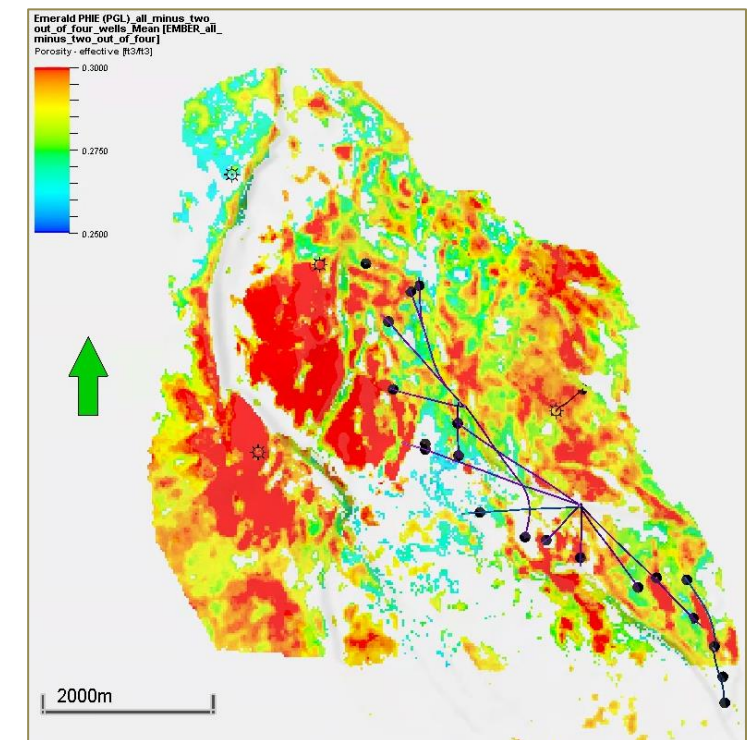


# Applying Machine Learning and GPM for Gaining Efficiency and Improved Predictability on the Cheviot Asset

Paul Armitage  
Subsurface Manager

Schlumberger Digital Forum  
Luzern, 21<sup>st</sup> September 2022



# Acknowledgements

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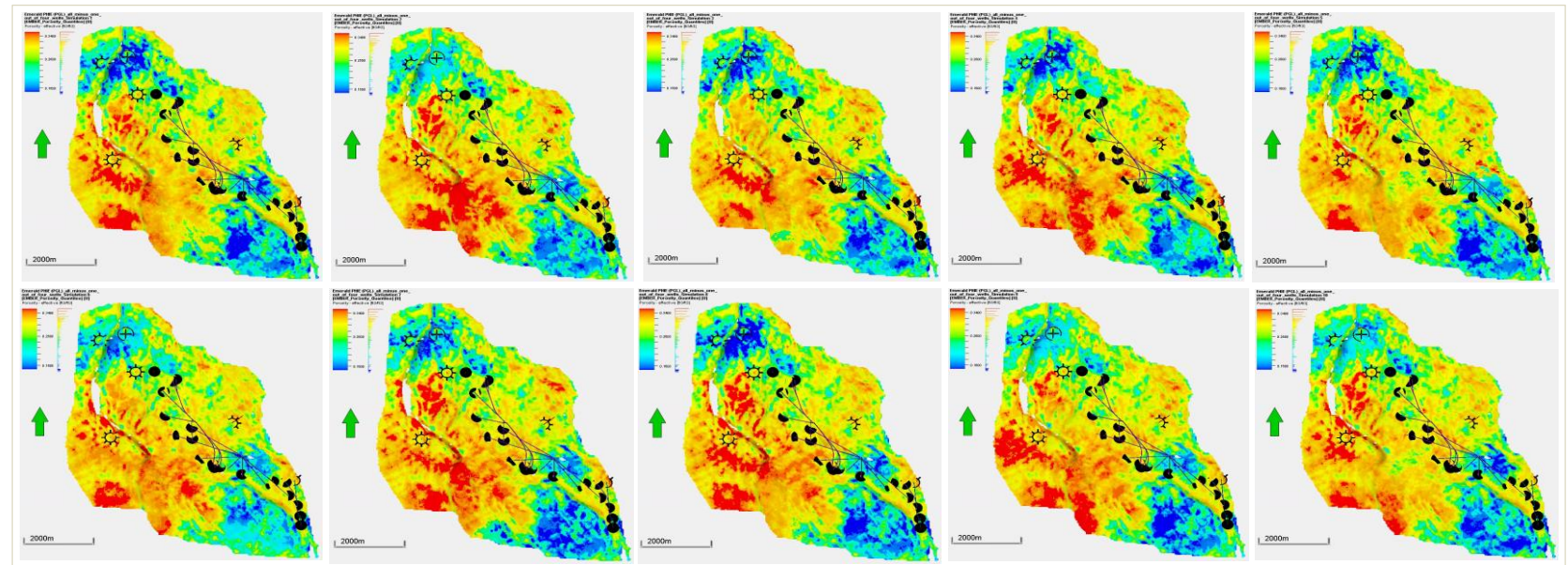
The real workers:

- *Alpha Petroleum*. Iyior Abumere, Penny Milner
- *Schlumberger*. Ammar Ahmad, Sergio Courtade, Klaus Eder, Sonat Kaya

Thanks to the Management of Alpha Petroleum for permission to attend and present.

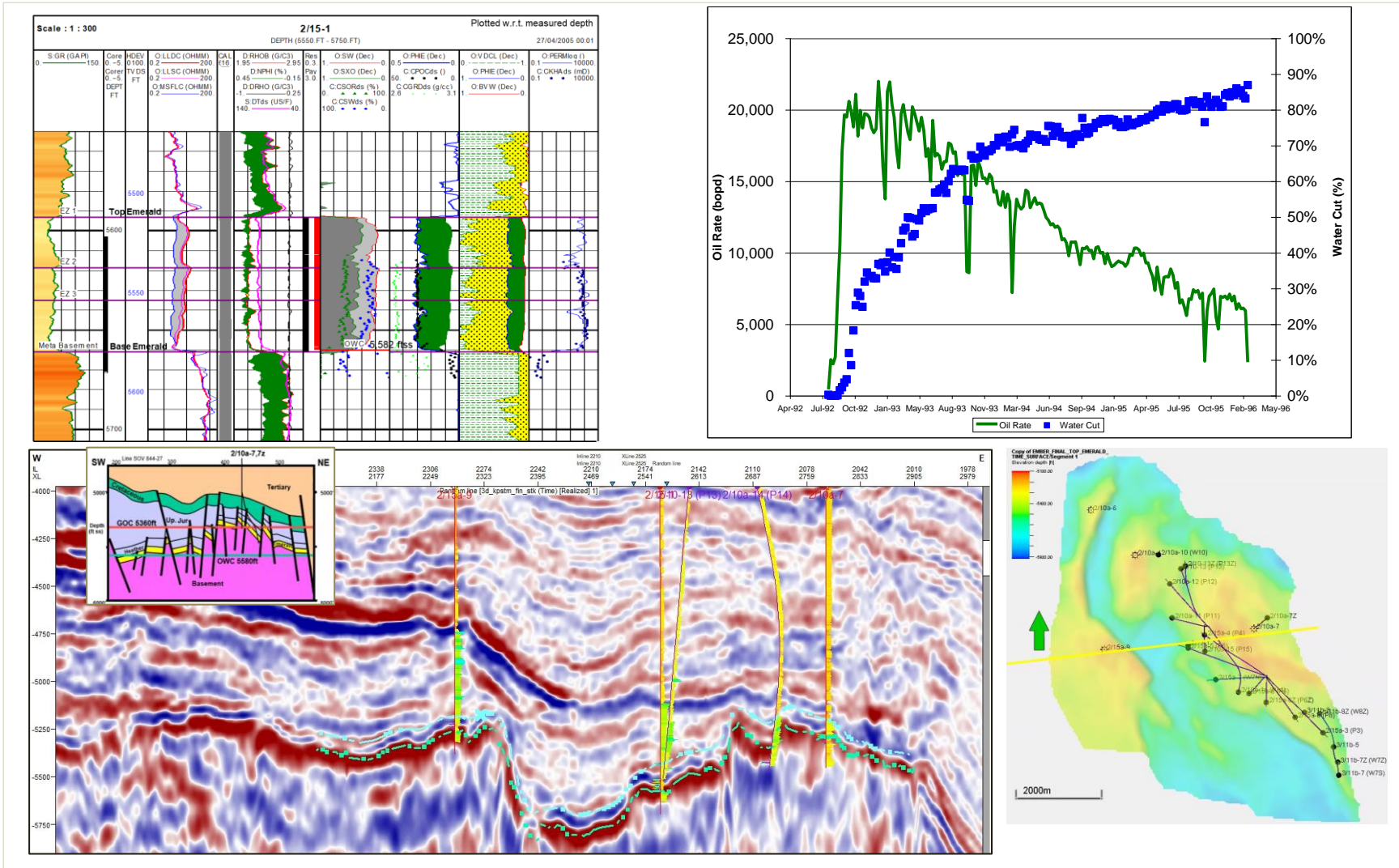
# Outline

1. The Cheviot Development Project
2. Current GeoModelling Workflows
3. Study Objectives
4. ML Workflow
5. Results
