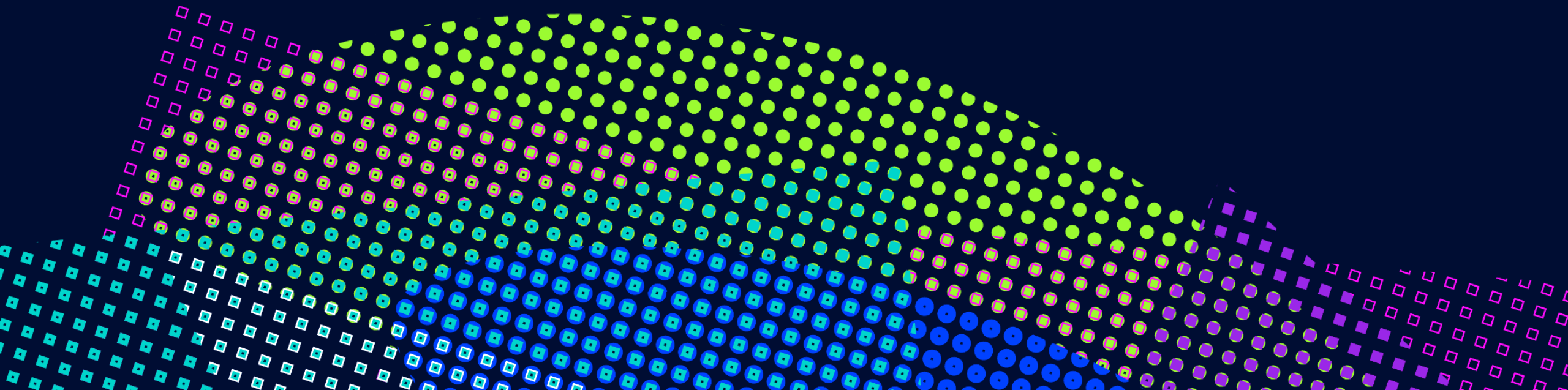
Diagnosing flow challenges in horizontal wells with smart completions

Vener Nagimov, Principal Domain Champion, TGT
Artur Giniyatullin, Snr Well Log Analyst



Presenter

Vener Nagimov, Principal Domain Champion

Artur Giniyatullin, Snr Well Log Analyst

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Learning outcomes

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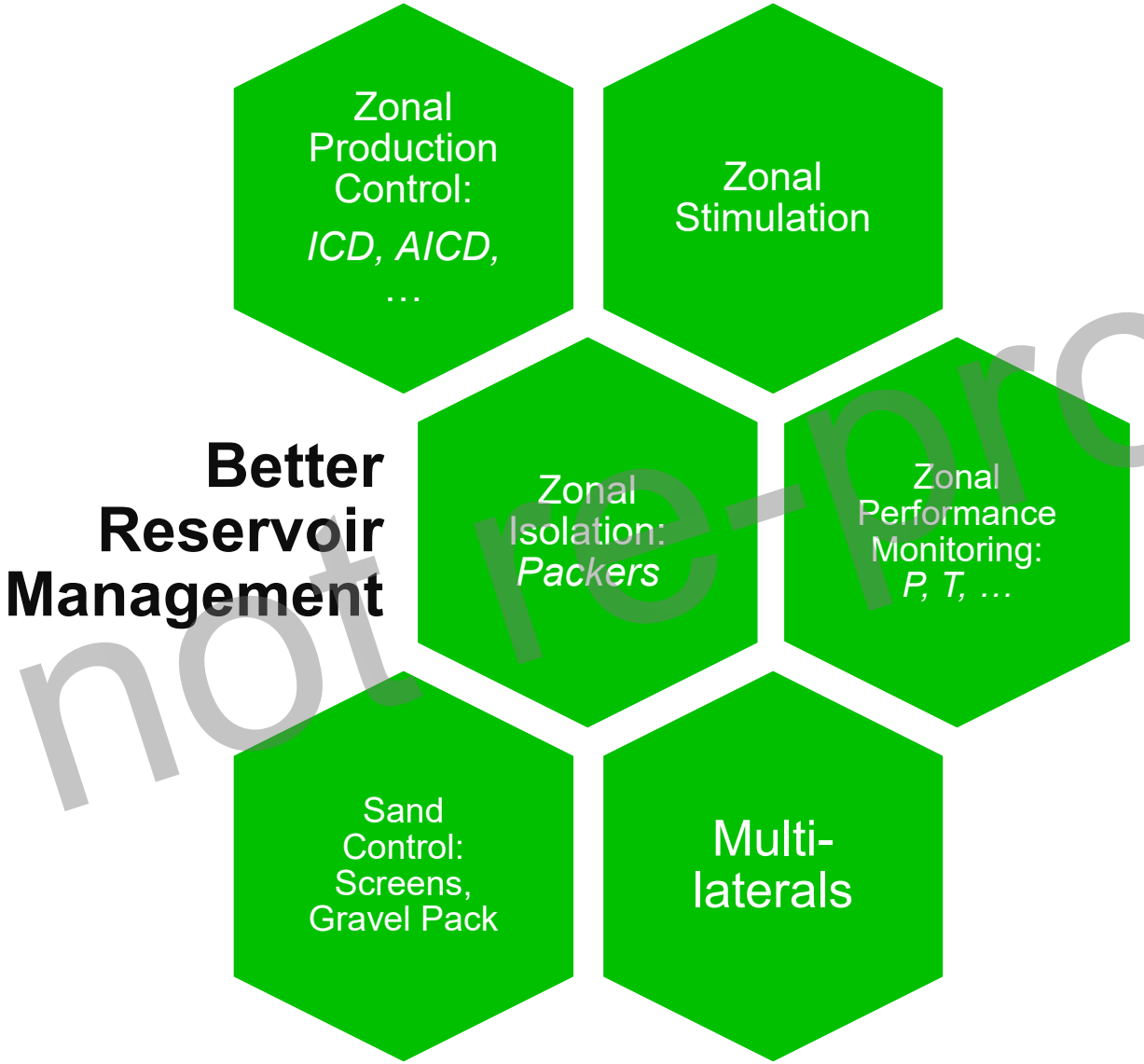
1. TGT Through-barrier Diagnostics is a key to assess reservoir flow profile and individual zones isolation
2. Through-barrier diagnostics can significantly improve smart wells completion design
3. Workover planning based on conventional PLT technologies are not sufficient in smart wells. Total Flow product is able to deliver accurately flow geometry around the wellbore for optimum workover planning

