetting
Slotted liner

First carbonate installation – USA

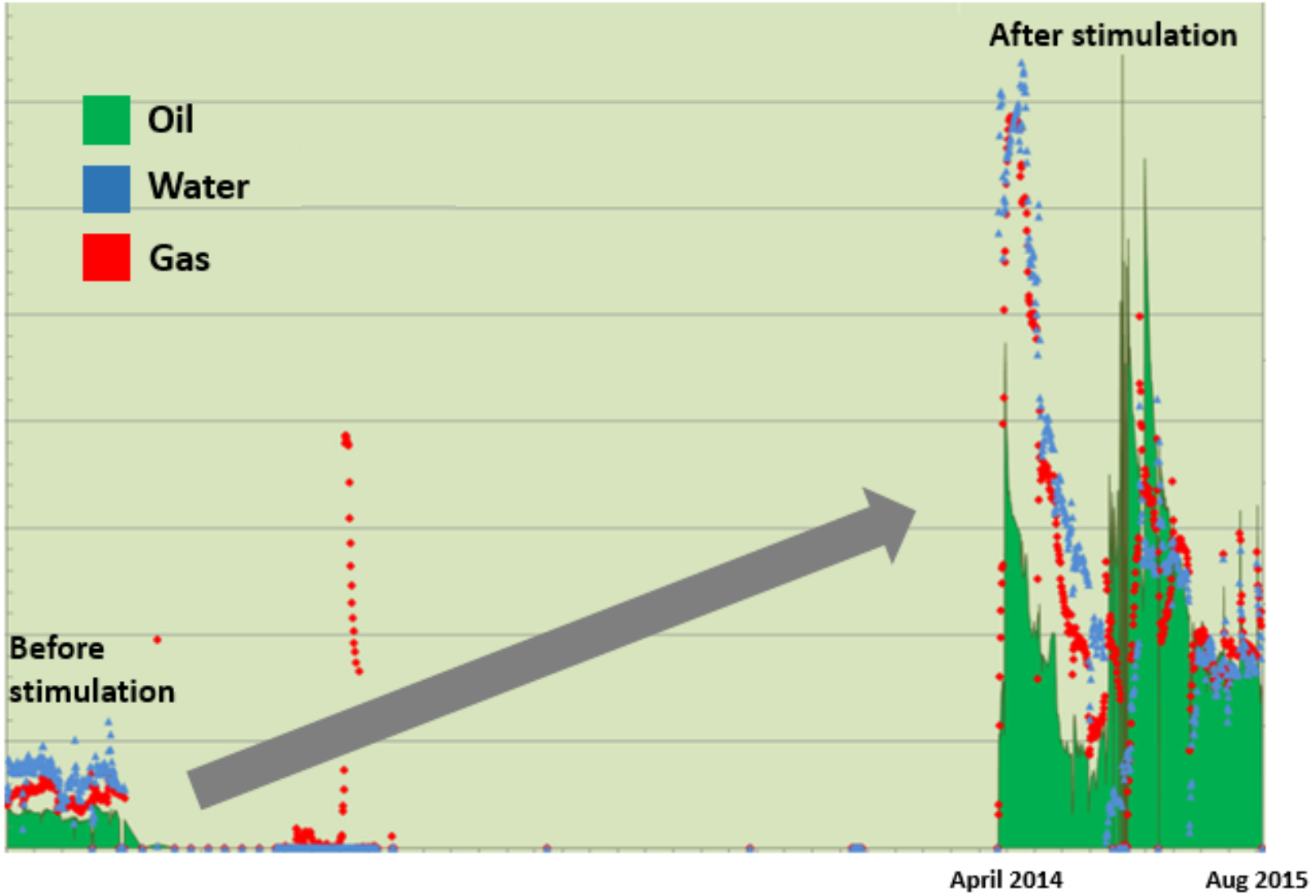
- JCR installation #1, April 2014
- Tight limestone formation in the Austin Chalk, Texas
- Horizontal well, 6.5” open hole
- 15 ea. Fishbones subs and 3 ea. Backbone anchors
- Successful installation
  - Run to TD
  - Needle extension confirmed
- 60 laterals created, 5 hrs total pumping time
- SPE 171804


7 5/8"
29.7#
10,250' TVD
10,531' MD
11,355' MD
6 ½"
OH
+/-5% porosity, fractured, 250°F, Pres1500psi , unstable hole, multiple prior acid stimulations