6. Impact of Geological Process Modelling (GPM)
7. Next Steps

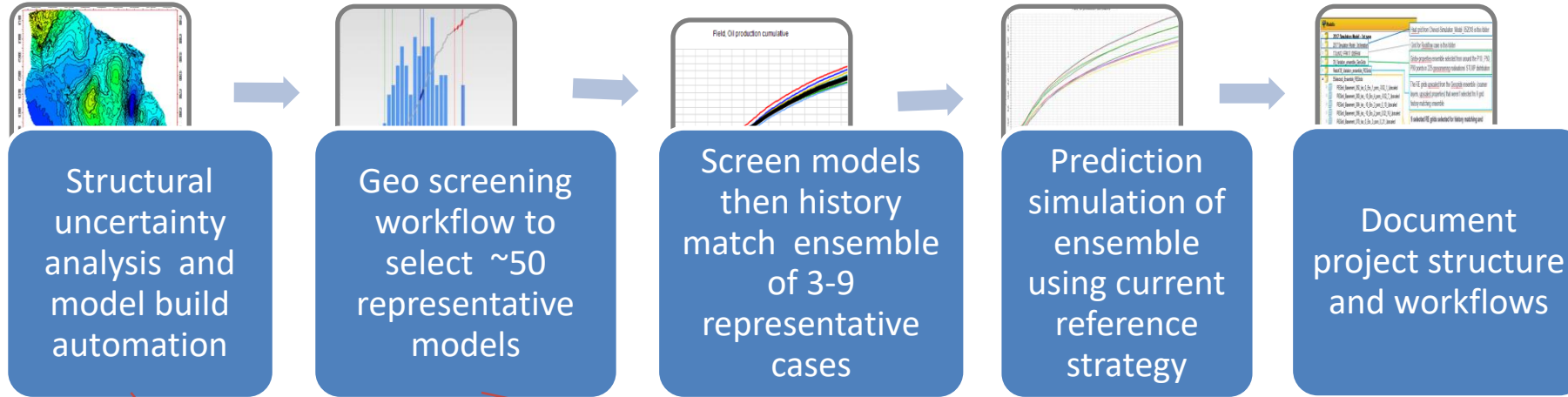


# Cheviot Field Overview

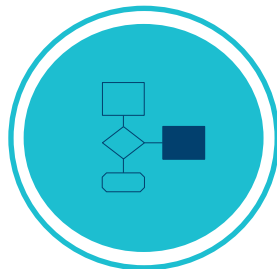
- Redevelopment of the Emerald Oil Field (renamed Cheviot)
- Conventional Oil
- Reservoir Depth around 5500 ft
- Excellent Jurassic Reservoir with 25 to 30 % Porosity
- High Water Cut Development



