

# Ensemble Methodology on Edvard Grieg

ResX Implementation With a Success

Ophelie Durand (on behalf of Kristian Eide-Engdahl)

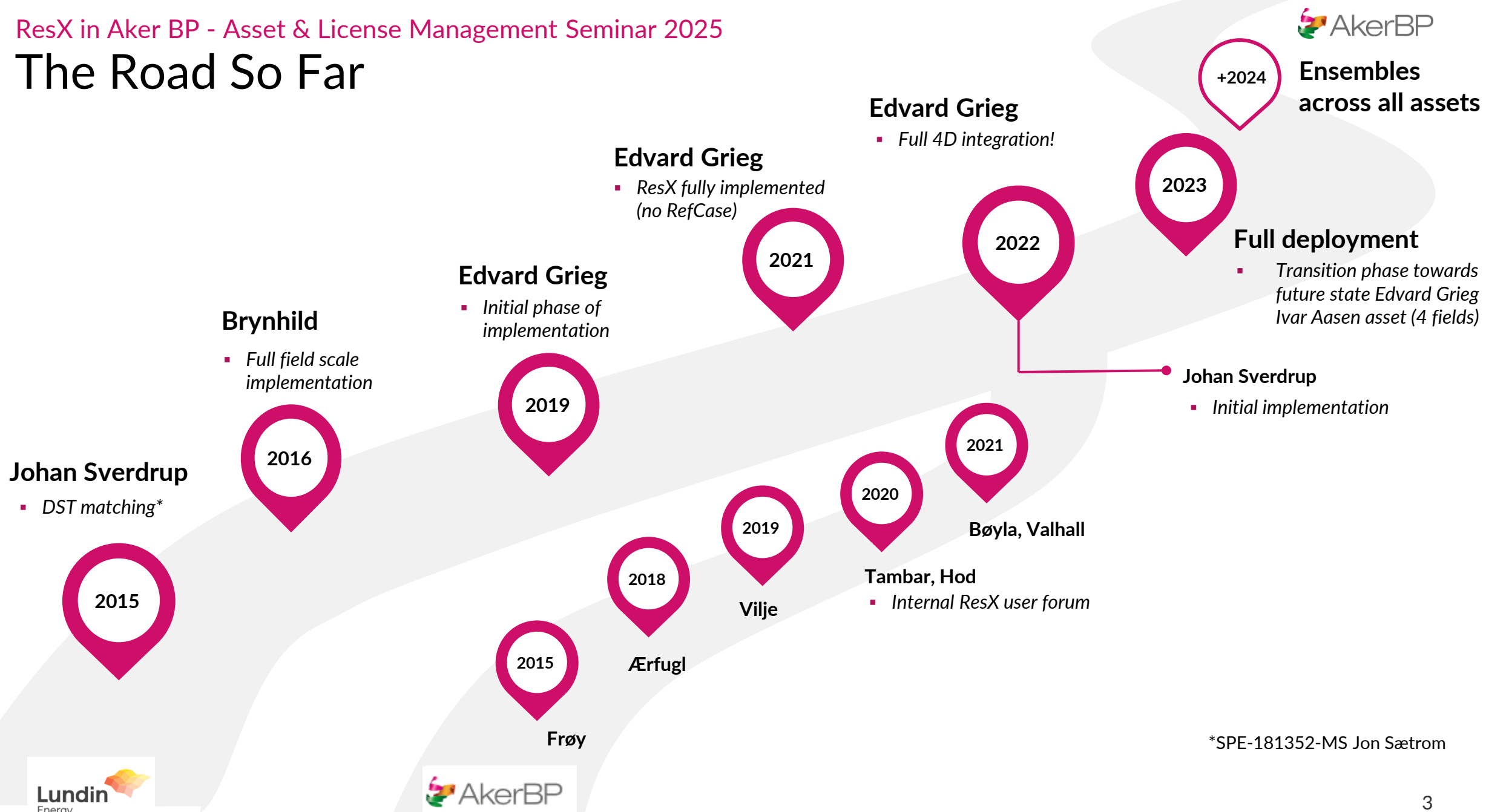


Aker BP Strategy

Subsurface Digitalisation

Ensemble Across All  
Assets

# The Road So Far



\*SPE-181352-MS Jon Sætrum

# Edvard Grieg

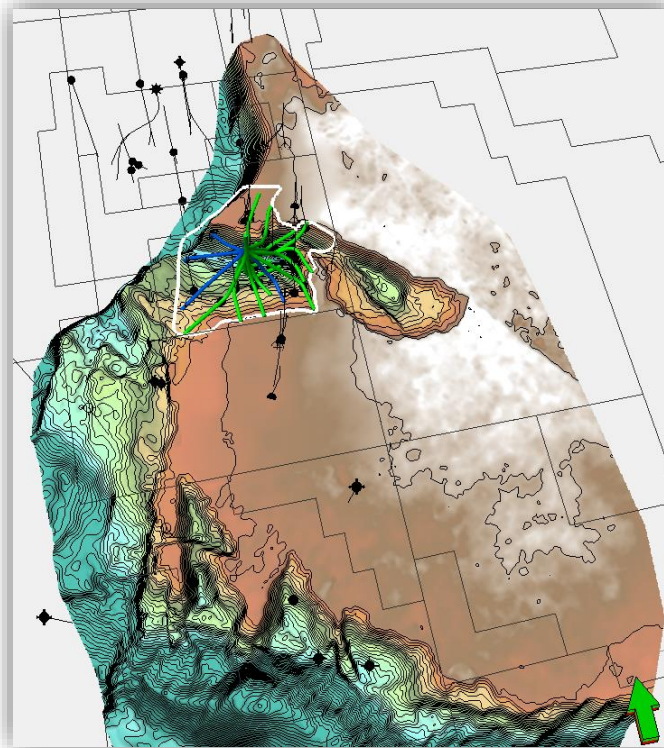
## General Information

- ❑ Oil field discovered in 2007 (16/1-8)
- ❑ First oil 2015
- ❑ 14 Oil producers, 5 Water injectors
- ❑ Light oil with low viscosity
- ❑ Full processing platform
- ❑ Tie-ins: Ivar Aasen, Solveig & Trolldhaugen