Achievements

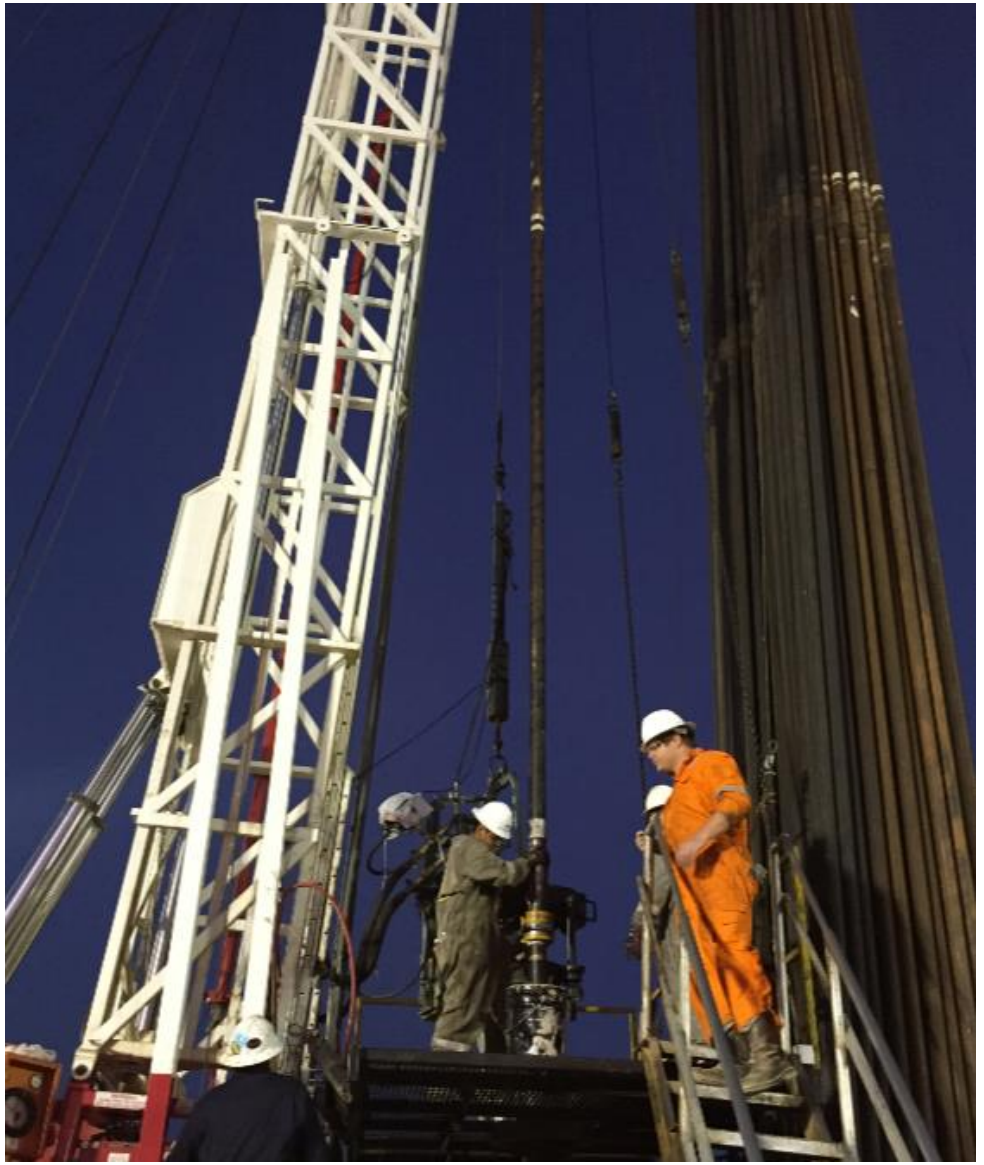
- Proved Fishbones can be safely and practically installed in a well, at an acceptable operational risk level. **No major issues.**
- Proved that the **liner may be rotated** while getting the completions to TD.
- **Full 40' (12m) deployment** of the Fishbones needles was confirmed from pressure chart reading. Also confirmed positive identification method.
- **The Backbone anchor was set.**
- **The acid releasable shoe closed.**
- **Lab jetting testing results** predict penetration rate and required pumping volume.
- **30 X PI**