Smart Completion



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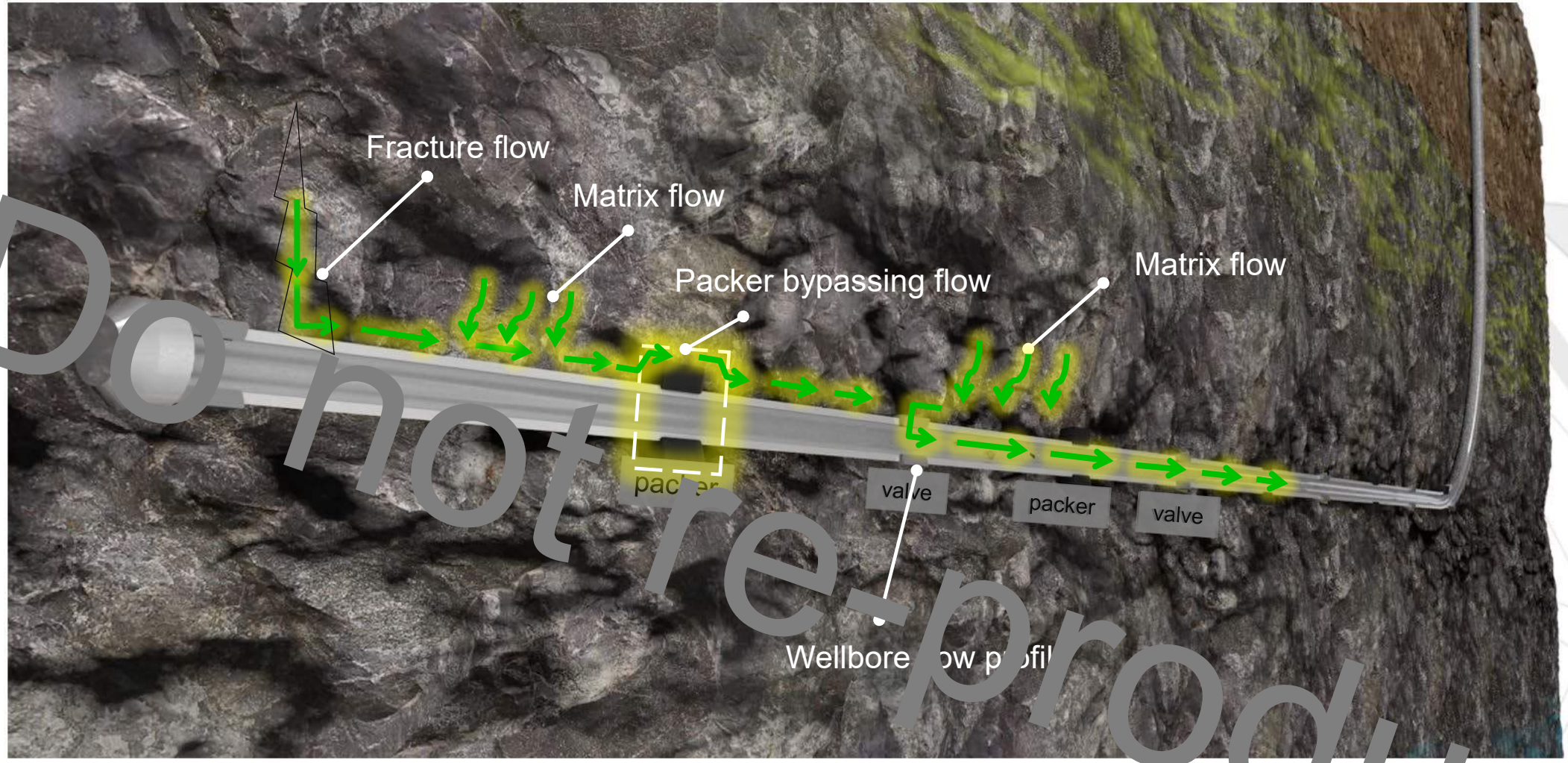
Smart Completion: Flow Challenges



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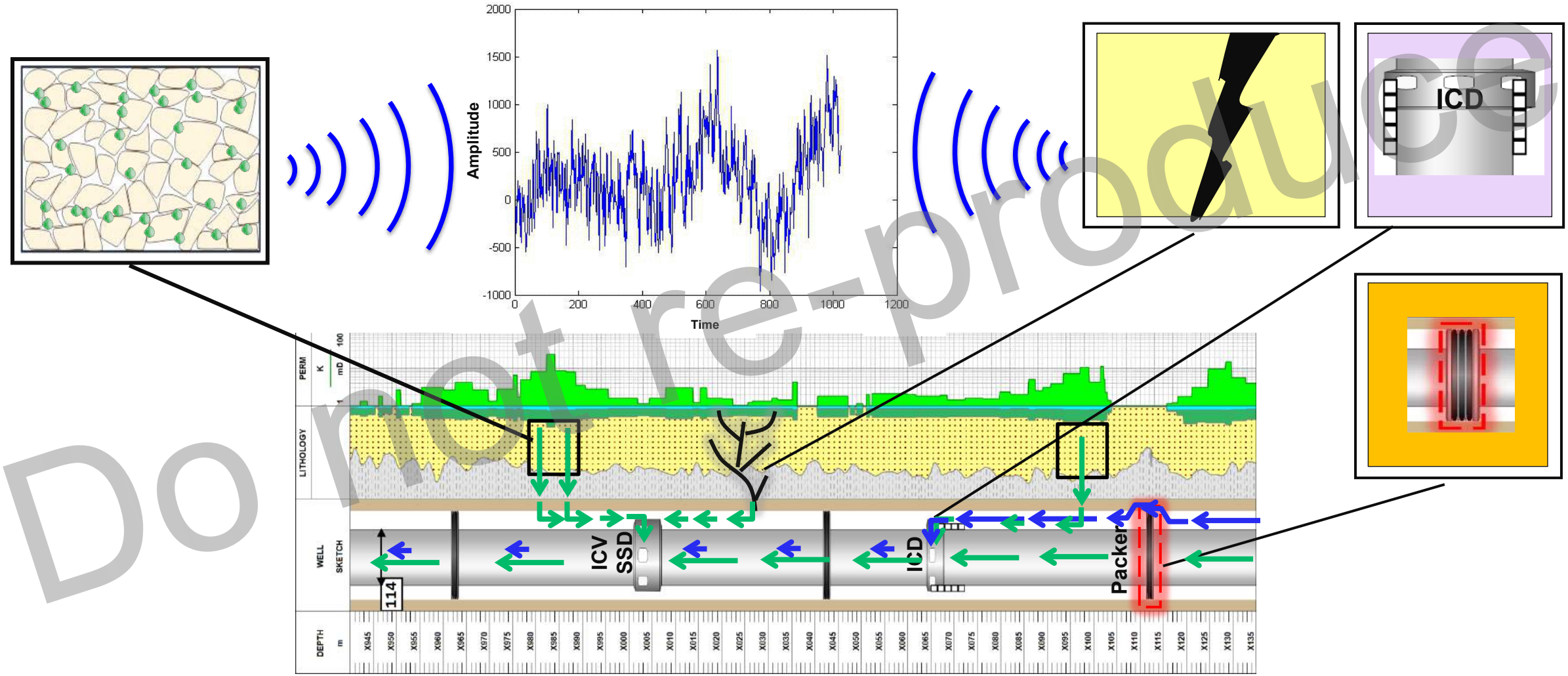
What is the Acoustic Sound Heard in Horizontal Wells?



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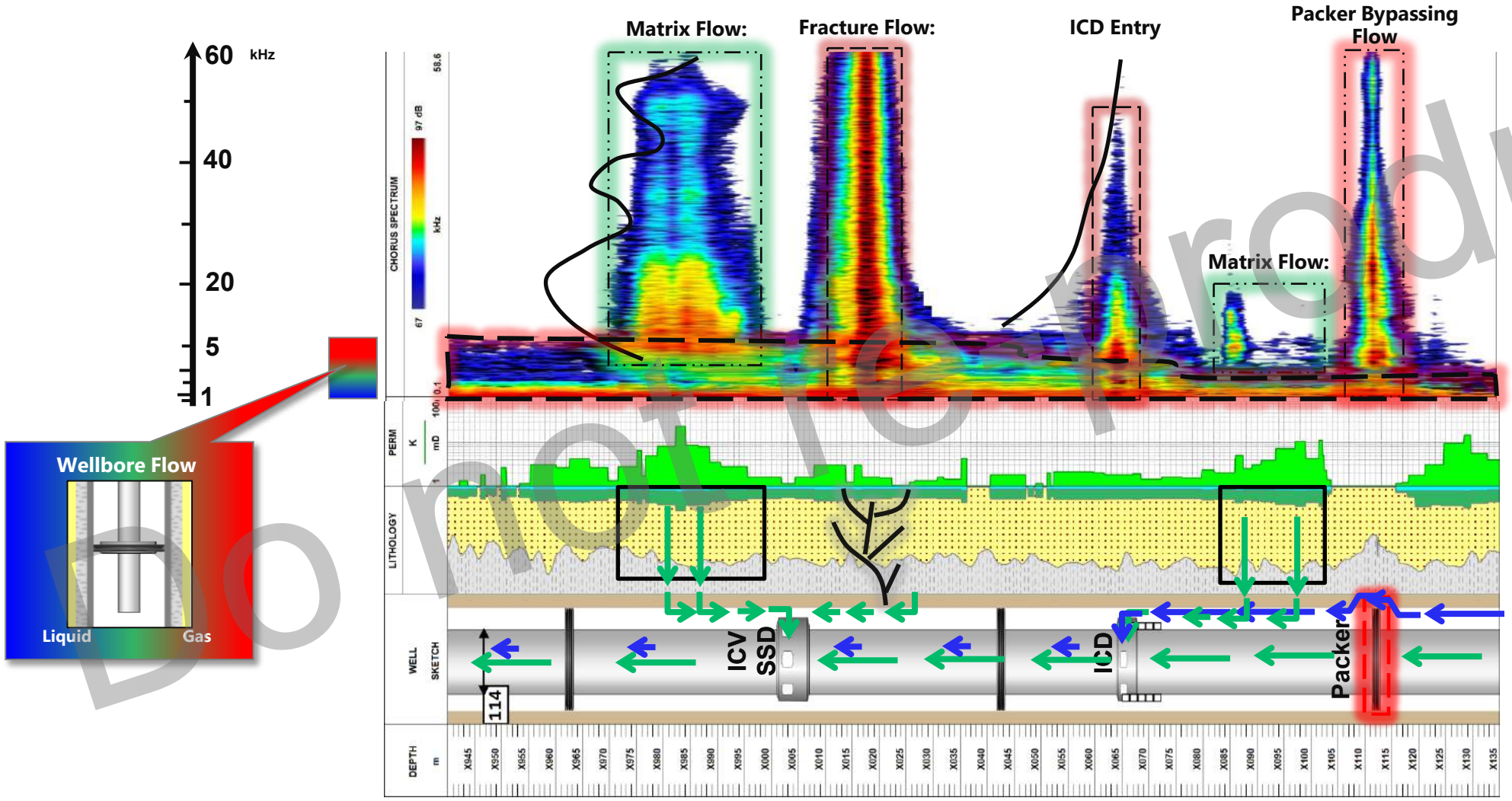
Acoustic Data Interpretation