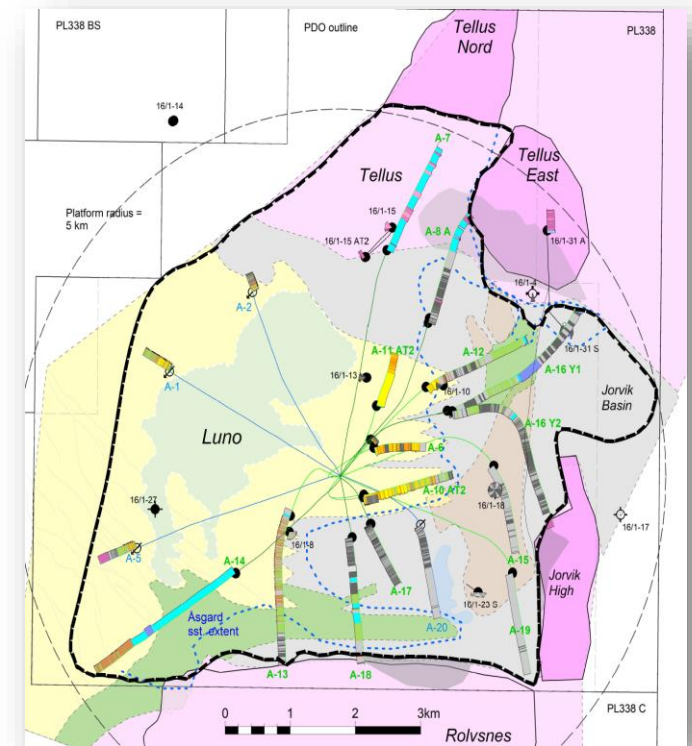
### Partnership

- ❑ Aker BP (OP), 65%
- ❑ OMV (Norge) AS, 20%
- ❑ Harbour Energy, 15%

## Utsira High - Basement map



## Main Facies Elements



# Edvard Grieg – Geological Setting

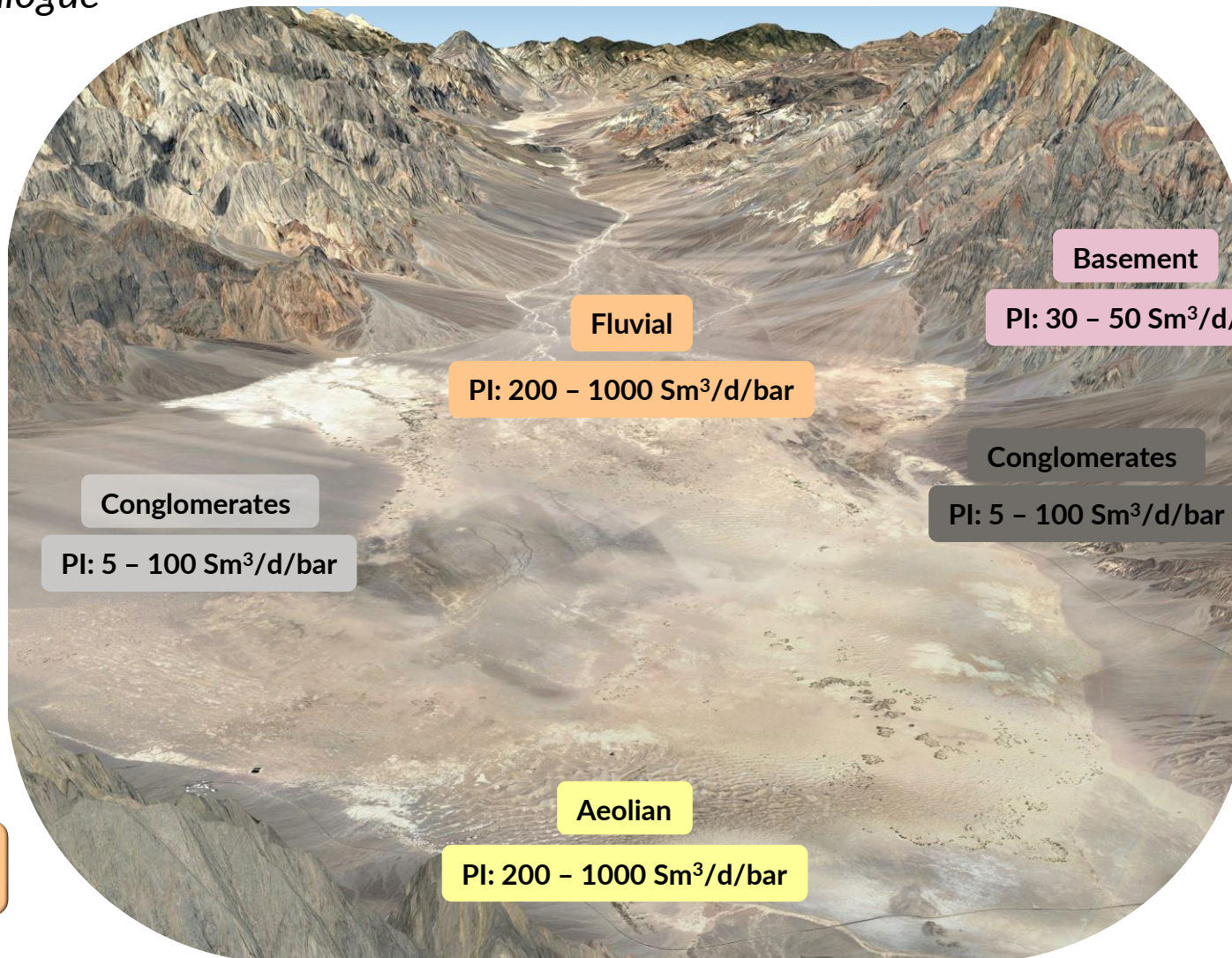
## Death Valley Analogue



Aeolian:  
5 – 15 Darcy



Fluvial:  
<1 Darcy



Sandy cgl:  
5 – 100 mD



Silty cgl:  
<1 mD



Basement:  
Low perm

# Edvard Grieg

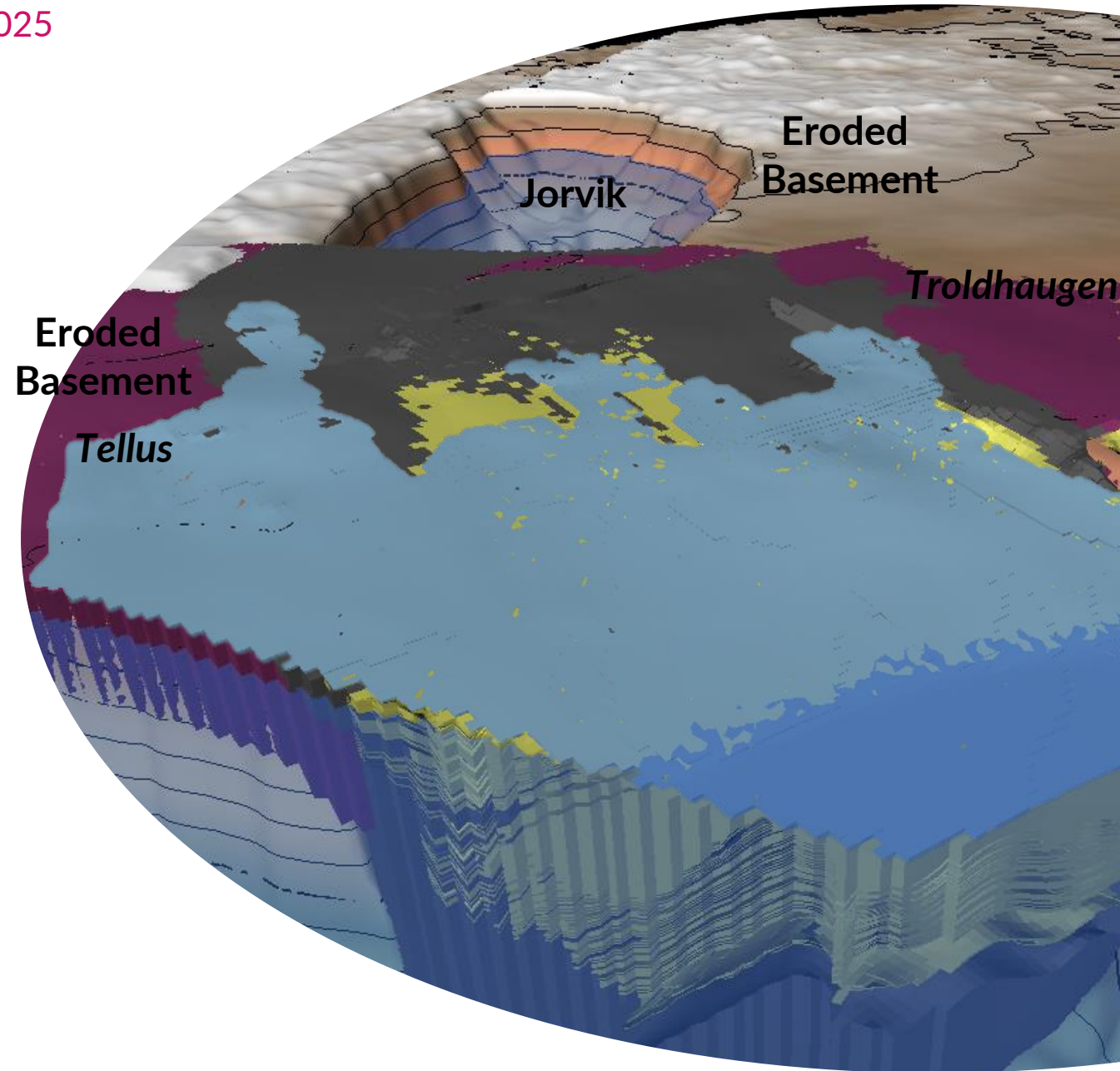
*Sediment-filled Half Graben*

## Structural Complexity

- The Utsira High - Uplifted basement block
- Half graben filled with sediments

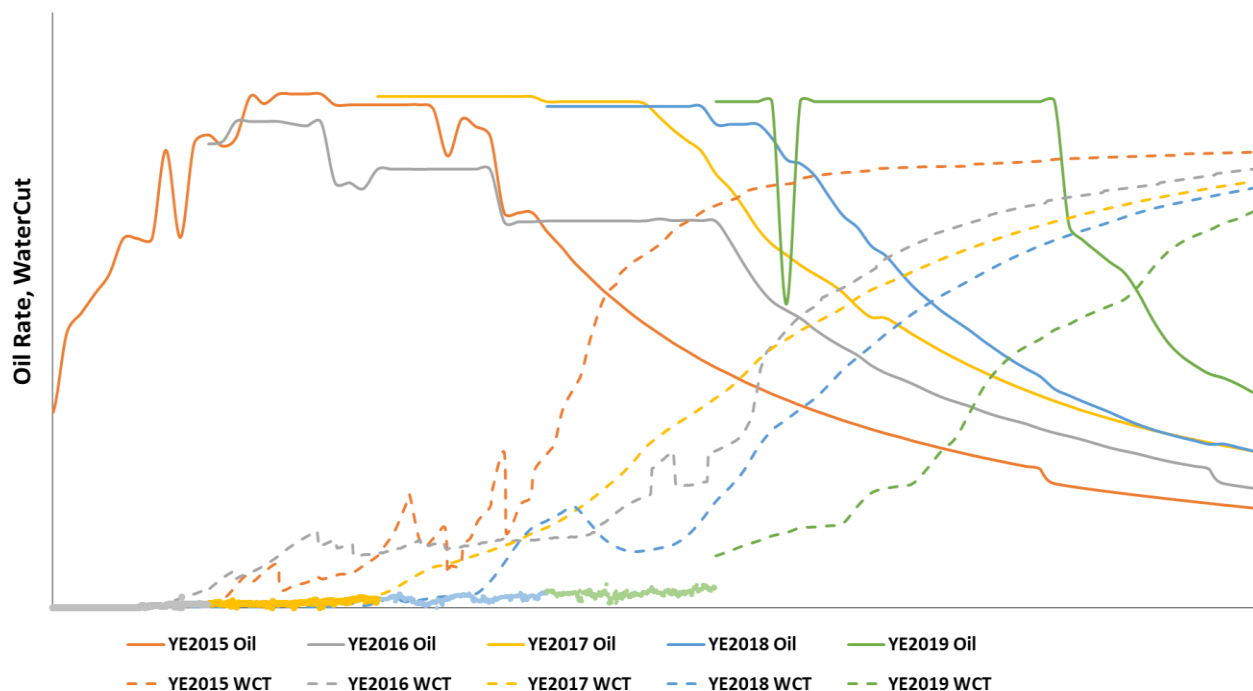
## Depositional Complexity

- Various environments