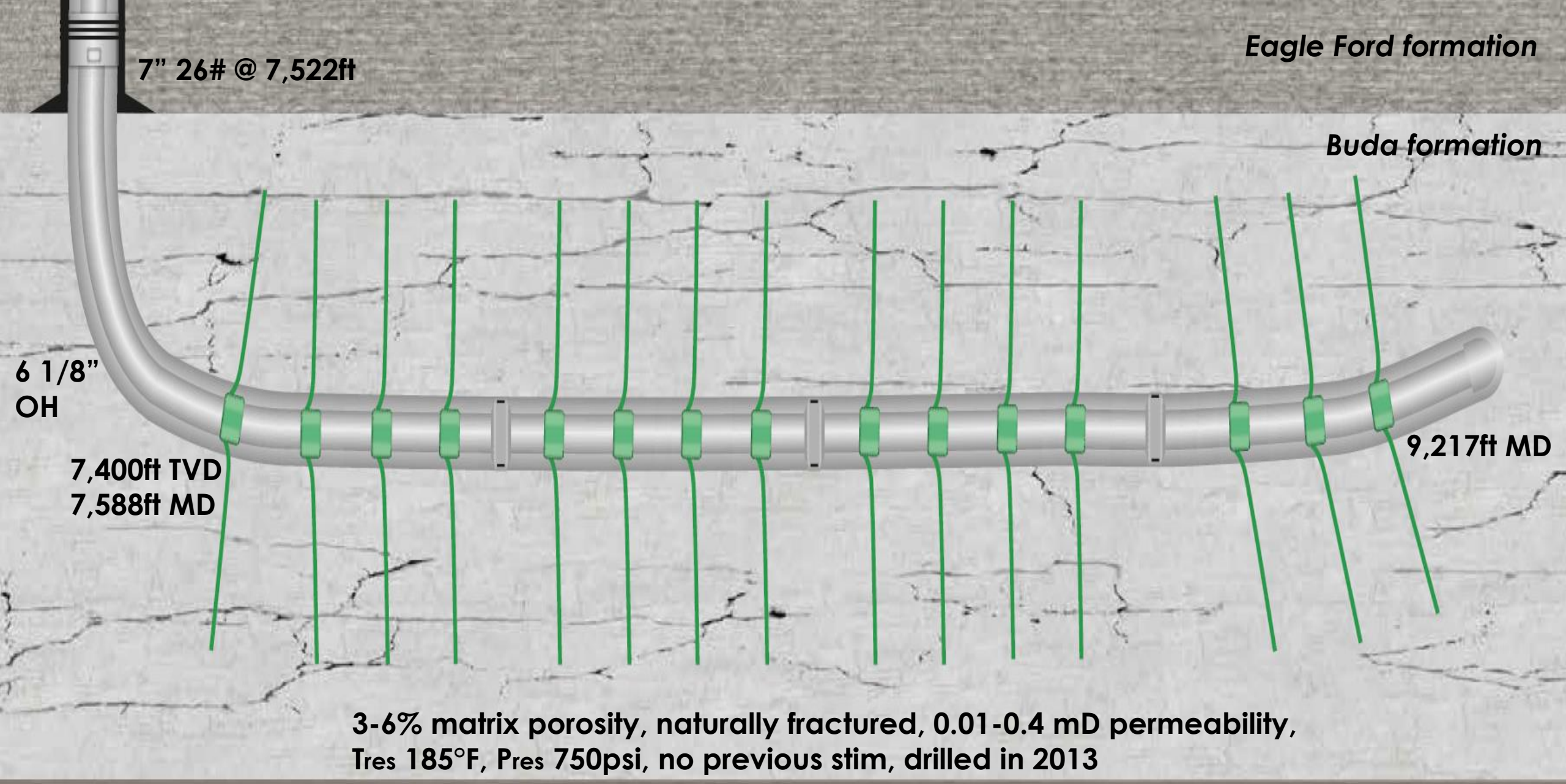
16 months' production



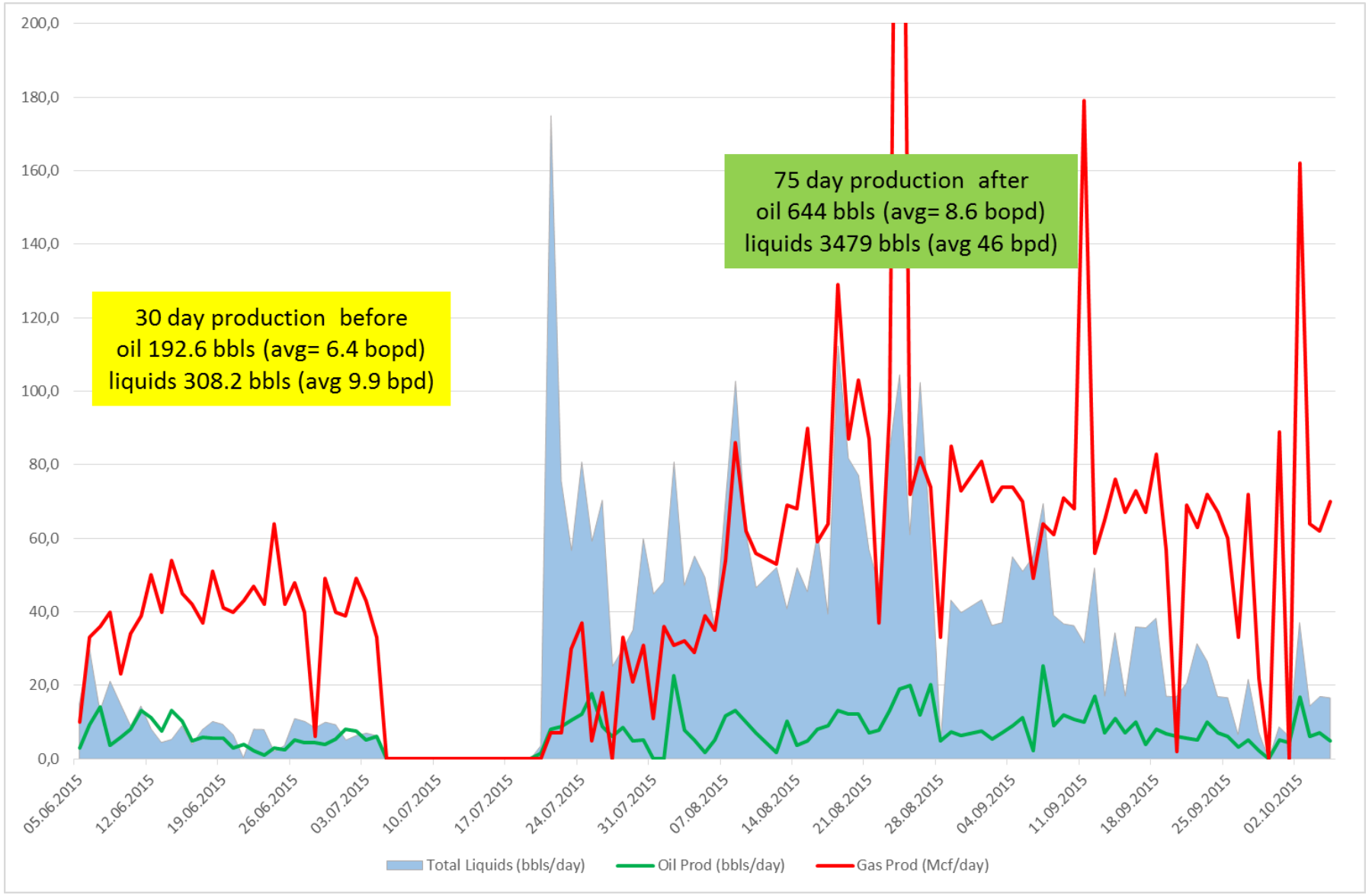
Fishbones MST installation #2 in USA

- JCR installation #2, June 2015
- Buda formation, Texas
- Tight, fractured limestone
- Horizontal well, 6 1/8" open hole
- 15 ea. Fishbones subs, 3 ea. Backbones
- Successful installation
  - 60 laterals, 4 hrs total pumping time
  - Similar pump chart profile as first well
- Flow back results are encouraging