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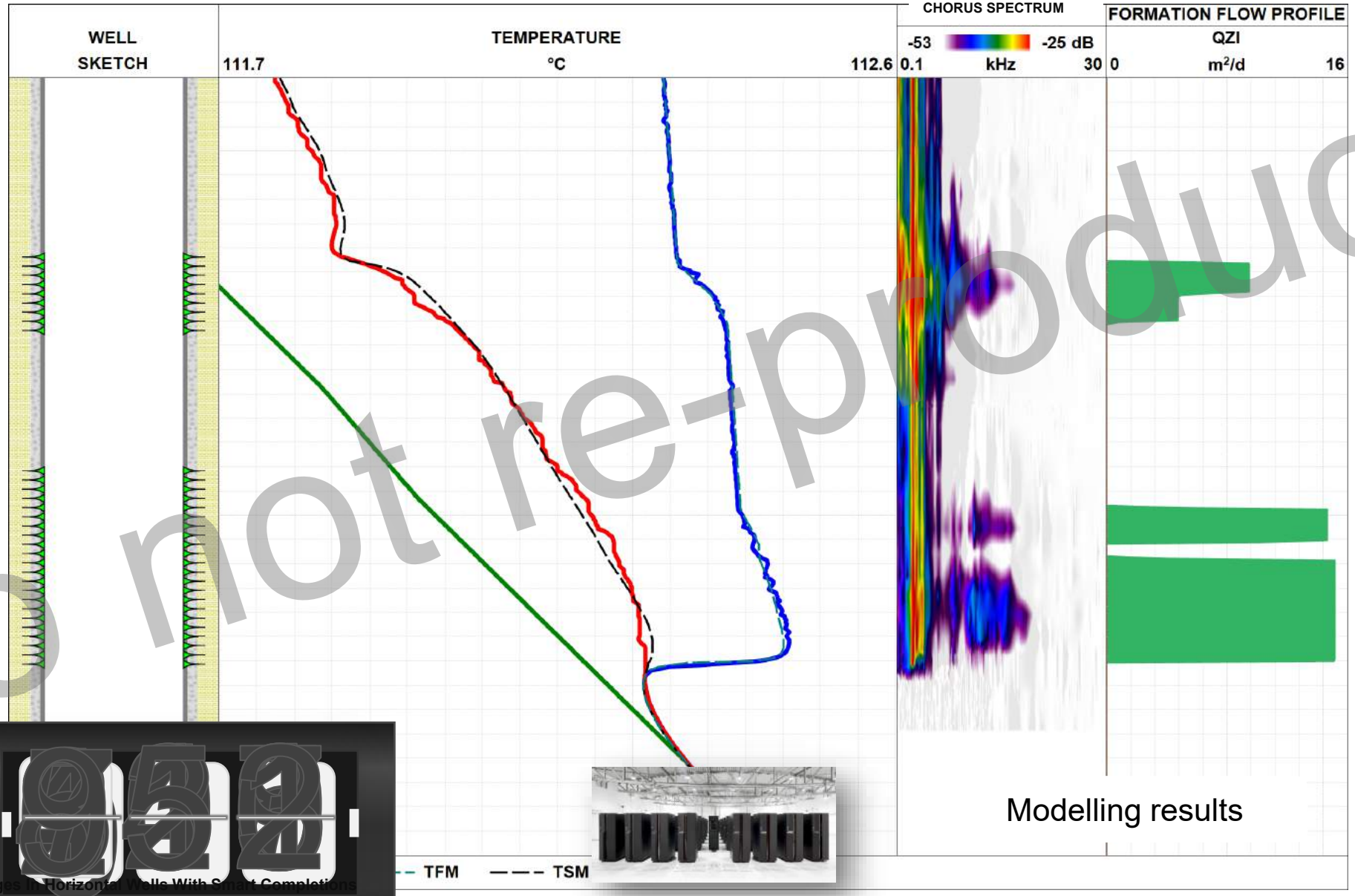
Temperature Modelling Basics

% = ?

% = ?

Modelling Procedure



20% (20 m^3/d)

80% (80 m^3/d)

Modelling results

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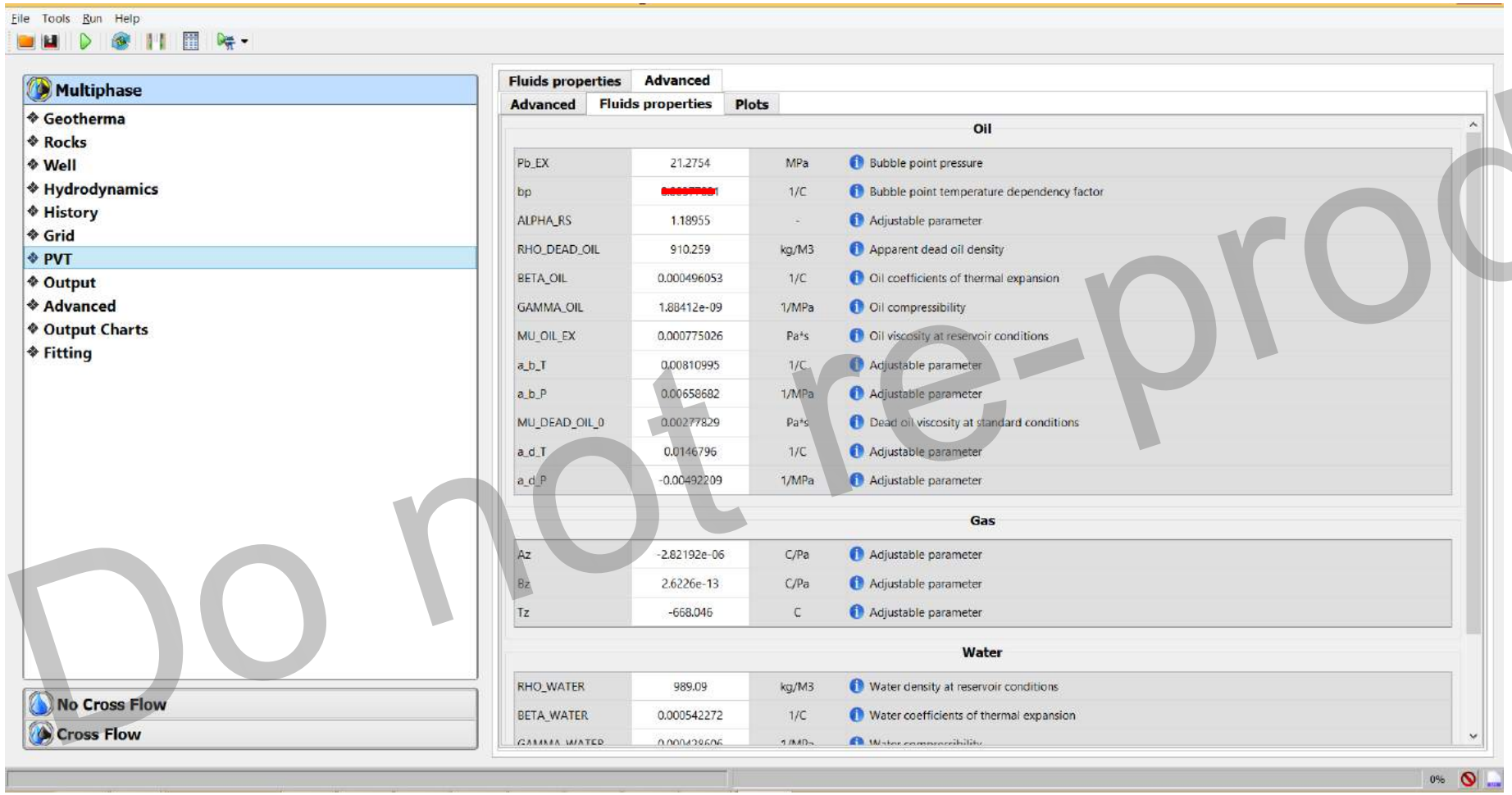
Cascade® Platform