- Sub-seismic heterogeneities



# Model Predictability

... or lack thereof



PDO – Design basis

First oil Nov 2015  
– PDO profiles

Field extension  
– Break through expected

Extending plateau further  
– Under dimensioned process?

Unable to postpone modelled water  
– No geological explanation

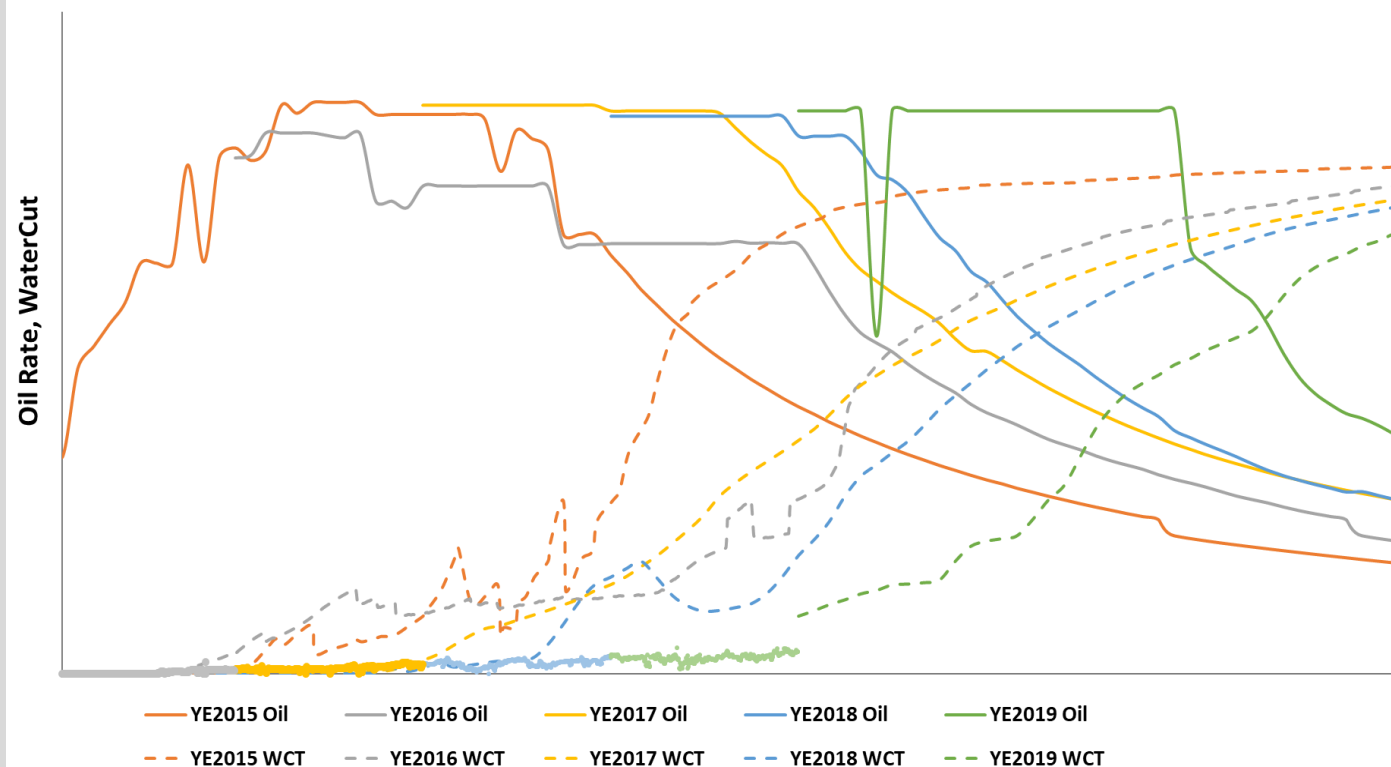
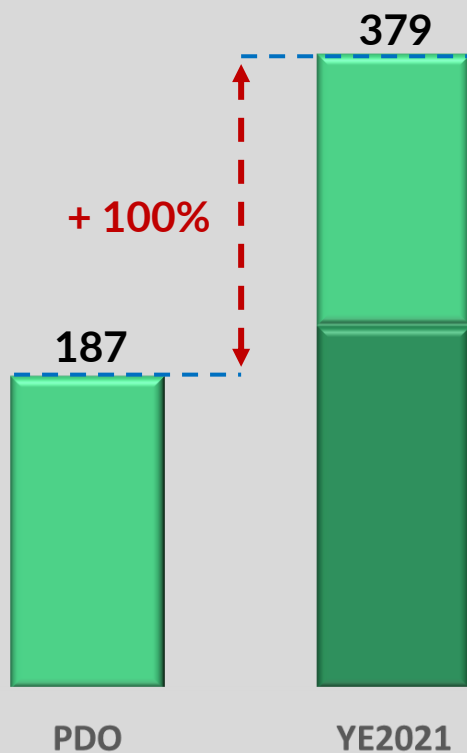
Challenging IOR planning  
– When will EG fall off plateau

# Model Predictability

... or lack thereof

Significant  
undervaluation

Gross Reserves Development

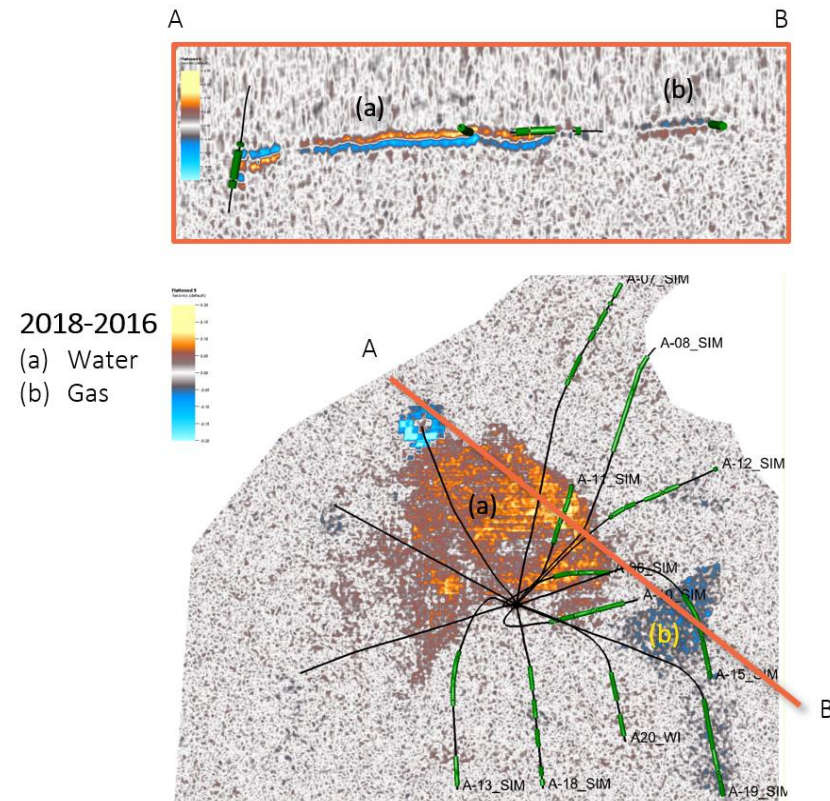


- Not able to capture the uncertainty
- Plateau length increased by 5 years
  - Doubling the reserves