# Cheviot Field Existing Geomodels

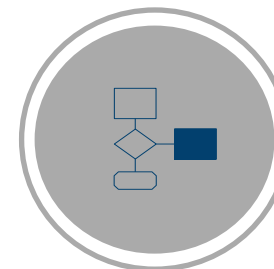


Base Case Workflow



300 lines  
~ 10-12 mins to rebuild geomodel from input surface

Base Case Workflow with uncertainty parametrisation



500 lines  
2-3 days to build over 300 realisation, and run volumetrics and flow connectivity calculation on each

# Cheviot Field: Objectives and Challenges

---

## Challenge

Is there an improved petrophysical properties correlation to be incorporated into Cheviot Field Geomodels?

## Solution

**Improving properties correlation using a random forest regression workflow.** Also, use additional training feature inputs (seismic and geometrical properties) to check for correlation coefficient improvements

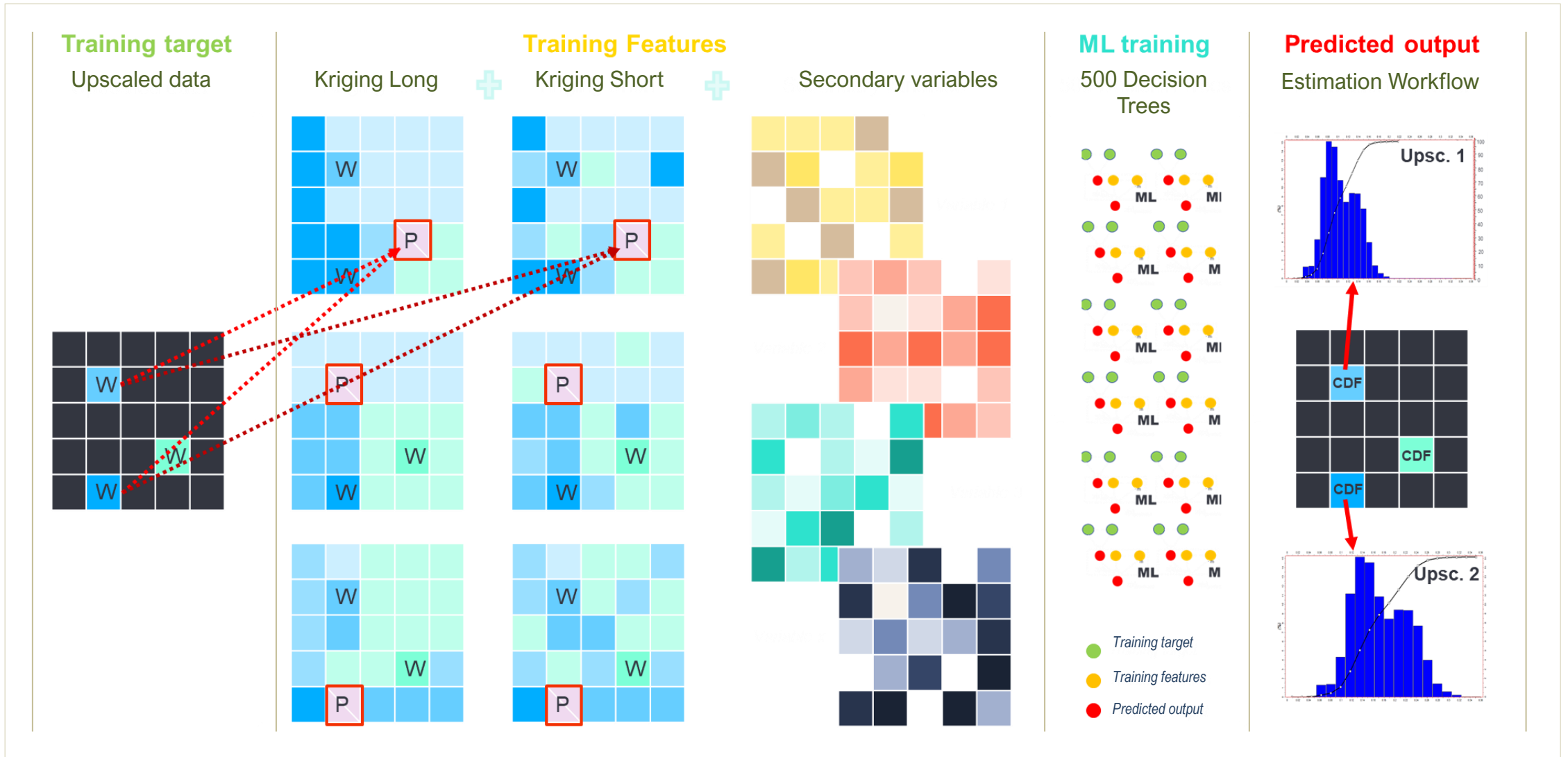
## Innovation

Integrating **Geological Process Modeling** workflow to be used as a **training feature** in the ML Property Modeling workflow for conditioning porosity and permeability.

## Results

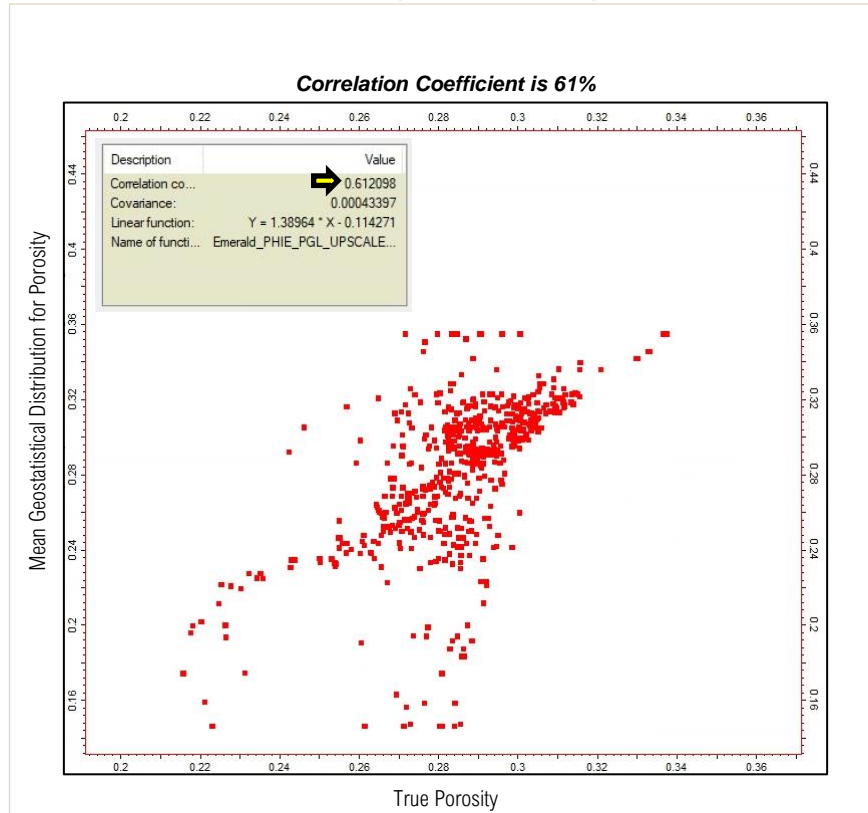
**Increased correlation percentage for porosity from 61 to 94%** on the blind testing validation workflow.