Well trajectory

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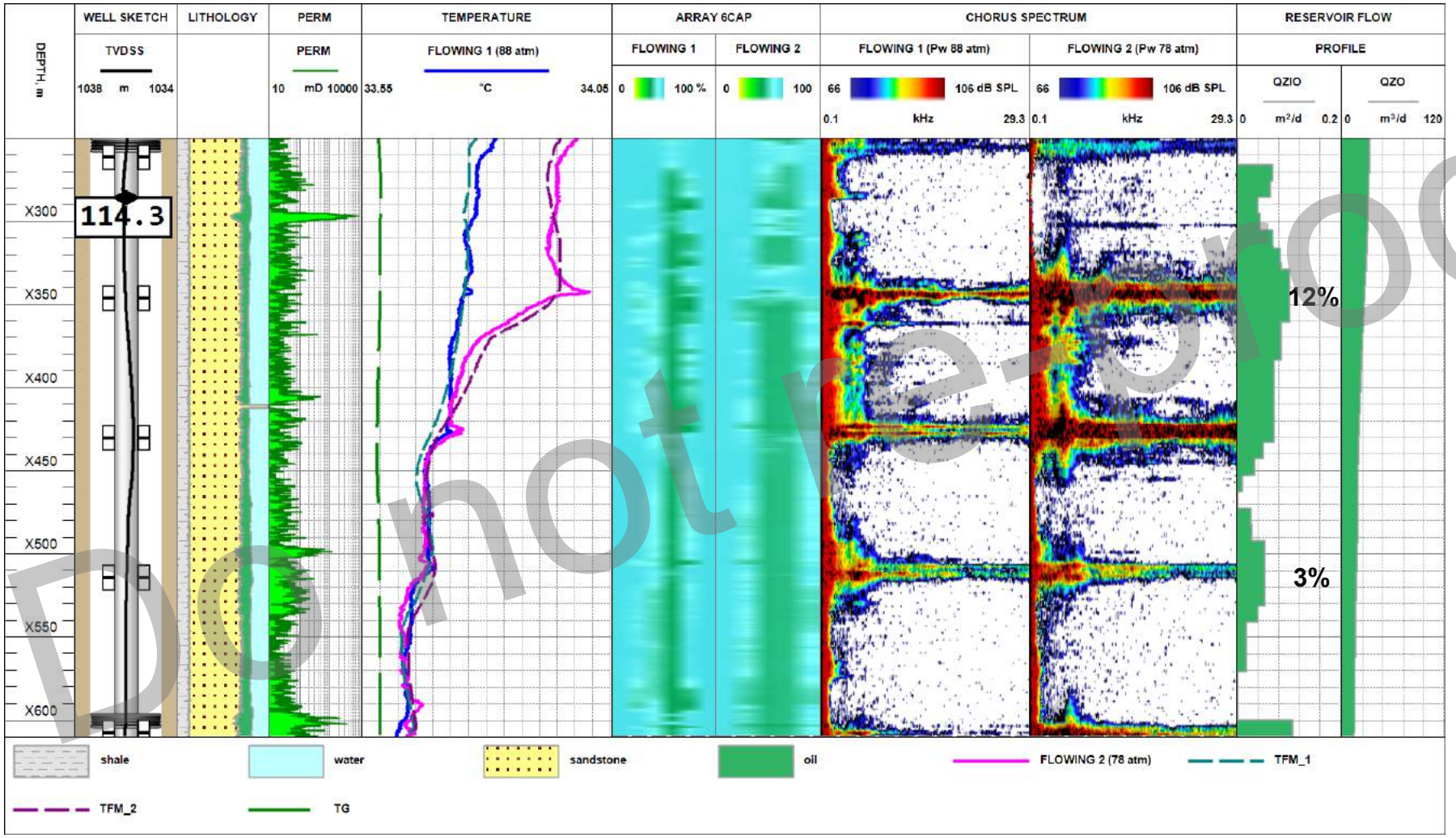
Profile Accuracy



Variable parameters

Zonal productivity σ_1

Zonal productivity σ_2

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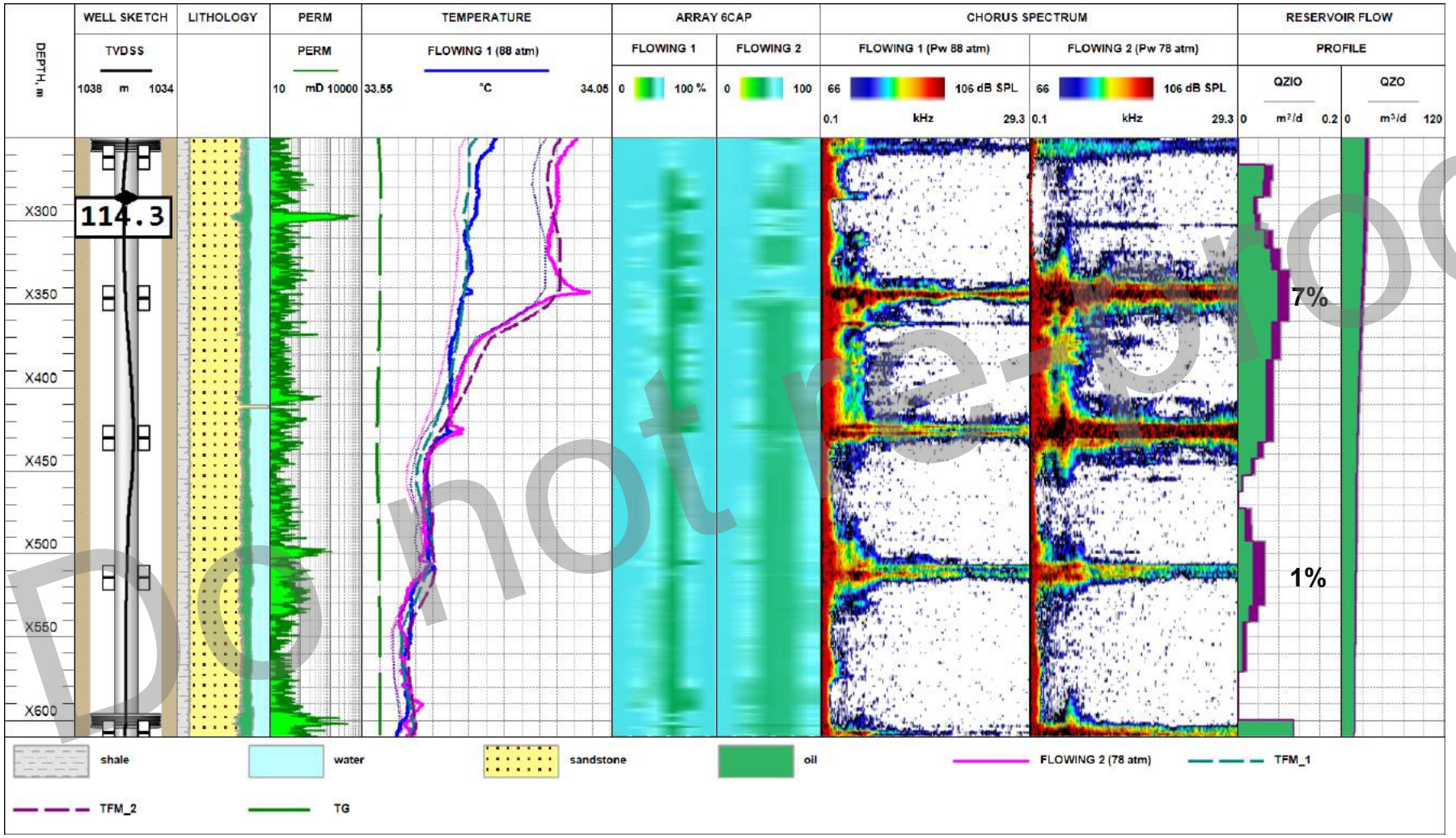
Profile Accuracy