# A 4D Story

*The Driving Mechanism*

## 2018 Model – Synthetic

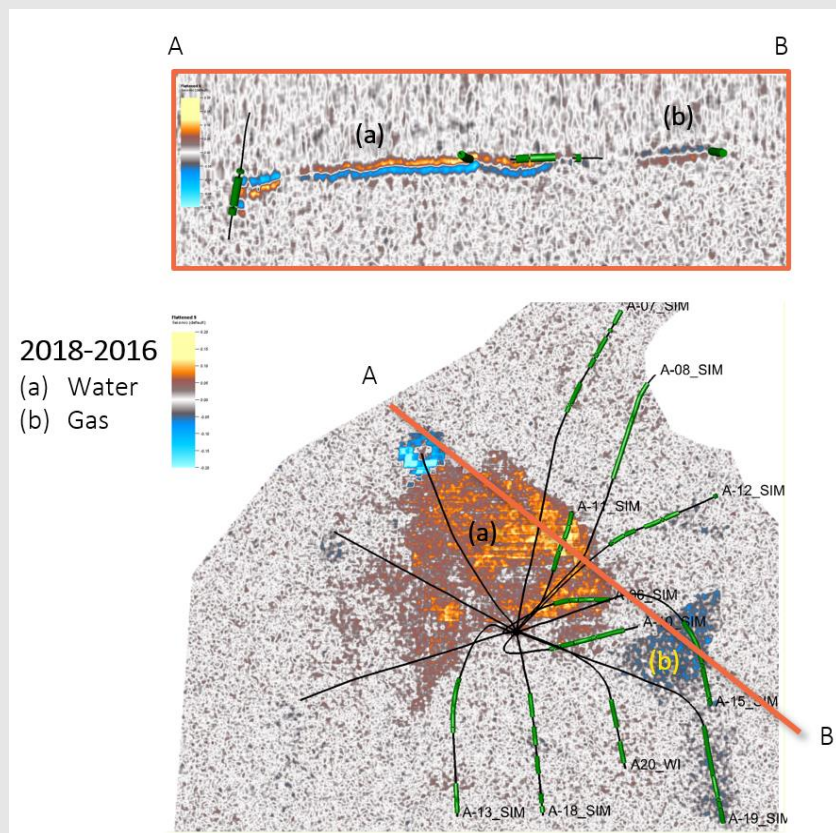


**Bottom Drive**

# A 4D Story

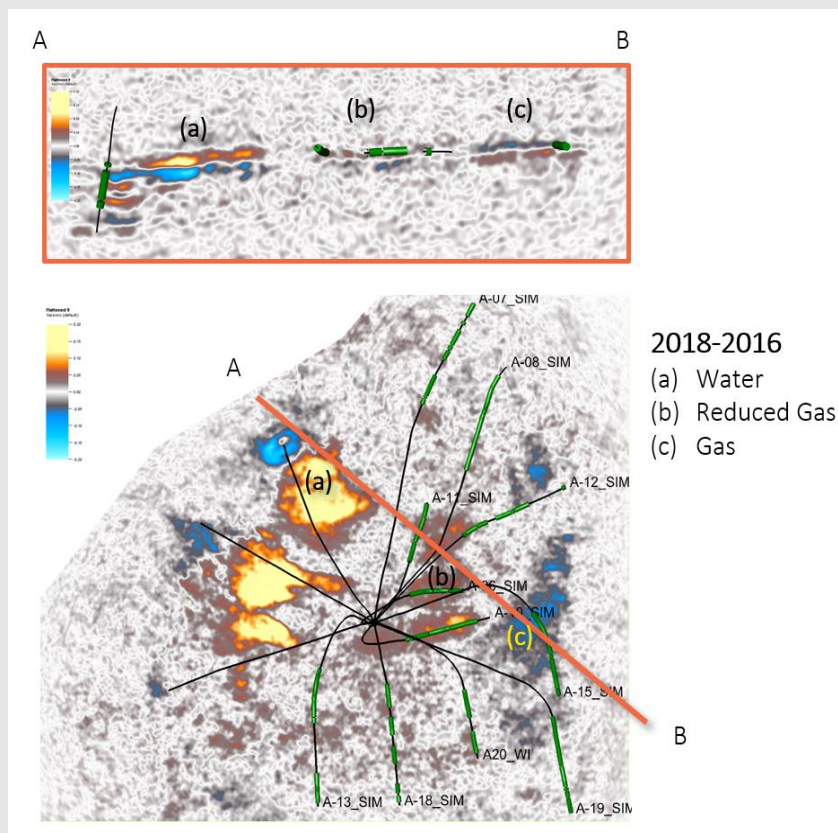
*The Driving Mechanism*

## 2018 Model – Synthetic



**Bottom Drive**

## 2018 Seismic Data

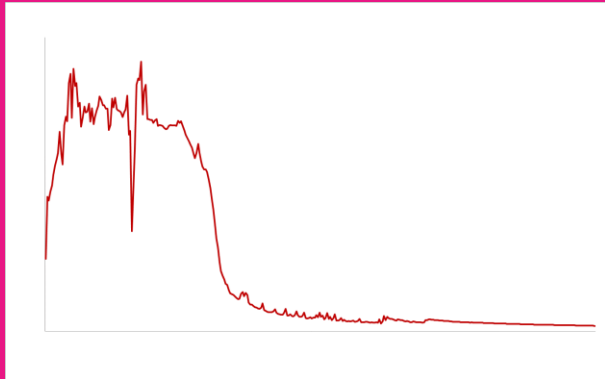


**Flank Drive**

# Ensembles & RefCase

*Let's Shake Hands*

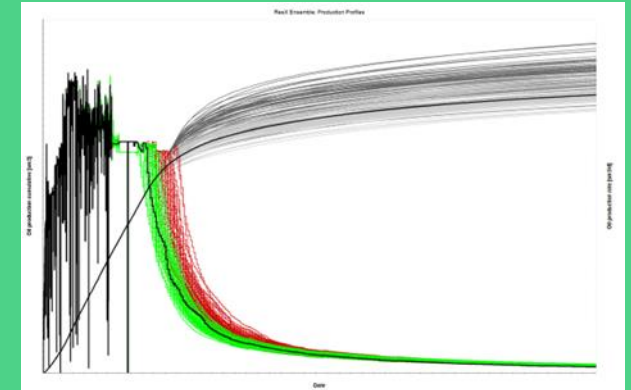
## Deterministic Cases



Understanding the fundamentals  
through **Concepts**



## The Ensemble



*"It is better to be APPROXIMATELY  
right, than PRECISELY wrong"*

- Warren Buffett

# Parallel Processes

*The Importance of Two Worlds*

## TestLab

Structural  
framework

Facies  
modelling

Property  
modelling

History  
matching

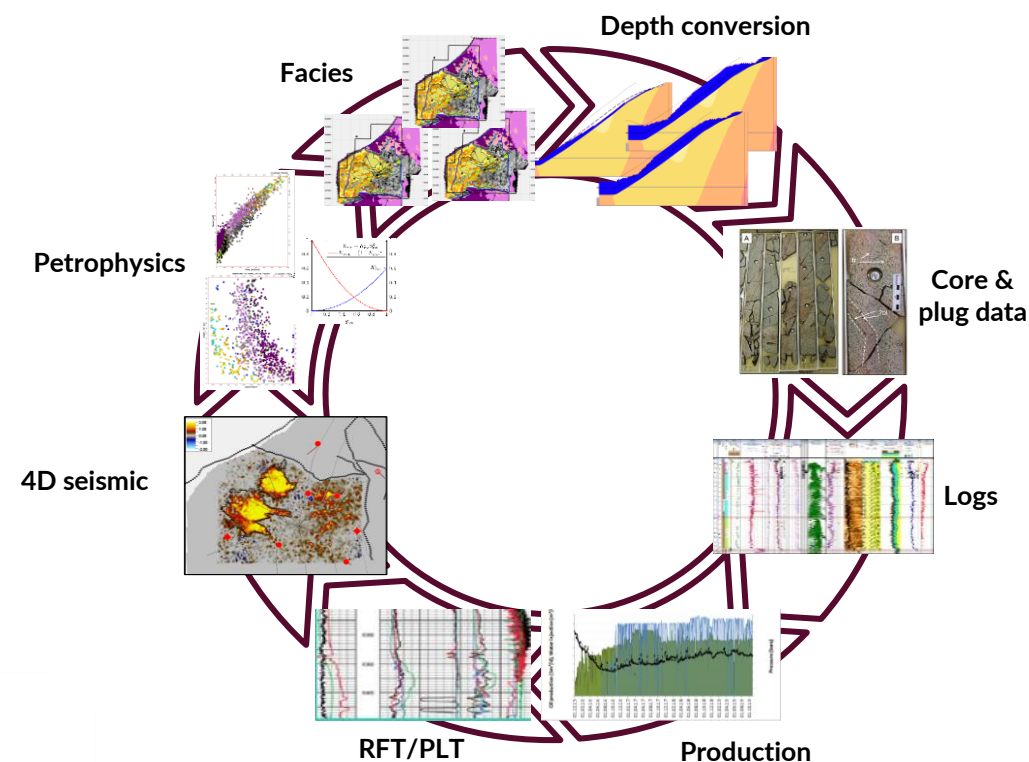
4D guiding

### Key elements

Sand – Conglomerate – Shale  
“Special geological features”  
Distributions

**Improved 4D match was key for capturing the dynamic behavior. This is a pre-requisite for initiating the ResX history matching process**