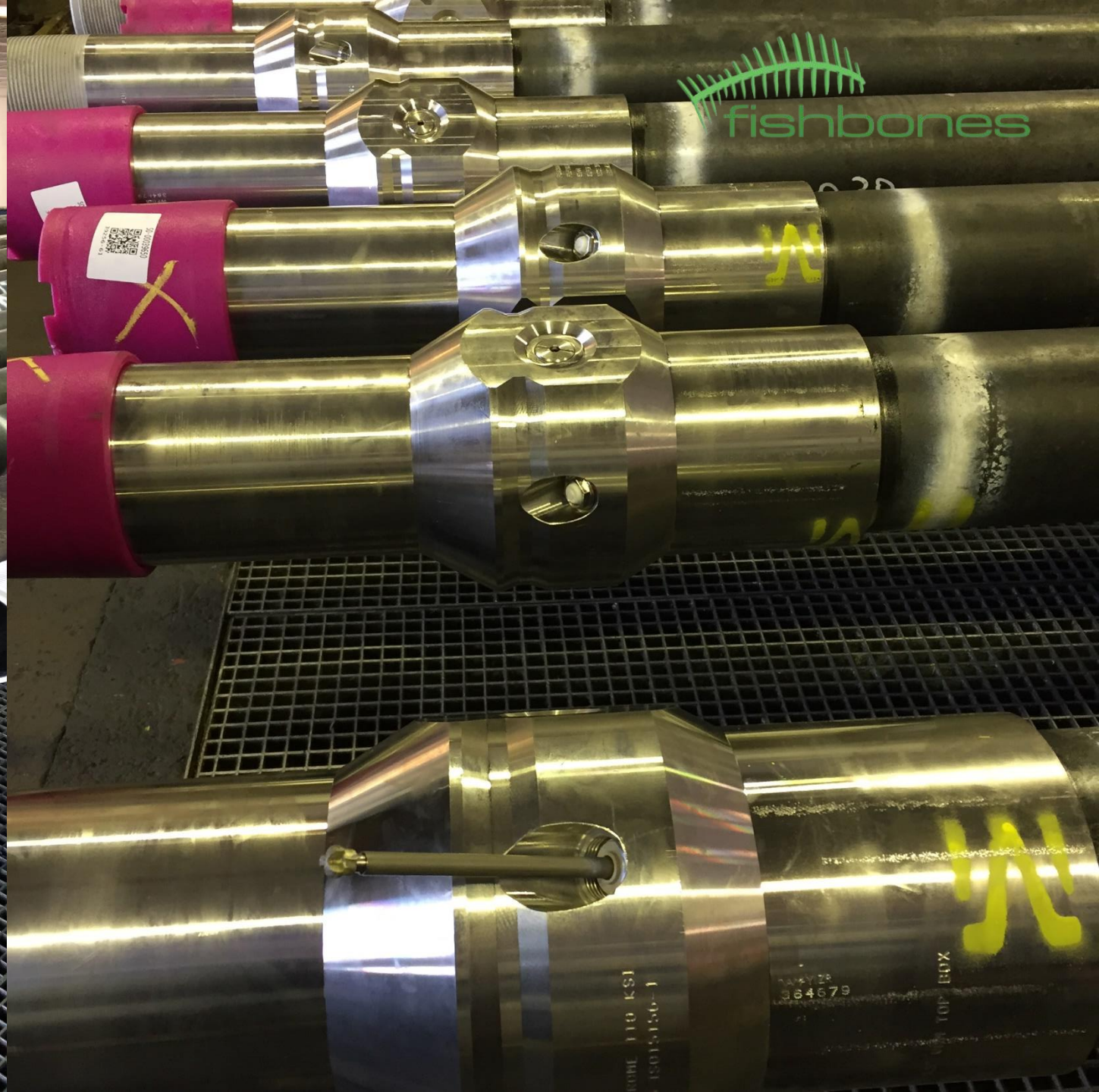

7” 26# @ 7,522ft
Eagle Ford formation
Buda formation
6 1/8”
OH
7,400ft TVD
7,588ft MD
9,217ft MD
3-6% matrix porosity, naturally fractured, 0.01-0.4 mD permeability,
Tres 185°F, Pres 750psi, no previous stim, drilled in 2013

75 days' production



First Dreamliner MST installation

- Offshore Norway, July 2015
- New well in tight sandstone formation
- 2012m / 6600ft horizontal section
- 8.5” open hole with 5.5” liner
  - 48 ea. Dreamliner subs – 144 laterals
  - 7 ea. Backbone open hole anchors
- Successful installation
  - Liner run to TD without issues
  - 6 hours mud circulation time for laterals drilling
  - Pressure responses indicate extension of needles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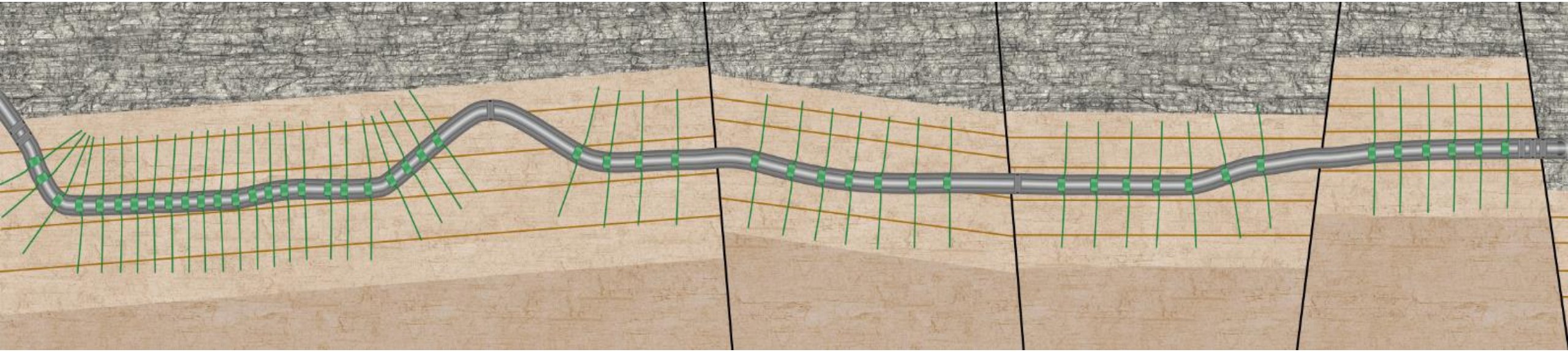
Motivation for using Dreamliner MST