Variable parameters

Zonal productivity σ_1 ↓

Zonal productivity σ_2 ↓

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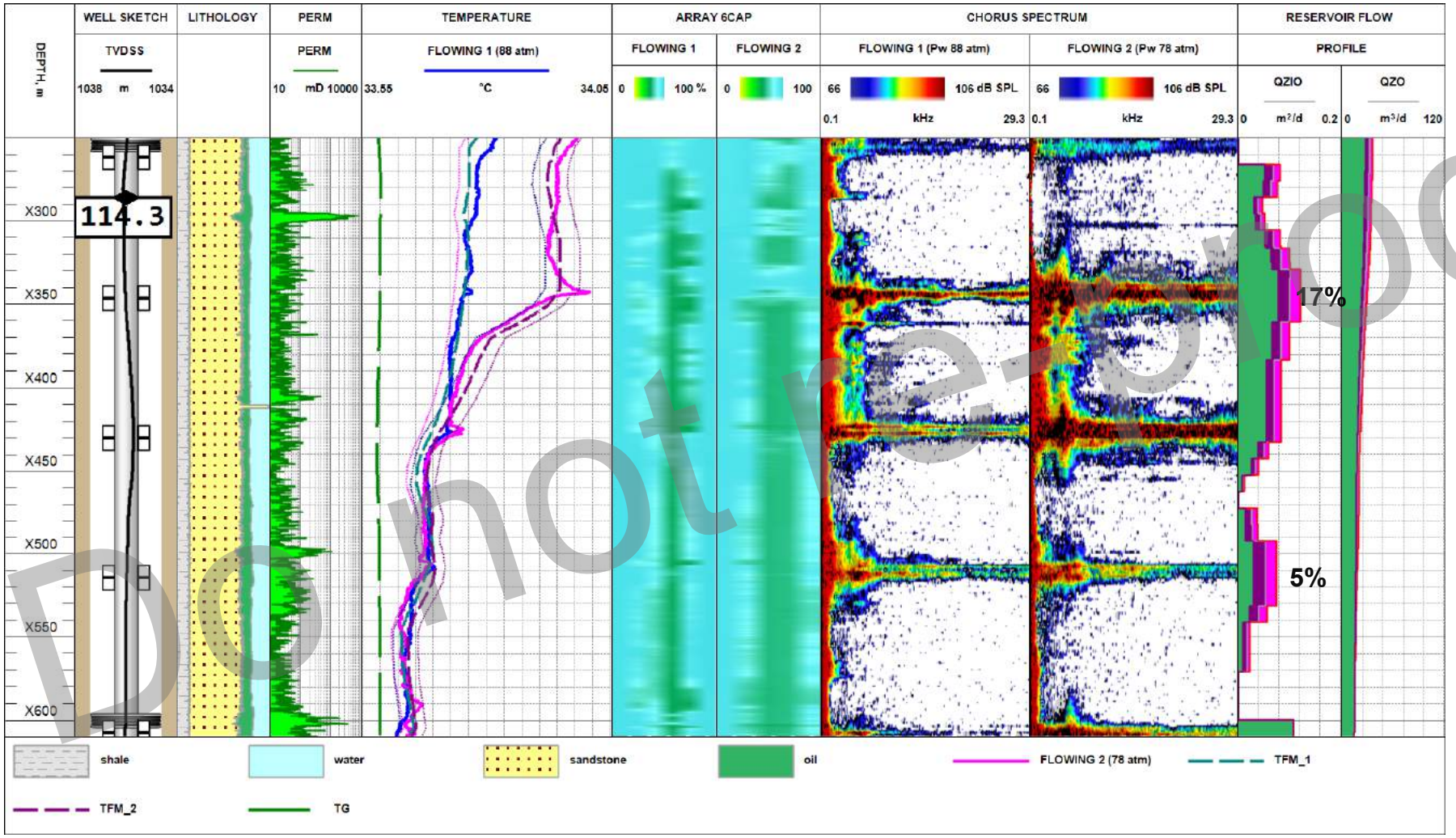
Profile Accuracy



Variable parameters:

Zonal productivity σ_1 ↑

Zonal productivity σ_2 ↑

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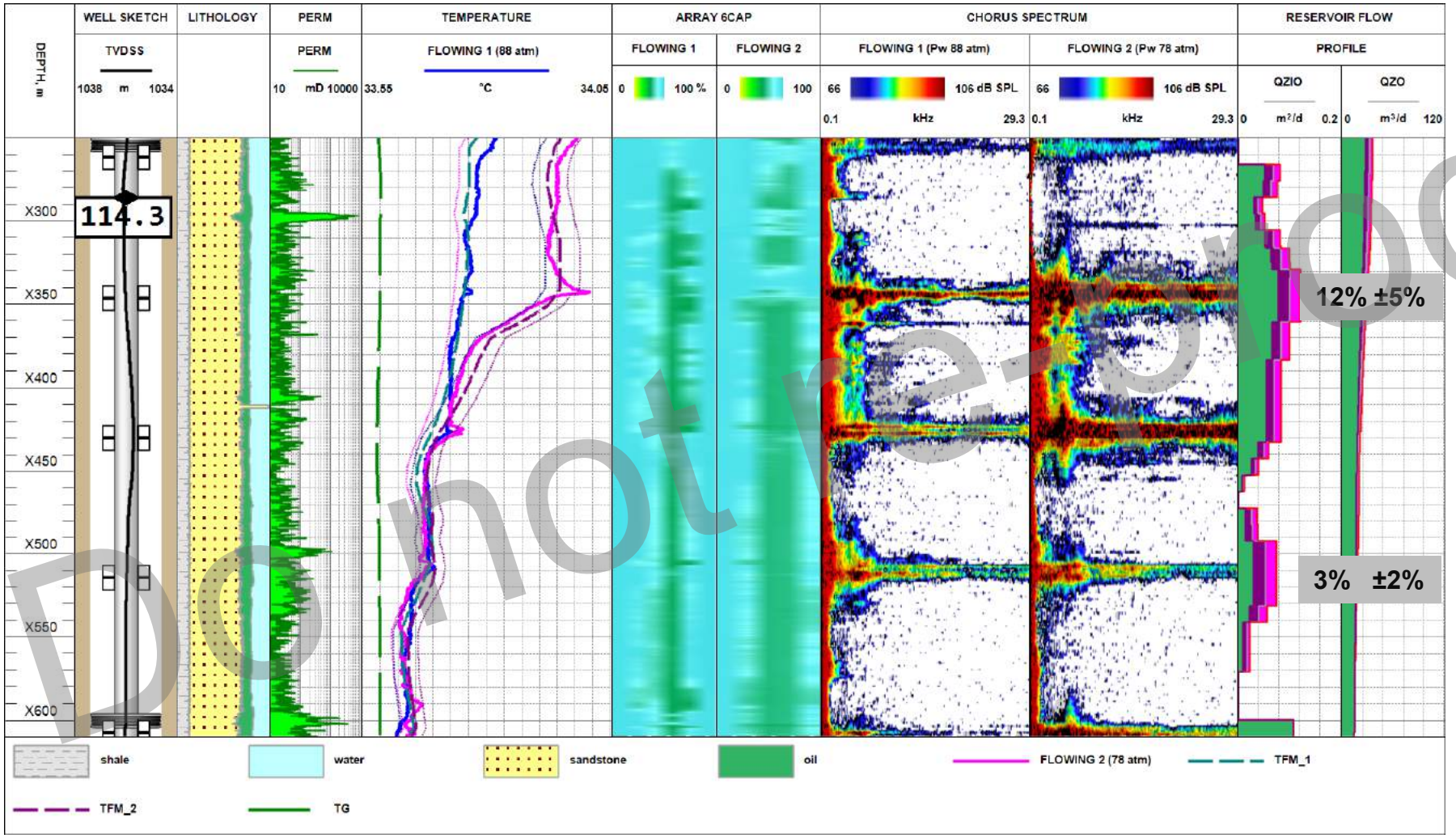
Profile Accuracy