## ResX Assisted HM



# TestLab & ResX

Working Together

## TestLab

Structural  
framework

Facies  
modelling

Property  
modelling

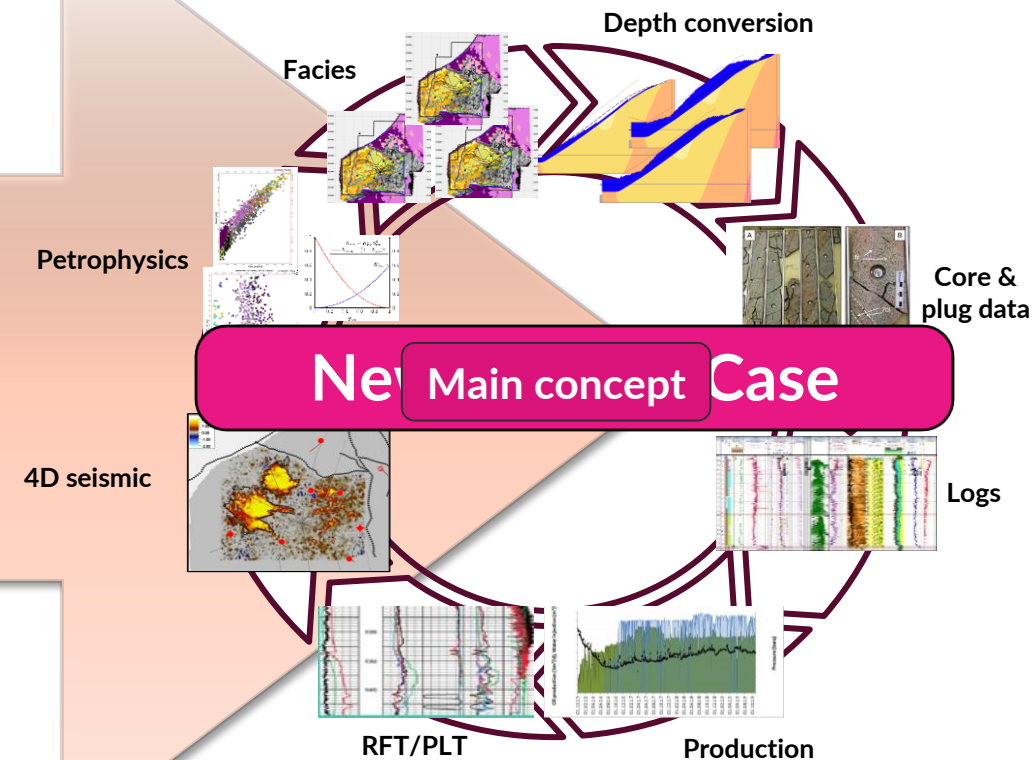
History  
matching

4D guiding

### Key elements

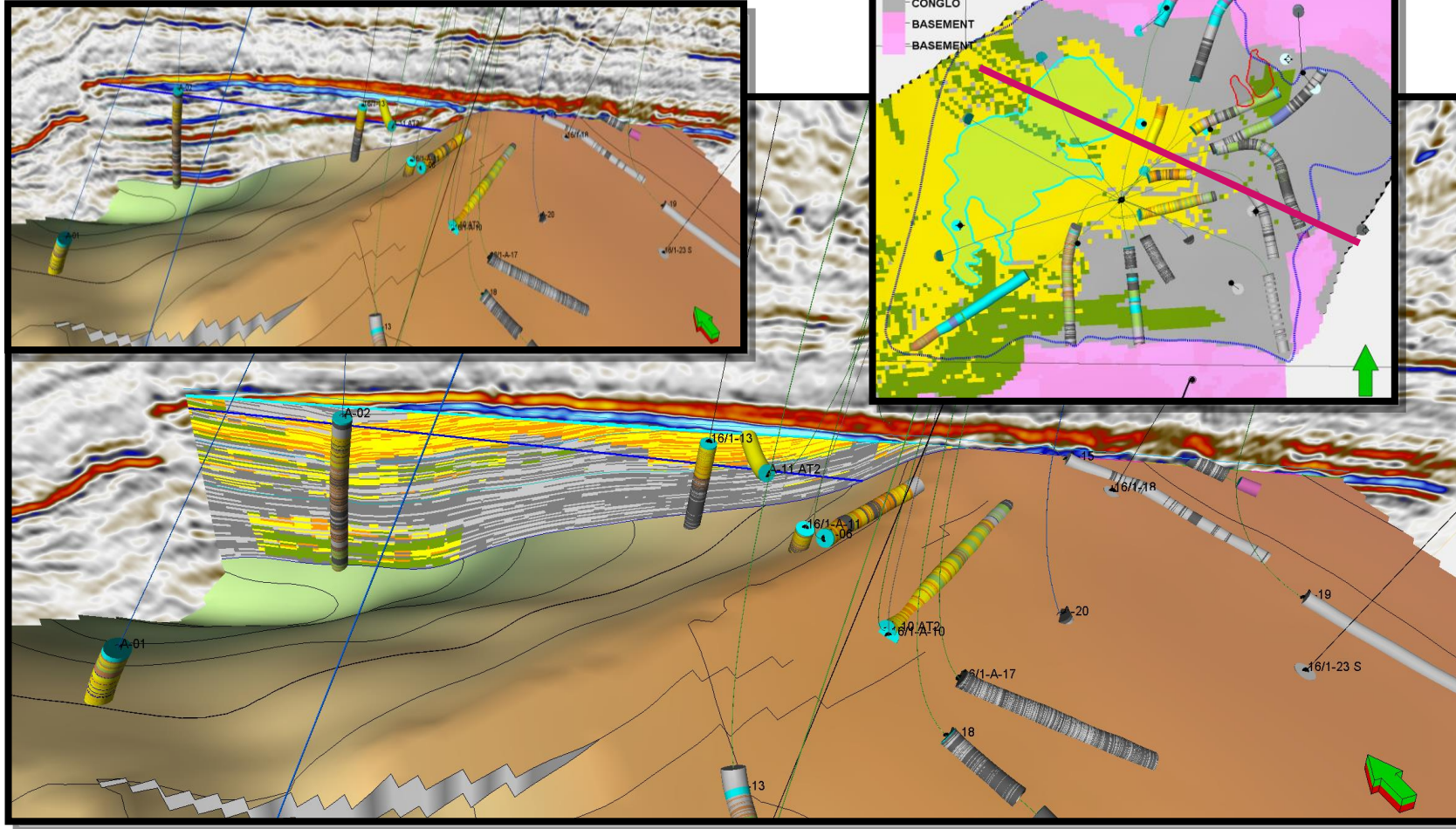
Sand – Conglomerate – Shale  
“Special geological features”  
Distributions