- Fracture length – Underlaying reservoir is gas filled. Risk of fracturing into with conventional fracturing
- Internal barriers –Internal barriers in reservoir that need to be penetrated for increased reservoir contact
- Sand strength – Competent and consolidated sandstone requiring no sand control
- The downside risk assessed to be limited



Statoil news release September 4th

Smørbukk South Extension in operation – producing from «tight» reservoir

Two and a half years after project sanction, production commences from Smørbukk South Extension. The offshore project at the Åsgard field is a world class project in production from tight formations.

Through a combination of wells with long well sections and new completion technology, oil and gas are now produced from a reservoir previously regarded as not feasible. This pioneer project opens up for other similar developments.

The reserves in the Smørbukk South Extension project are estimated to be 16.5 million bbl oil equivalent and will contribute significantly to the production from the Åsgard A FPSO in the times ahead.

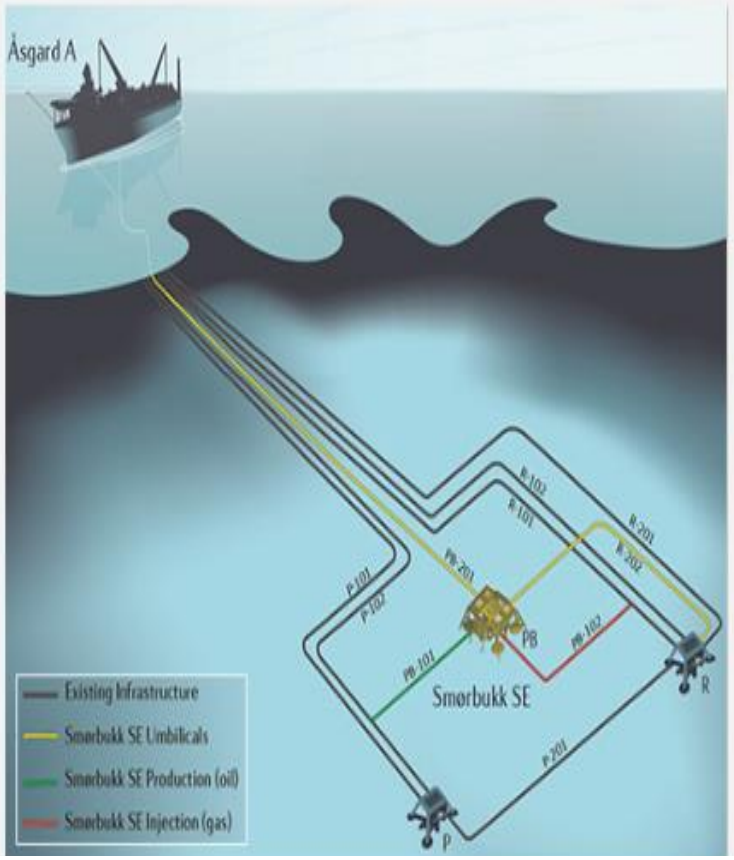
"The project is delivered below the initial sanctioned cost estimate at sanctioning and exactly on the date of startup. The future of the NCS is to a large degree dependent on cost-efficient development of small but important projects like Smørbukk South Extention."

New technology

In addition to drilling long reservoir sections, the so called «fishbone"-technology has been implemented for the first time on the NCS to further increase productivity. This technology involves drilling 150 «fishbones» where each "bone" is 10-12 meters long into the reservoir from the main well.

This technology involves drilling of «fishbones» into the reservoir from the main well.

"This is an important step forward in testing and implementing a technology that enables increased oil recovery from reservoirs where the method of fracking is not feasible. The experience gained with long reservoir sections and «fishbones» opens up for several new projects both at the Åsgard field and elsewhere on the NCS," states Petech manager at Åsgard Mari Skaug.