Zonal accuracy ±5%

Zonal accuracy ±2%

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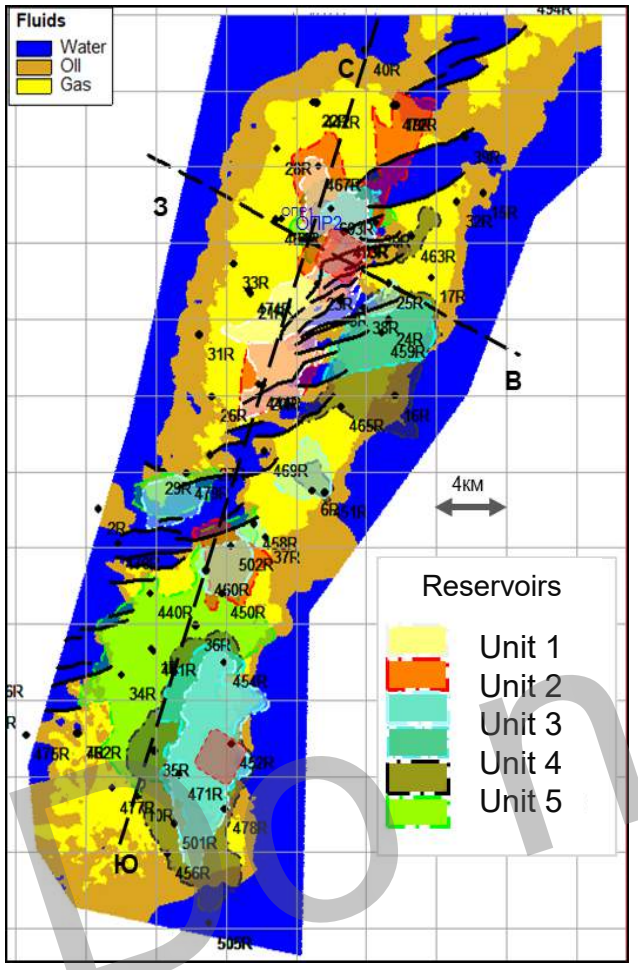
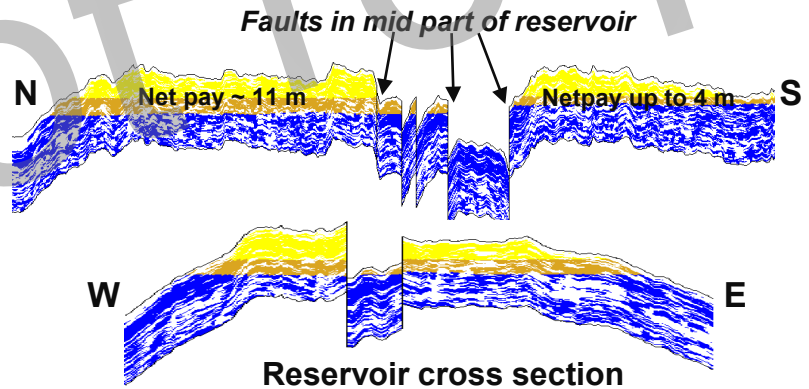
Case 1
Diagnostics in Smart Horizontal Wells in Sandstone Reservoir

Case 1: Reservoir Description and Geological Challenges



Geological Challenges:

- Thin oil rim thickness (4-20 m)
- Gas cap (up to 35 m)
- Aquifer (more than 40 m)
- Variable and heterogeneous deposits
- Reservoir is represented by poorly consolidated sandstone
- High oil viscosity in reservoir condition (>50 cP)
- Permeability in heteroliths:
  - Tidal Flat (Delta) facies: ~500-1000 mD,
  - Channel facies: up to 10000 mD



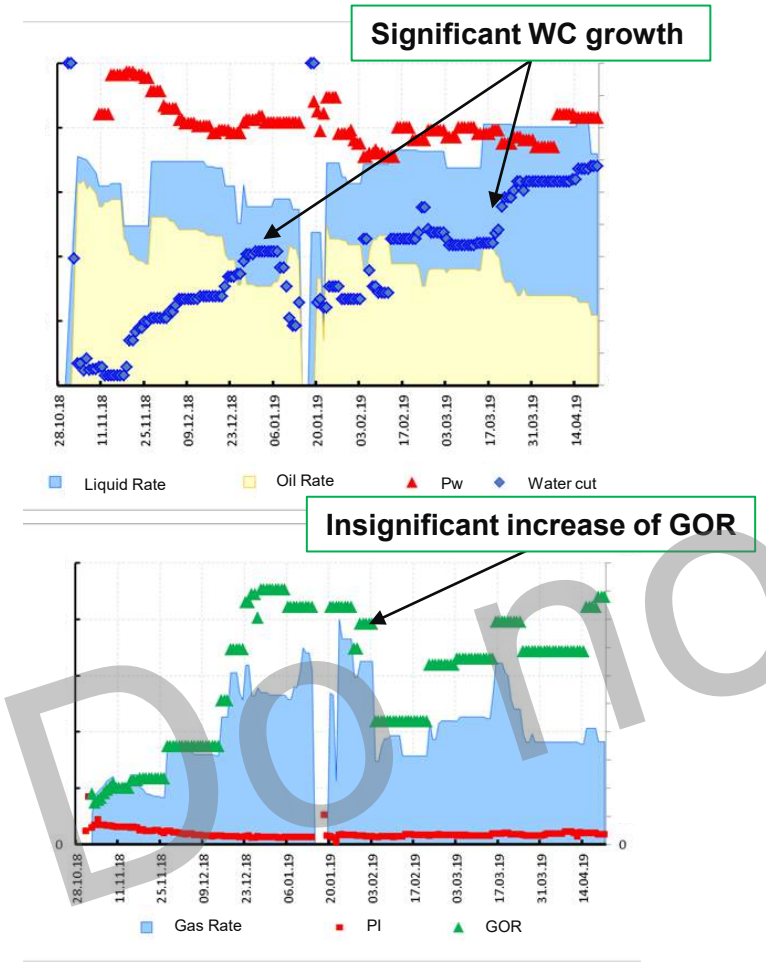
Reservoir cross section

Delta system

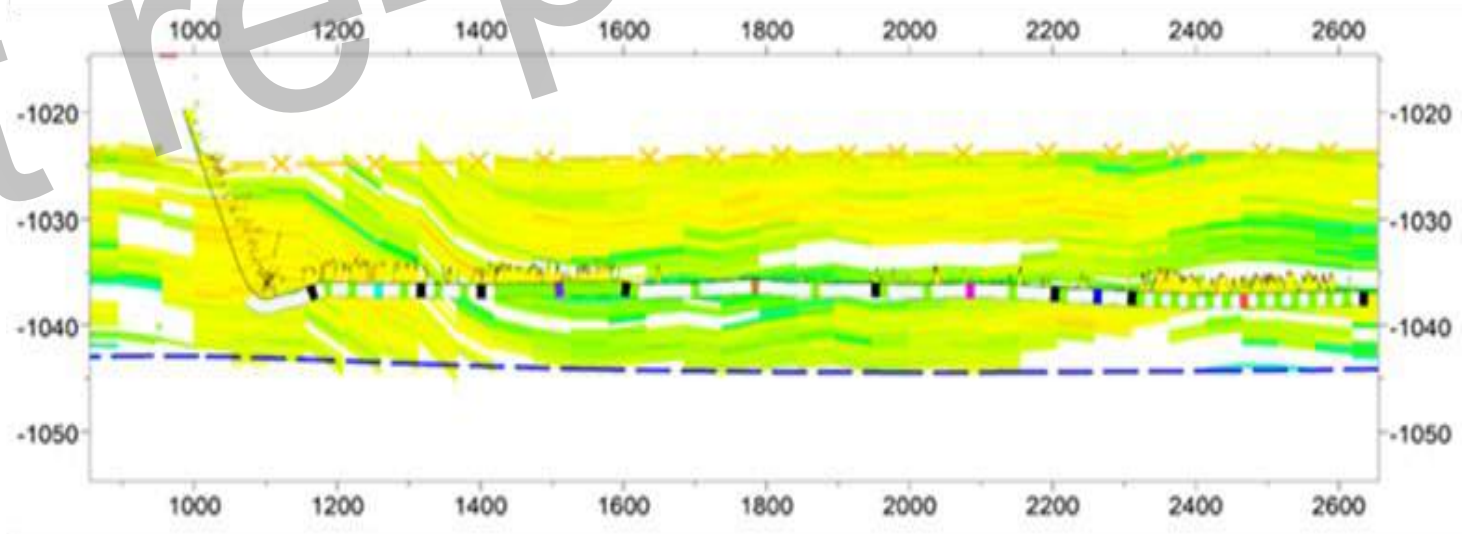
Channel facies (sandstone) up to 10000 mD