## ResX Assisted HM



# Concept Drive

*A Solid Foundation*



**Main concept**

**Seismically Controlled**

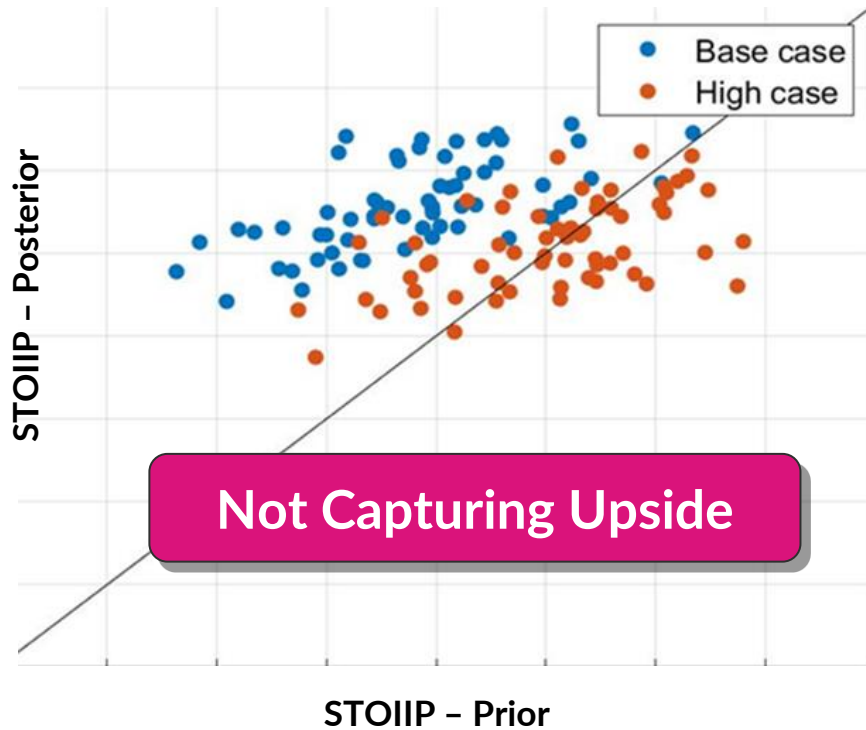
**Zonation**

**Sand vs. Conglomerate vs.  
Basement**

**Specialized Geological  
Features**

# Concept Drive

*Increasing the Uncertainty*



**Main concept**

**Seismically Controlled**

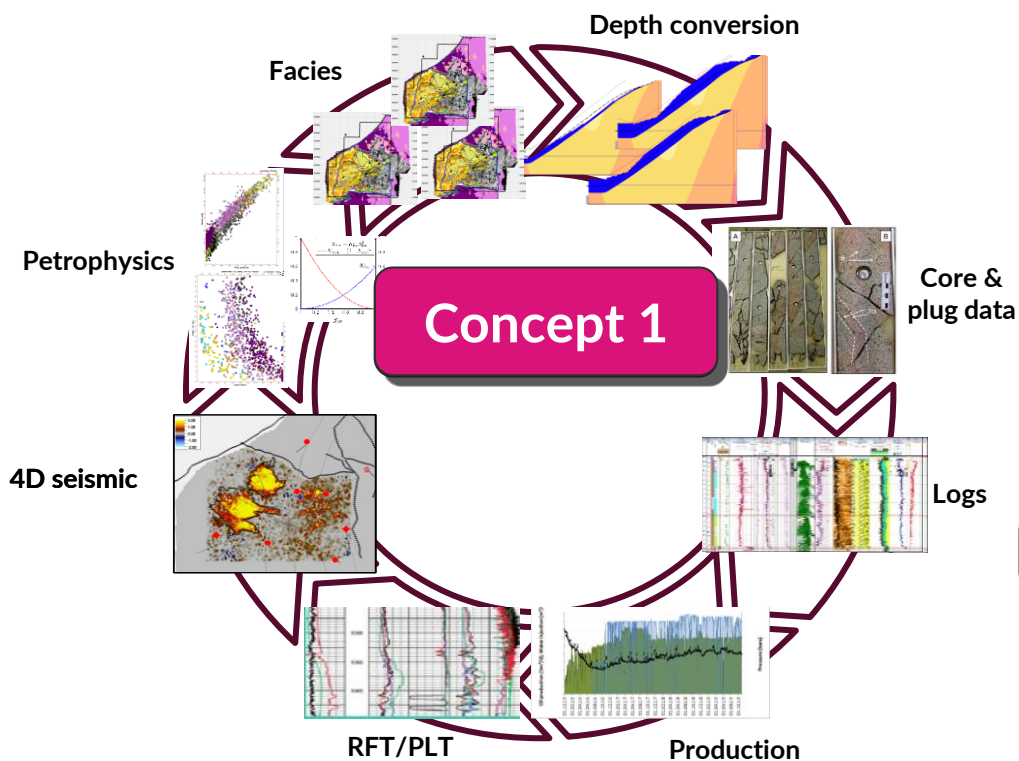
**Zonation**

**Sand vs. Conglomerate vs.  
Basement**

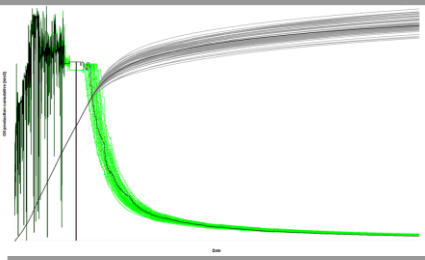
**Specialized Geological  
Features**

# Ensemble of Ensembles

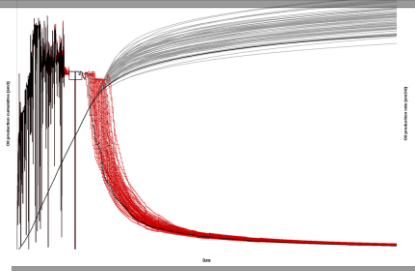
## Building Blocks



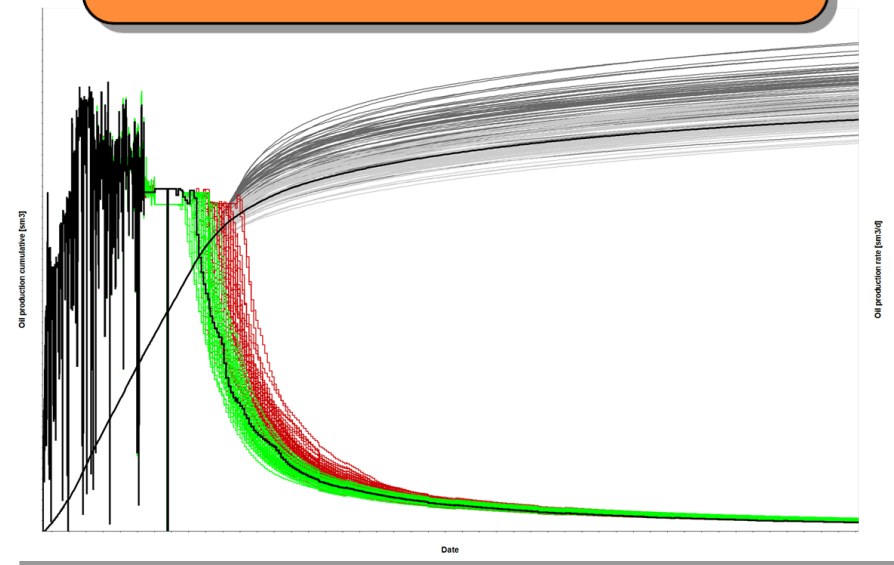
## AHM Concept 1



## AHM Concept 2

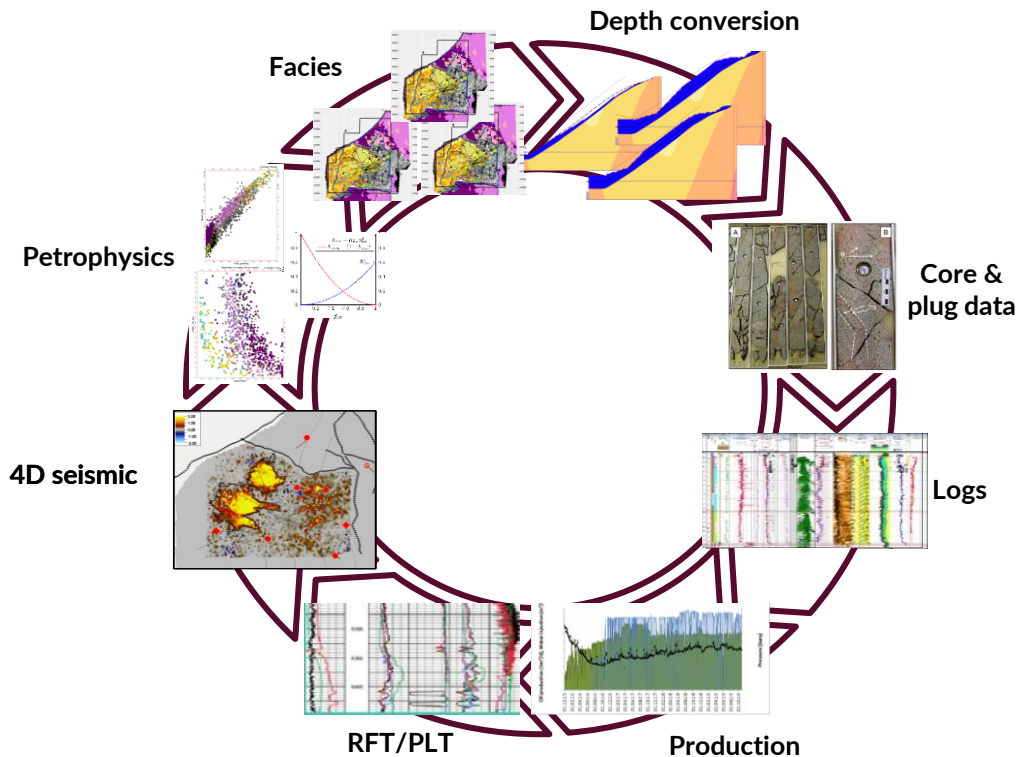


## Ensemble of Ensembles



# Uncertainty Centric

*Uncertainty in all disciplines*

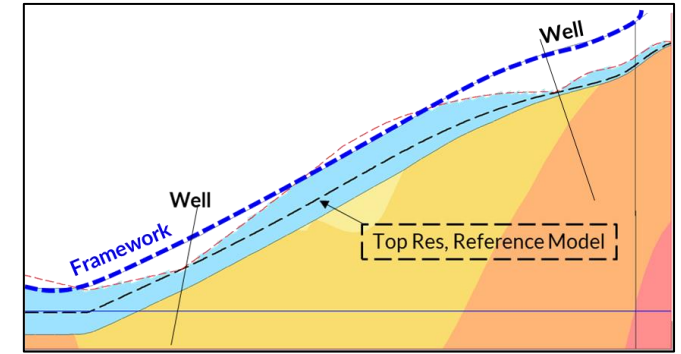


Structural Uncertainty

Porosity & Permeability  
Uncertainty

Main facies groups – Concept  
Sub-facies variation

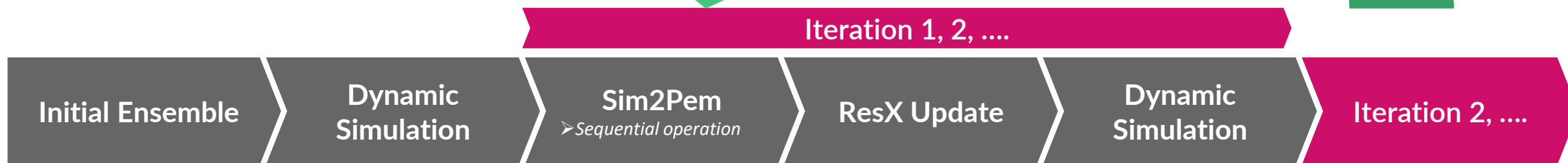
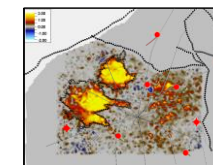
Saturations  
Relative Permeability