Source: www.statoil.com

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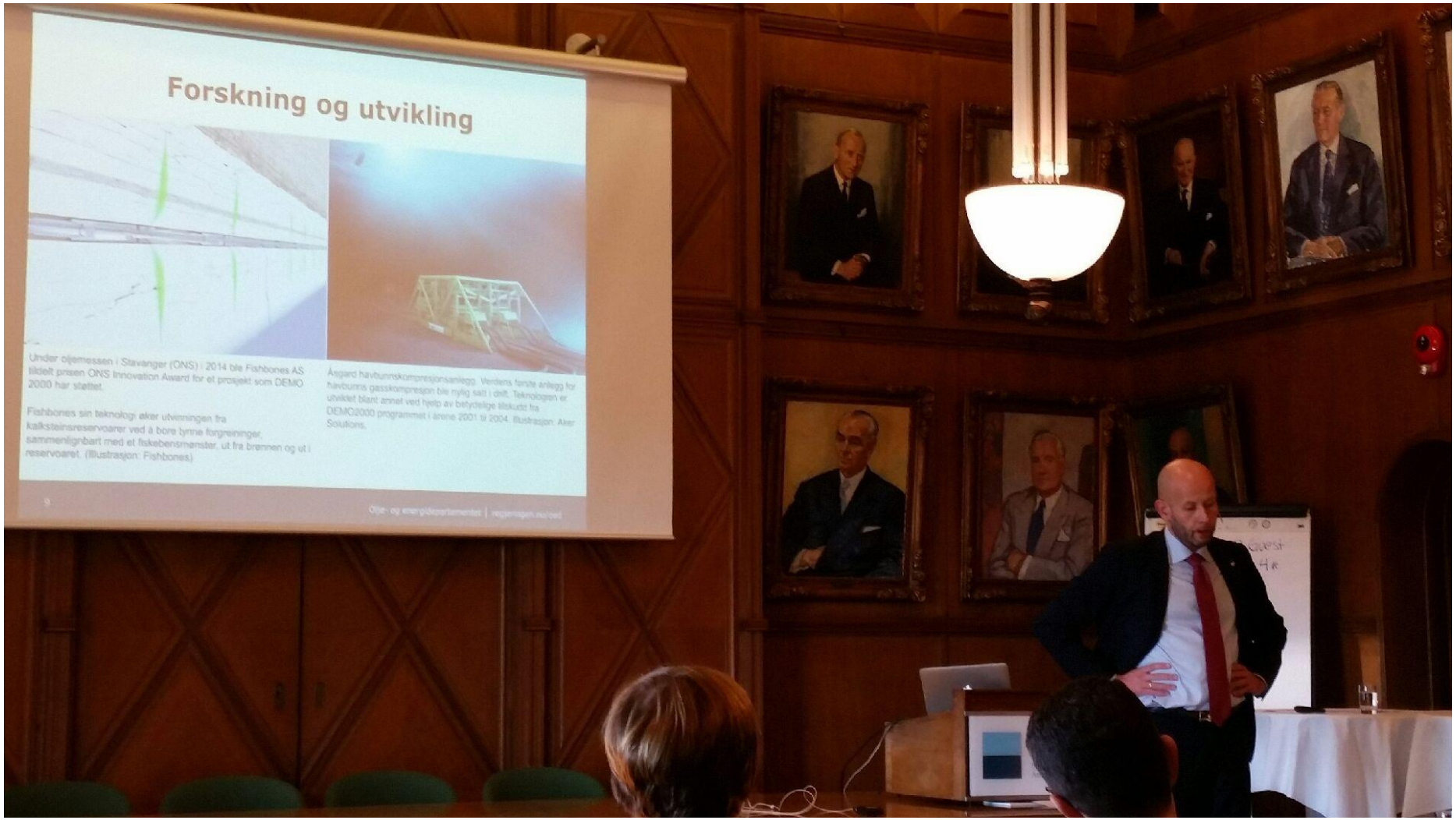
Minister of Petroleum & Energy, Norway