Tidal Flat (Delta) facies (clay sandstone) 100-1000 mD

Case 1: Well Information

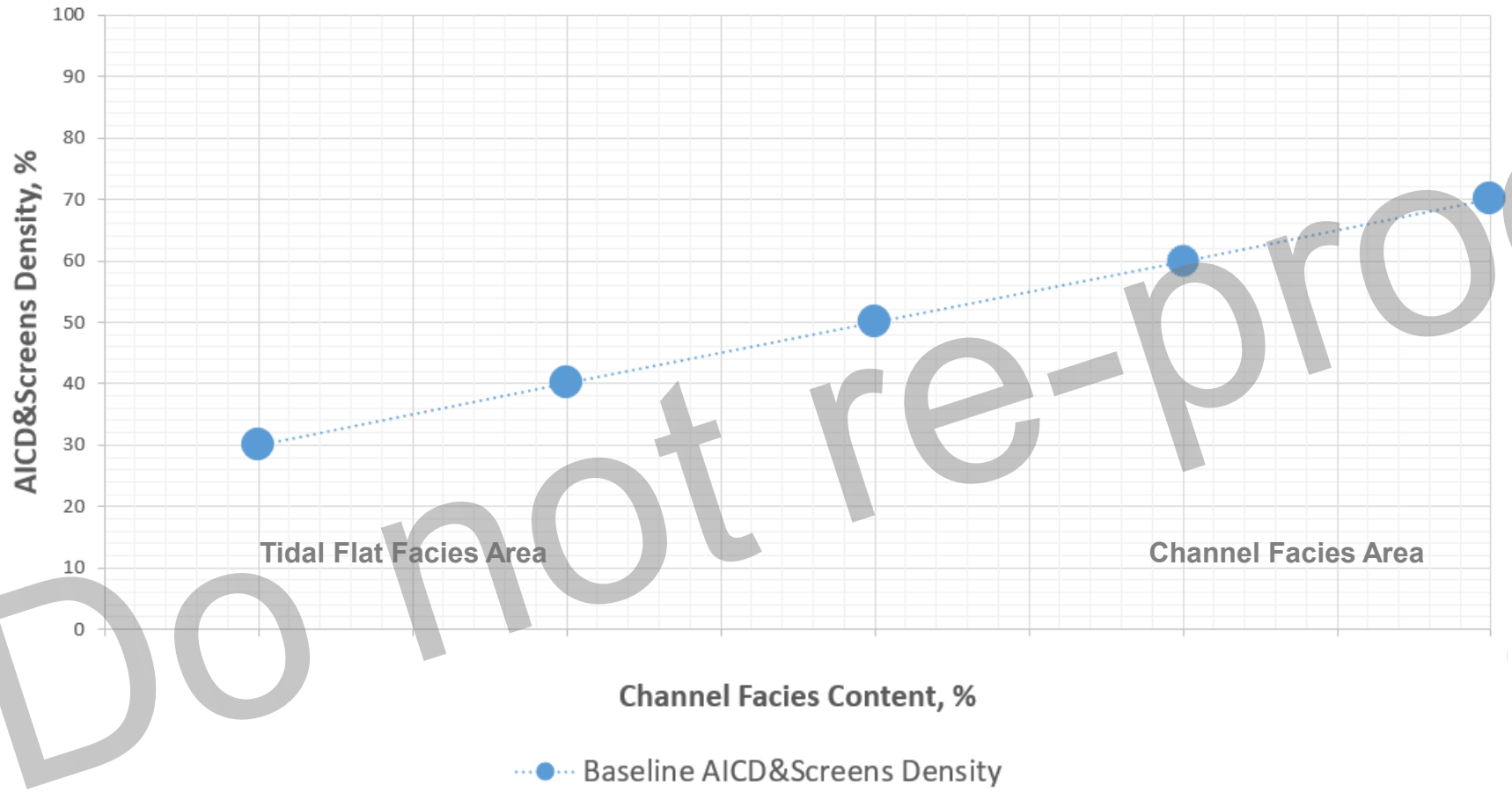


- Completion:
  - 7” casing and 4-1/2” liner
  - 7 separated zones
  - Swellable packers
  - Autonomous ICD (AICD)
  - Sand screens



Case 1: Through-barrier Diagnostics Results

Completion Strategy Improvement



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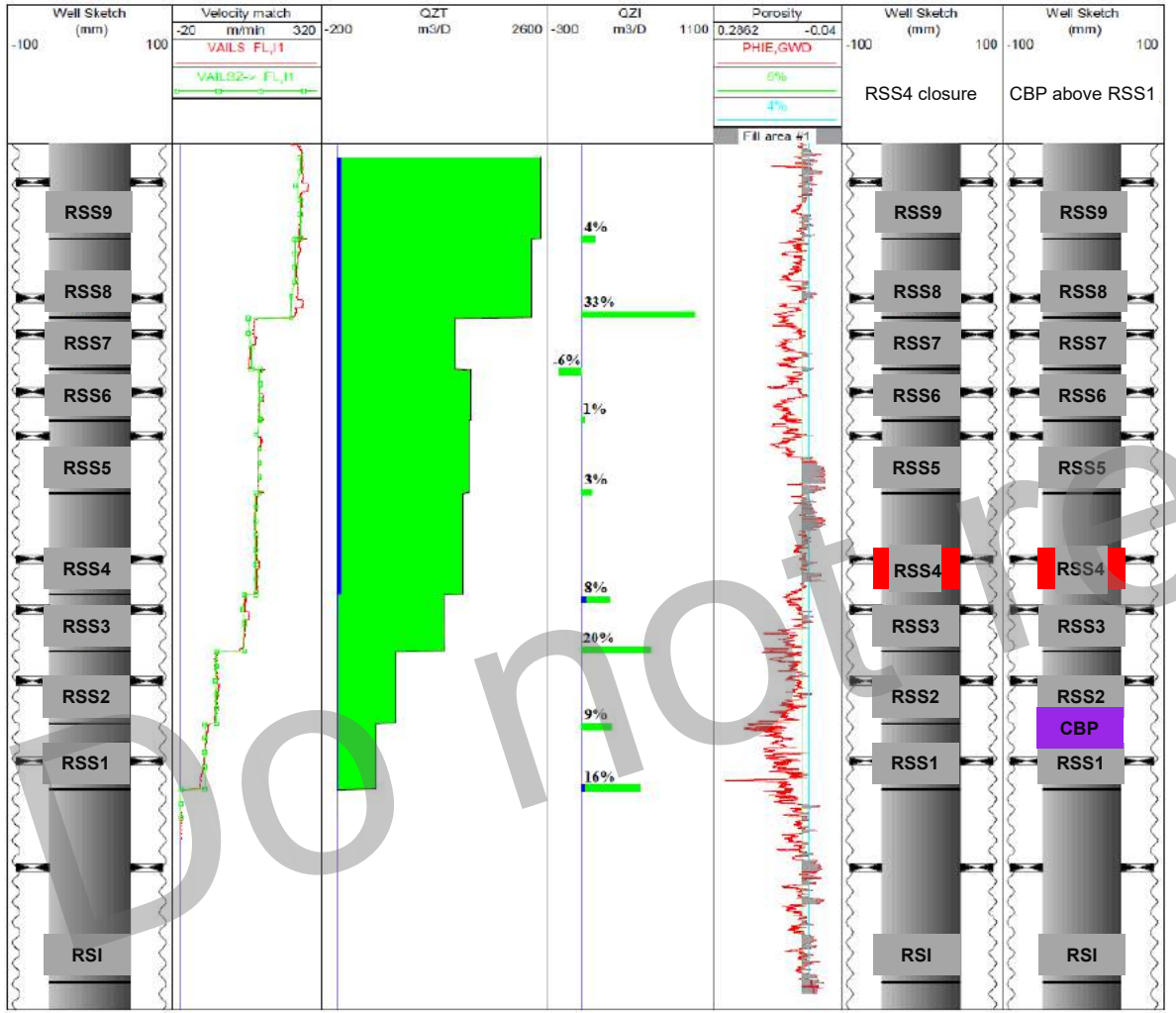
Case 2
Diagnostics in Smart Horizontal Wells in Carbonate Reservoir

Introduction to Case 2 - Water Shut-off Based on Conventional PLT



- Water from RSS4 and RSS1 by PLT
- Mechanical water shut-off by closing RSS4 (due to its high WC and low oil contribution): no change in either the water or oil production.
- Further steps: setting a composite bridge plug above RSS1: WC remained the same, but a drop in oil productivity was observed.
- Conclusion: mechanical water shut-off was considered a ***failure***, due to a combination of inaccurate diagnostics of the water ingress and complex near wellbore fluid movement.