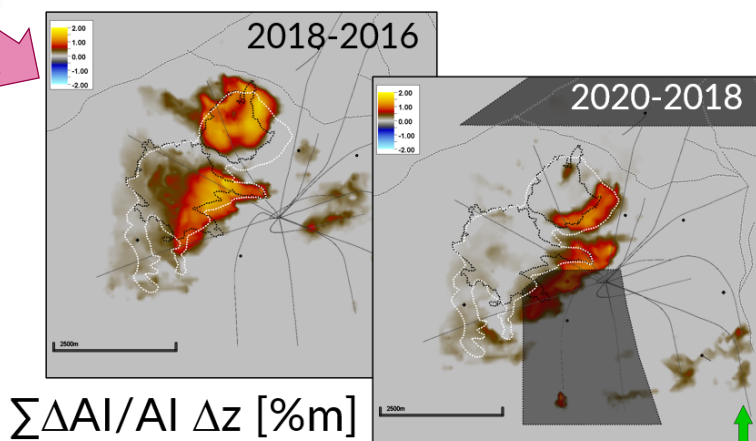
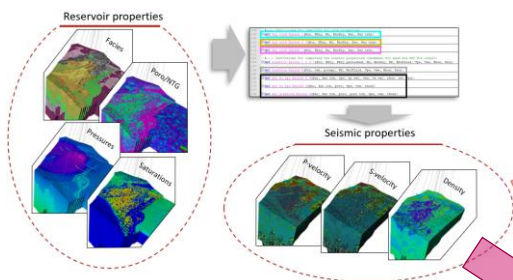
# Assisted 4D Matching

Integrating a New Dimension of Data

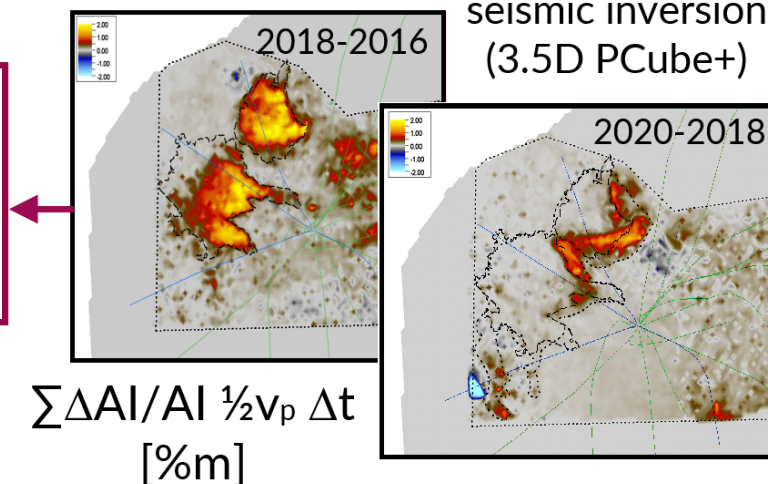
4D seismic



- SIM2SEIS < 30 min per realization
- SIM2PEM ~ 3 min per realization



Model derived attributes –Relative AI change thickness map



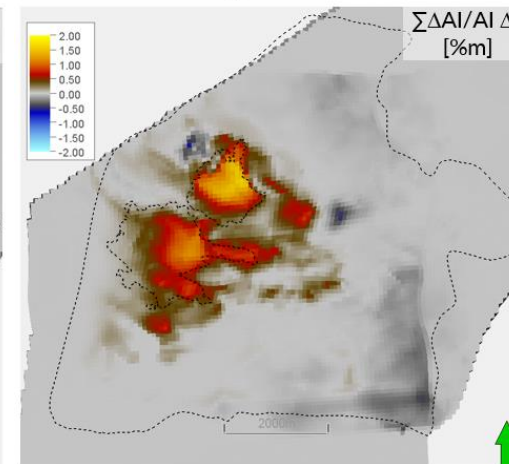
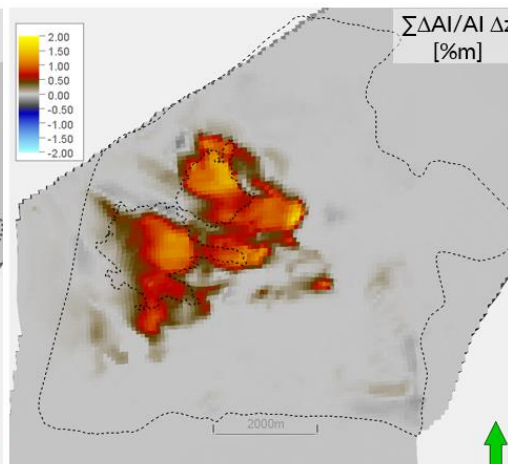
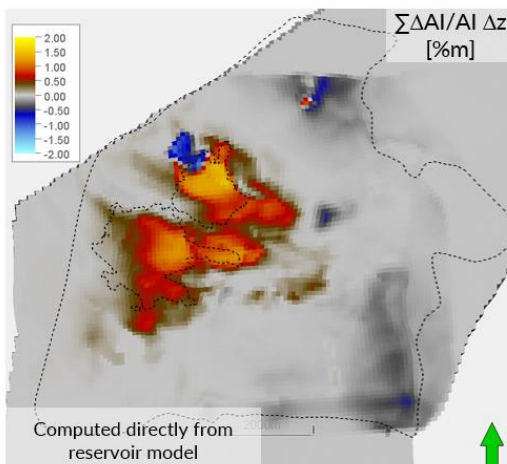
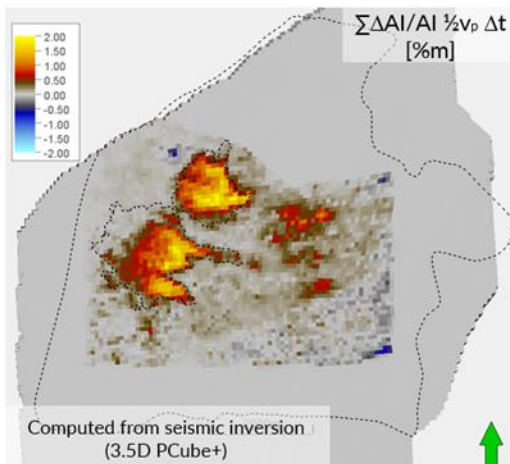
Computed from seismic inversion (3.5D PCube+)