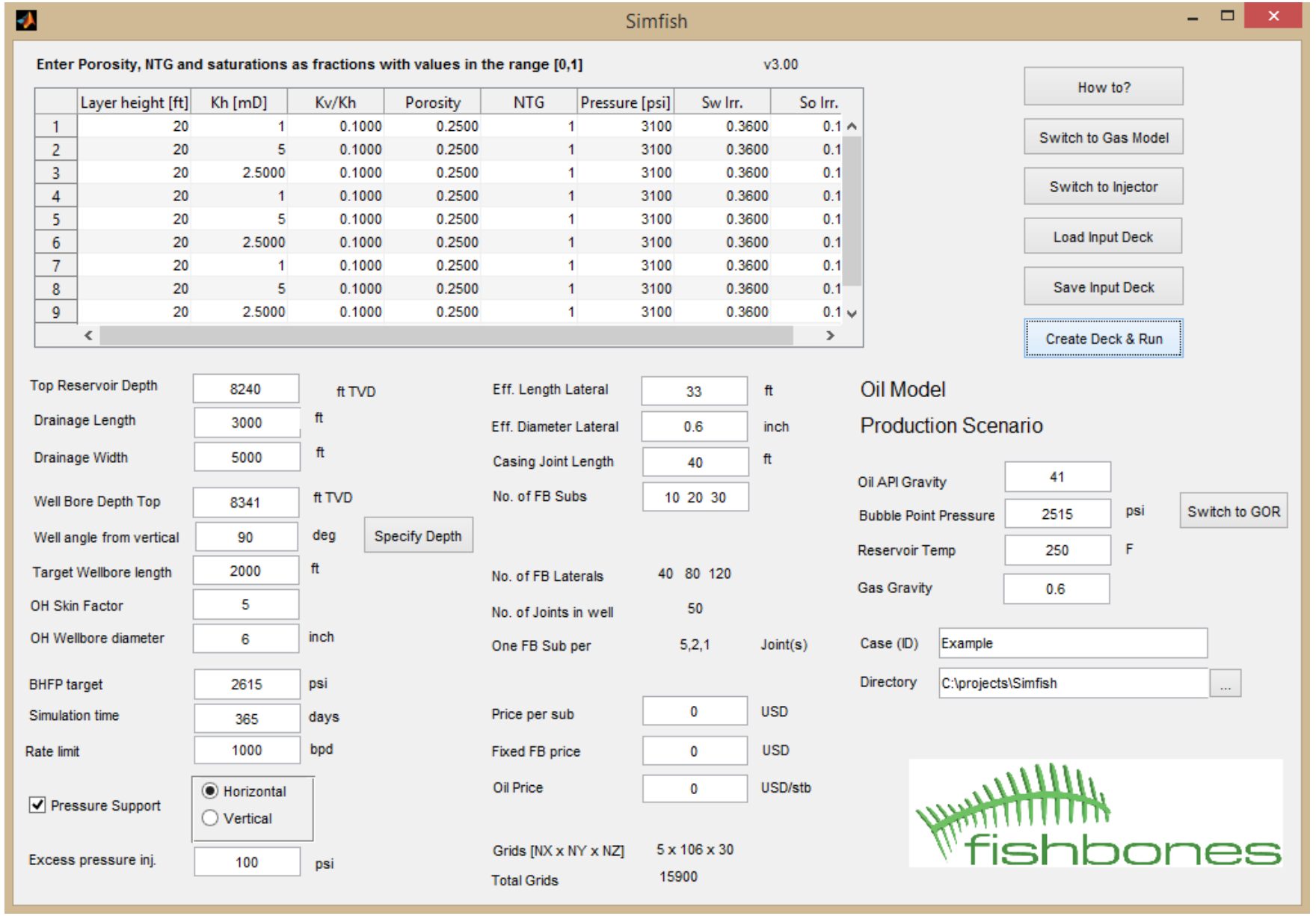


Oslo 15. October 2015

Simfish

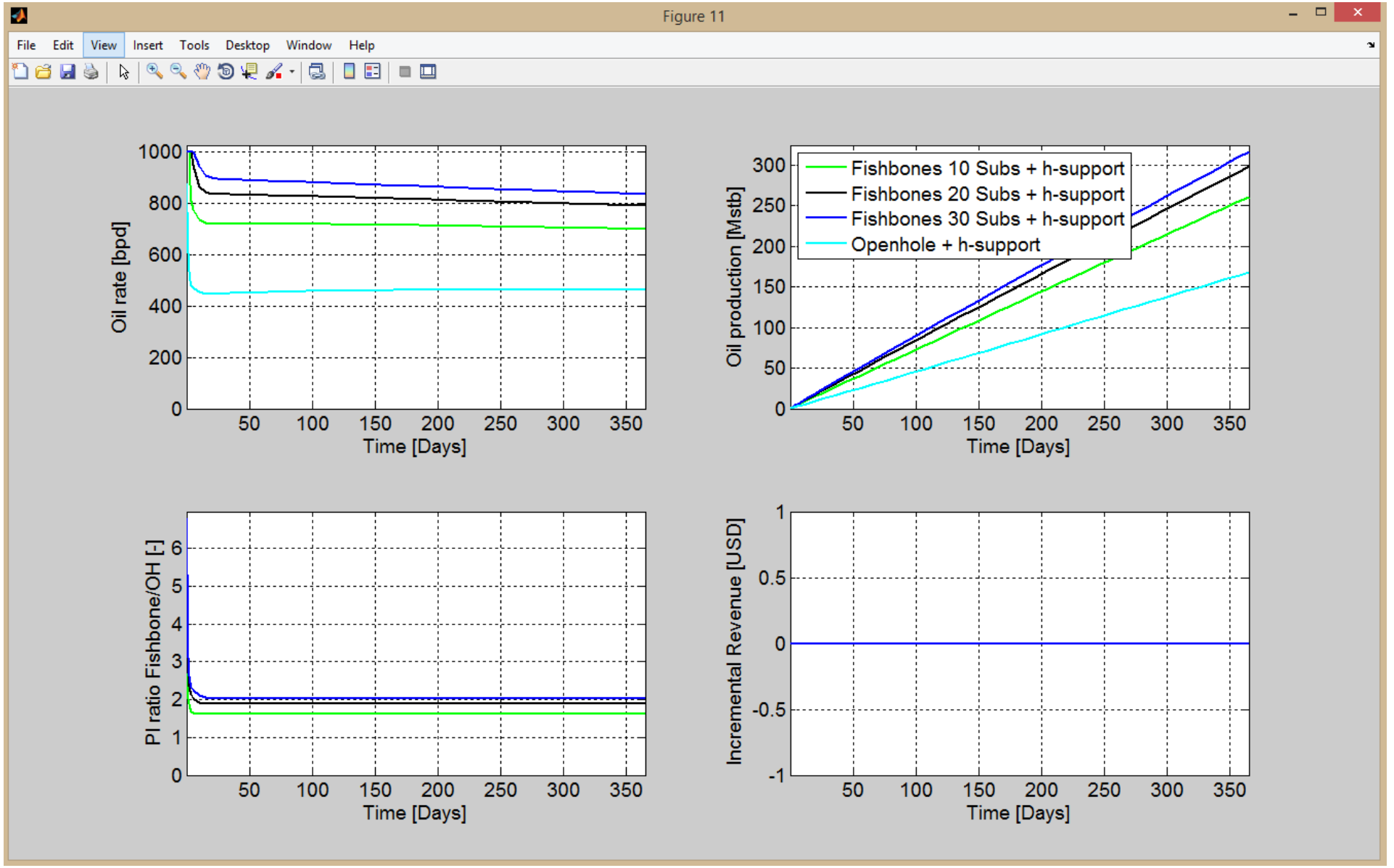
- SINTEF MRST - Fenix Consulting Delft
- Fishbones vs. Open hole
- Simplified grid
- Estimates oil rates, PI increase and incremental oil
- Producers and injectors
- 1-6 min execution
- Generates Eclipse compatible wellbore geometry