SPE 182587 Production Logging and Spectral Noise Logging Tools in Optimising Water Shut-off in a Carbonate Environment // SPE Caspian, Nov 2016

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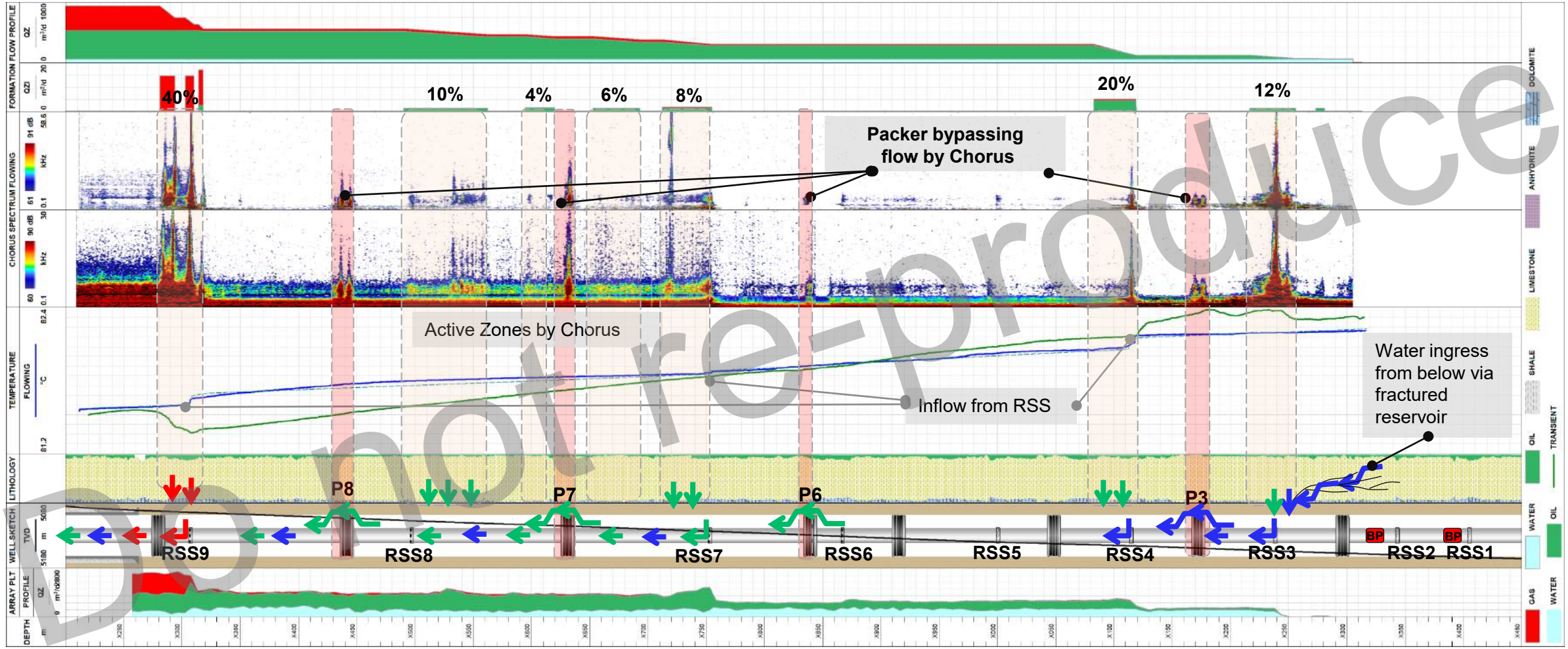
Case 2: Smart Well in Carbonate Reservoir



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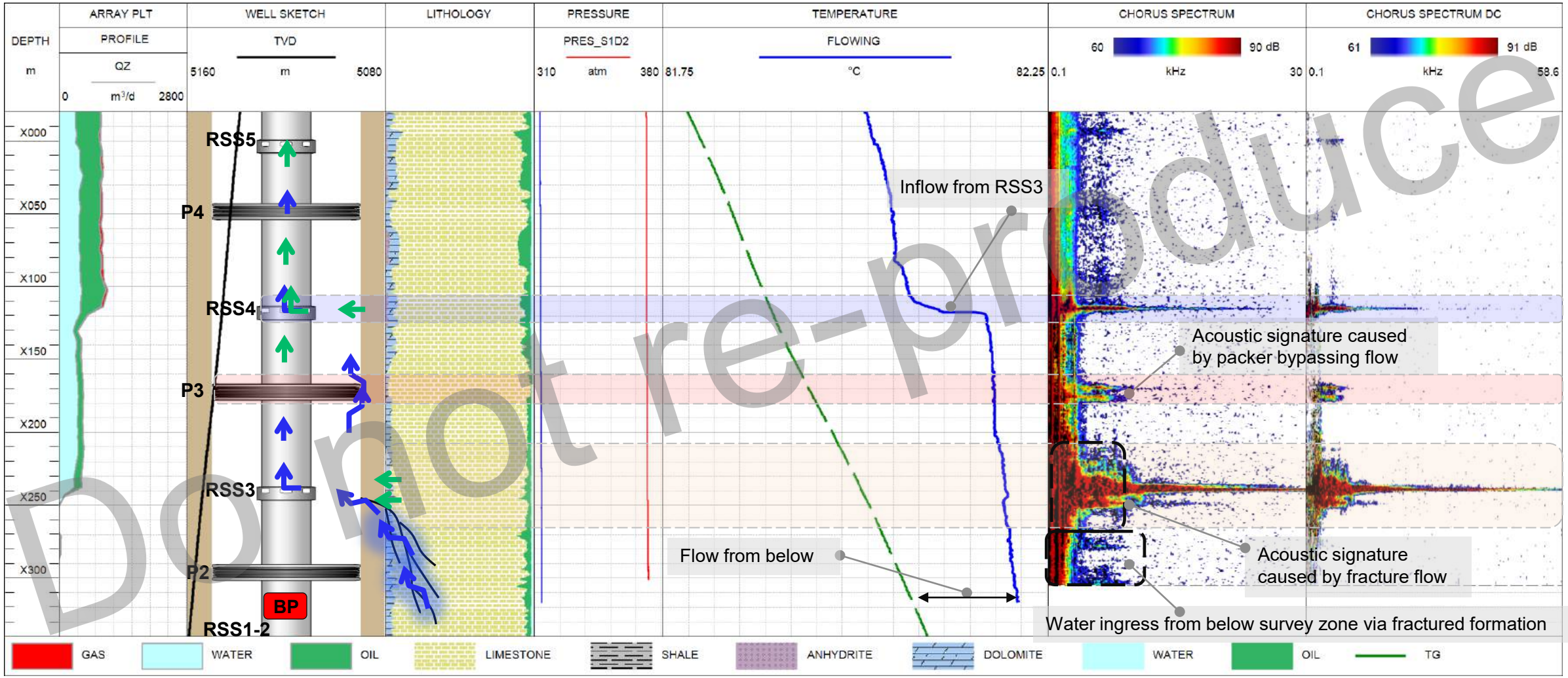
Case 2: Smart Well in Carbonate Reservoir



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Conclusions

- TGT's True Flow System provides a complete assessment of reservoir flow dynamics and zonal isolation, in horizontal wells
- TGT Through-barrier diagnostics can significantly improve smart well completion designs
- Workover strategy based on conventional PLT is not sufficient in smart wells
- Horizontal well workovers can be complex and costly. 'Total Flow' diagnostics provide the insights you need to plan and execute them efficiently and effectively.

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Thank you

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