# 4D Matching With Success

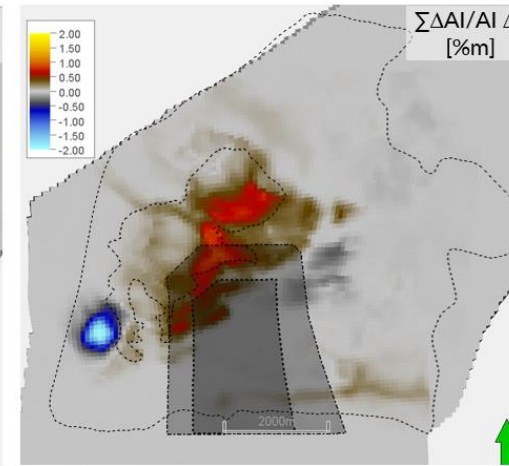
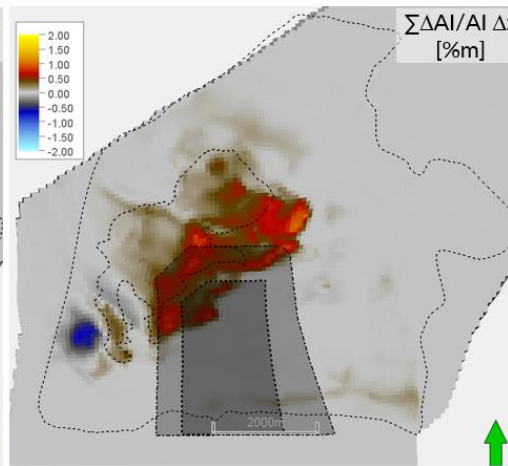
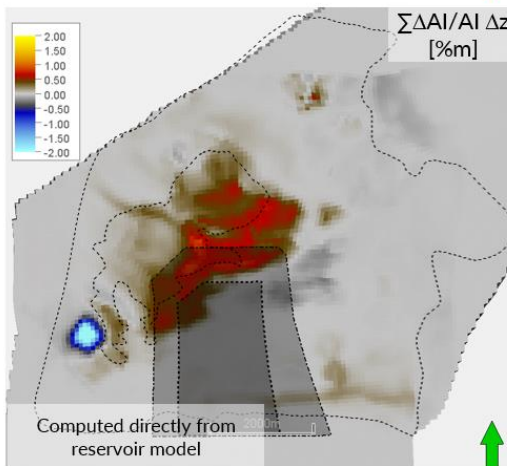
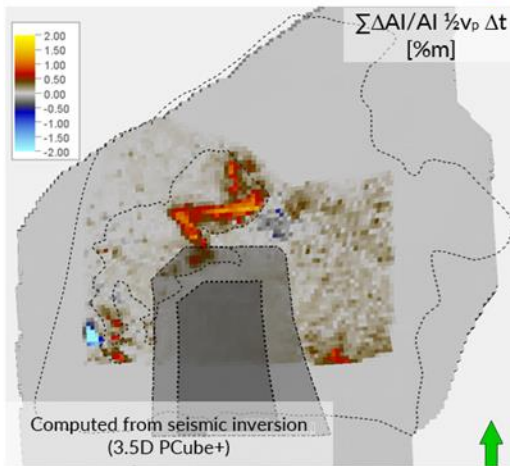
Impressive Results

Quantitative Comparison

2018-2016



2020-2018



“Real Data”

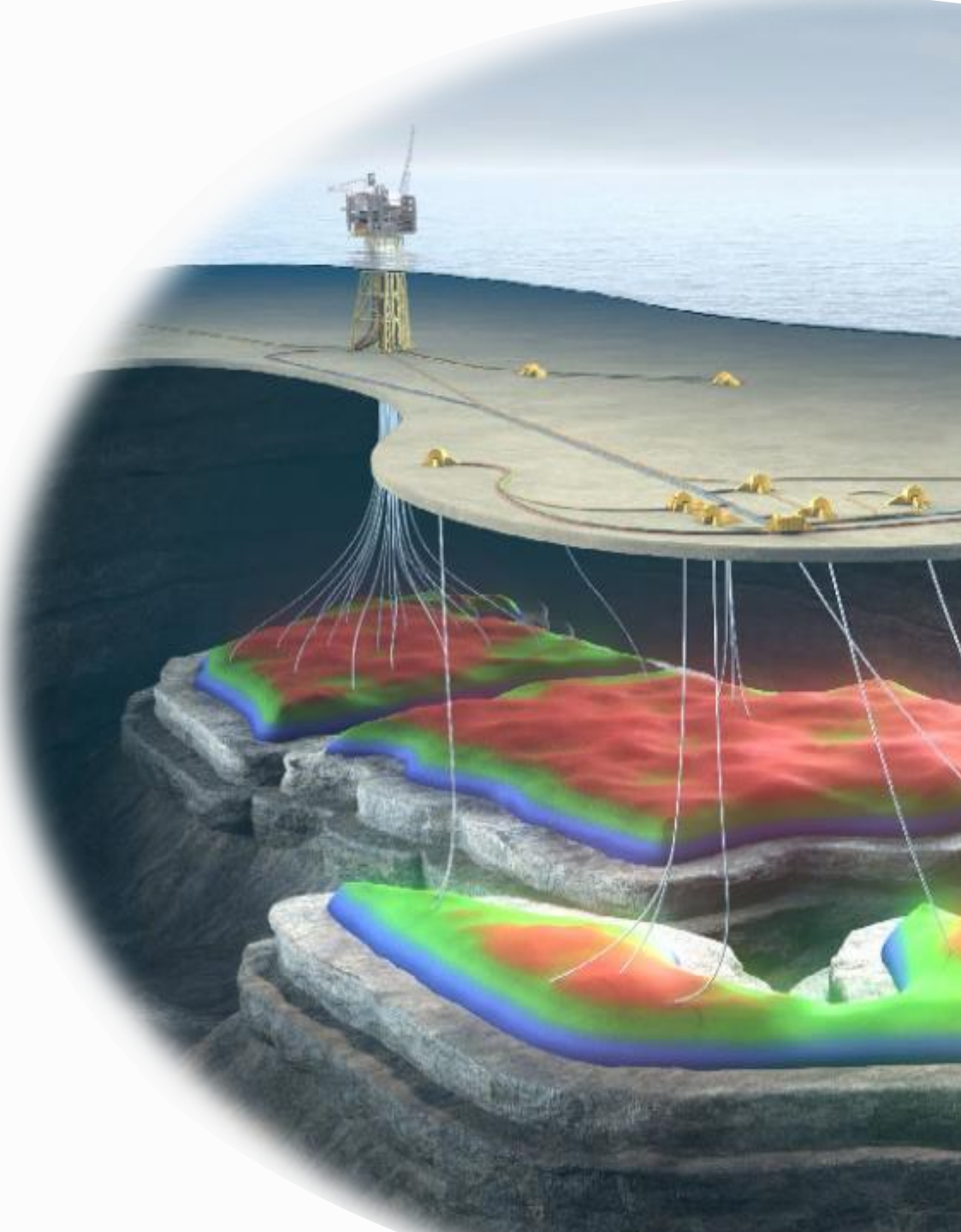
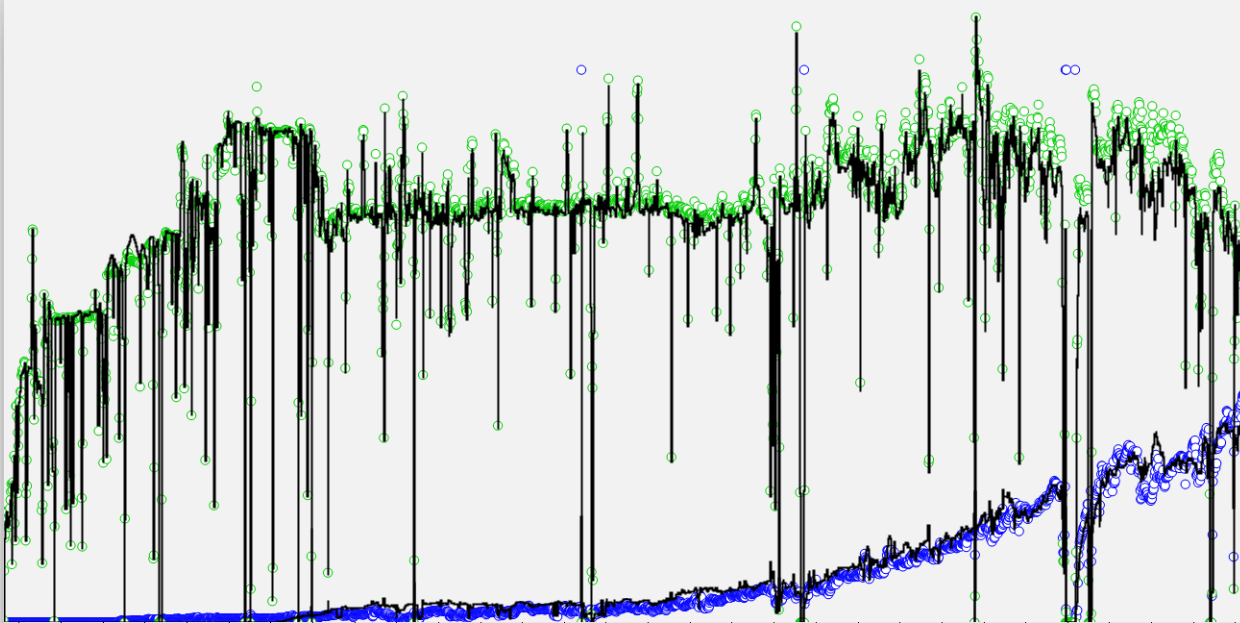
Mean Prior

Mean Posterior  
- Prod only

Mean Posterior  
- Prod + 4D

ResX in Aker BP - Asset & License Management Seminar 2025

# Did We Improve?



# Value of Significance

Improvement & Value Across the Business

Postponed IOR  
campaign

Optimised  
Drainage Strategy

More Wells

## MUSD 40

NPV net Aker BP (post tax) on Edvard Grieg

Optimal Well  
Placement

Robust Decision  
Making

Team & Discipline  
Integration

# Thank you for your attention!



## Acknowledgment

- Edvard Grieg subsurface team
- Partners; OMV, Harbour Energy, Halliburton (former Resoptima)

[www.akerbp.com](http://www.akerbp.com)