# Cheviot Field: Machine Learning Property Modeling Workflow

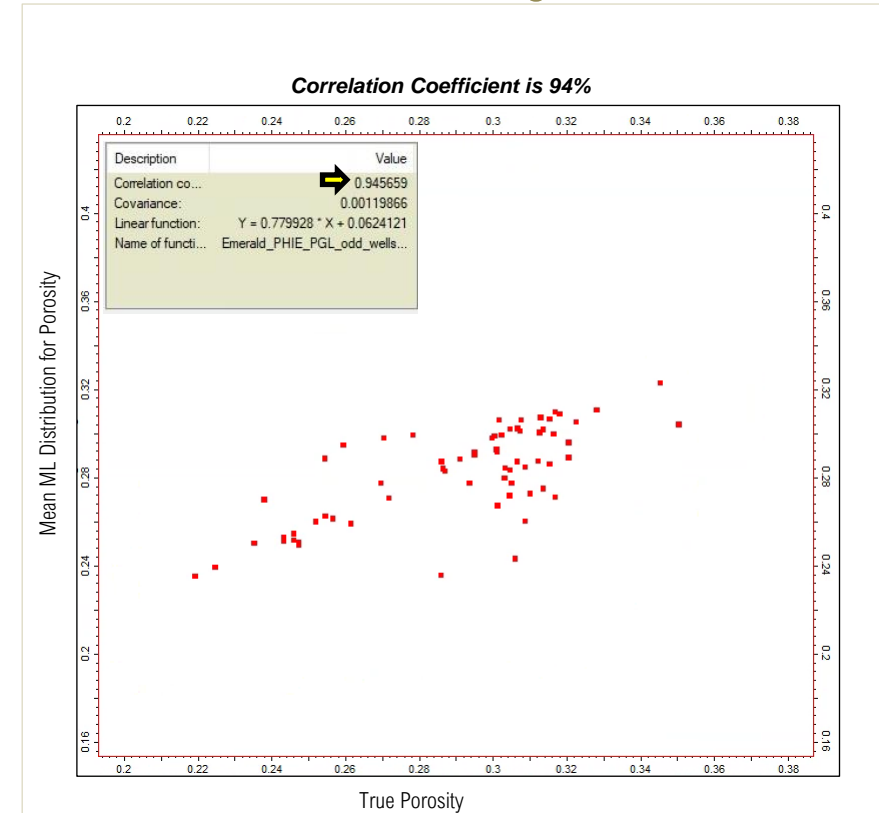


# Cheviot Field: Correlation Coefficients for Predicted Porosity

## Correlation Coefficient without ML Property Modeling



## Correlation Coefficient with ML Property Modeling

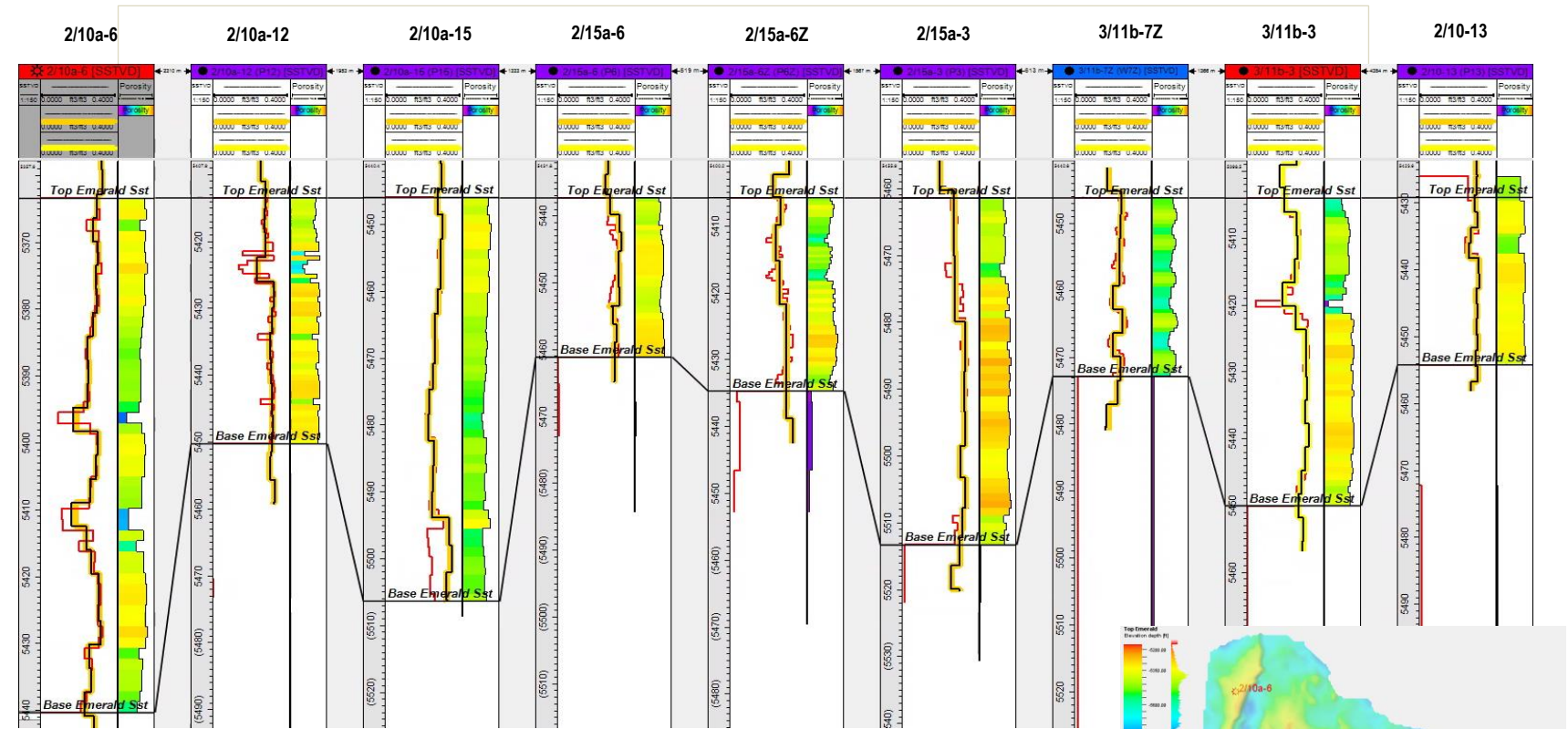


*\*Comparison of Correlation Coefficients for Porosity predictions with and without ML Property Modeling Workflow*

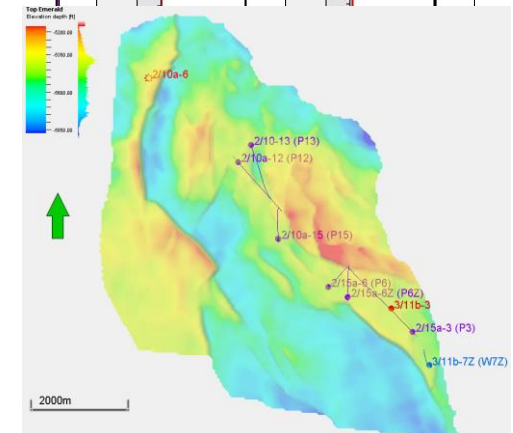


# Cheviot Field: Porosity Blind Testing Validation

- QA/QC Blind testing
- Several sets of wells selected in a random order to check for variability on model prediction
- Blind Testing for ML Property Model porosity showed a correlation coefficient of 94.5% vs. 61% for the geostatistical model.