Simfish example – input deck



	Layer height [ft]	Kh [mD]	Kv/Kh	Porosity	NTG	Pressure [psi]	Sw Irr.	So Irr.
1	20	1	0.1000	0.2500	1	3100	0.3600	0.1
2	20	5	0.1000	0.2500	1	3100	0.3600	0.1
3	20	2.5000	0.1000	0.2500	1	3100	0.3600	0.1
4	20	1	0.1000	0.2500	1	3100	0.3600	0.1
5	20	5	0.1000	0.2500	1	3100	0.3600	0.1
6	20	2.5000	0.1000	0.2500	1	3100	0.3600	0.1
7	20	1	0.1000	0.2500	1	3100	0.3600	0.1
8	20	5	0.1000	0.2500	1	3100	0.3600	0.1
9	20	2.5000	0.1000	0.2500	1	3100	0.3600	0.1

Simfish example – results



Work process

Initial contact/meeting

Client to fill in Well Information sheet

Fishbones evaluates information

Client to provide core samples for testing if deemed needed

Fishbones performs core sample testing and report

Fishbones develops technical solution if project is feasible

Fishbones technical / commercial proposal to client

Client Purchase Order

Well planning

Fishbones delivery, assembly and installation

Global footprint – Focus on NOCs & Majors

Joint Chalk Resource group (JCR)

bp
Eni
Statoil
Shell
TOTAL
HESS
ConocoPhillips
DONG energy
MAERSK

www.fishbones.as

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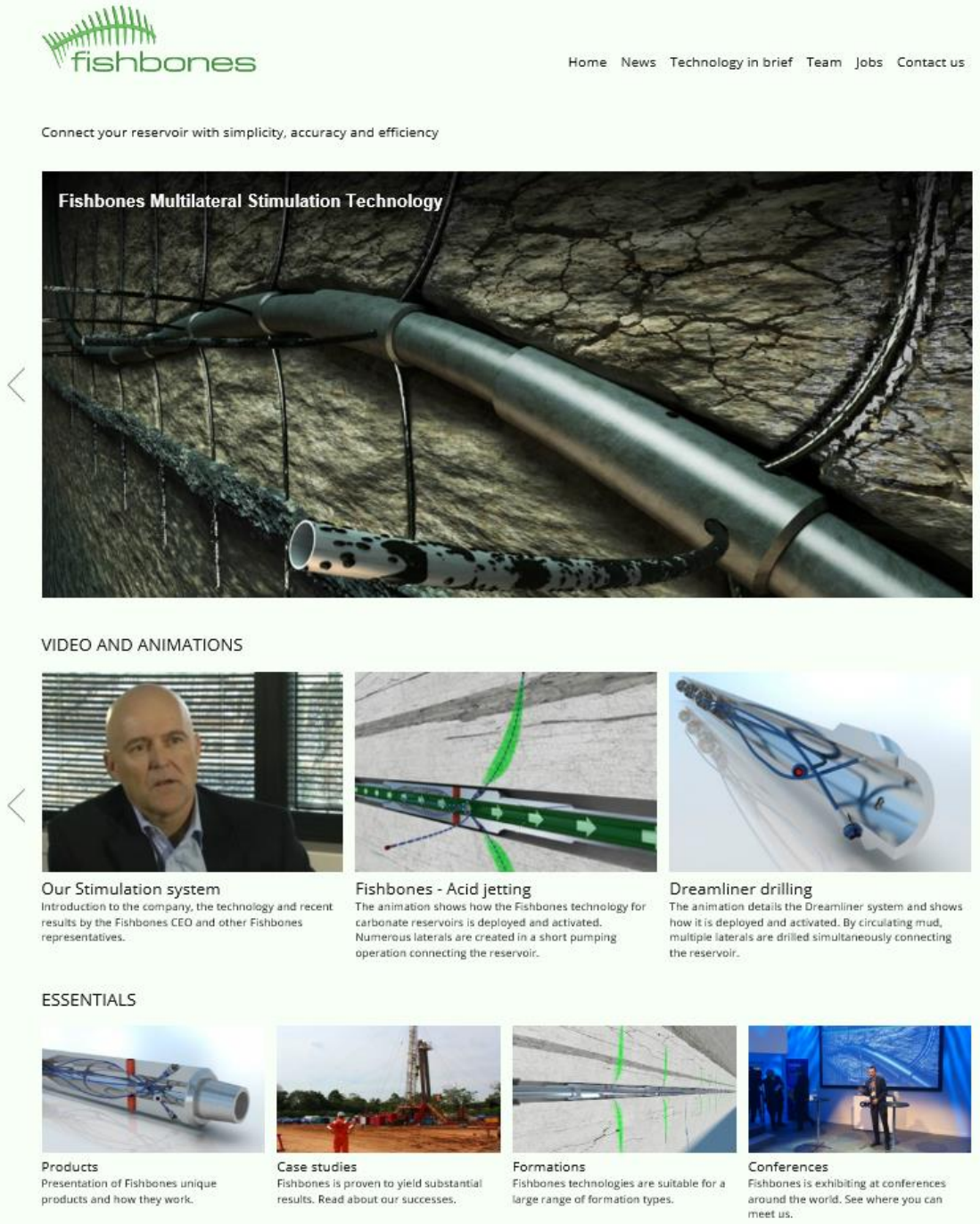

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Thank you

Connect your reservoir with simplicity, accuracy and efficiency