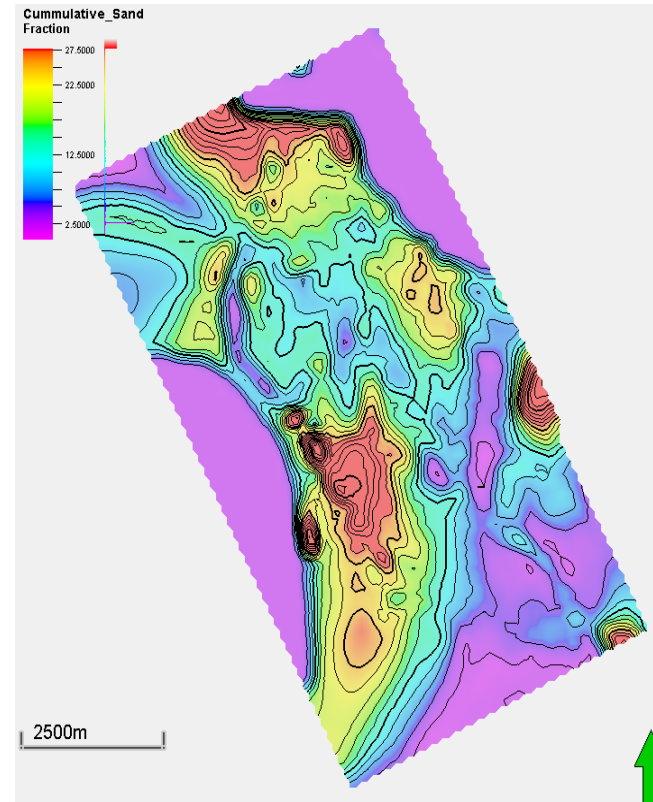


True Porosity  
 ML Property Modeling Porosity  
 Distributed Geostatistical Model Porosity (Blind Test Wells) Vs True Porosity  
*\*Key selected wells for Emerald Reservoir*

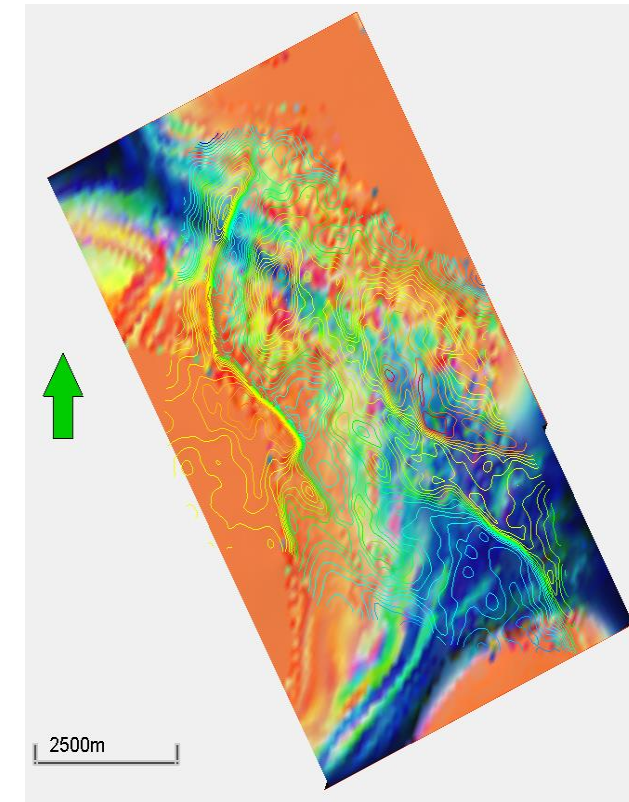


# Cheviot Field: Integrating Forward Stratigraphic Modeling

- Additional training feature integrated into the workflow
- Forward Stratigraphic Model generates a property model conditioned to facies framework
- Porosity correlation coefficient improved by additional 5%.



Cumulative Sand Fraction Predicted from GPM Simulations



GPM Simulation Results showing Lithological Units Predictions

# Next Steps

Better statistics for correlations achieved, but so what?

1. Improved confidence in model results?
2. Better development plan?

