

DELFI cloud native app as a solution to build the corporate cloud-based storage with wellbore interpretation parameters and prepare the environment for advanced analytics and data mining

Yngve Bolstad Johansen

Chief Petrophysicist – Aker BP



Schlumberger

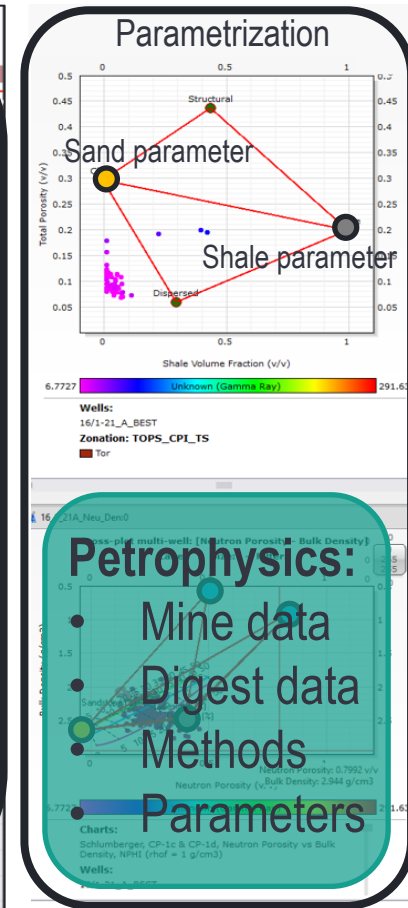
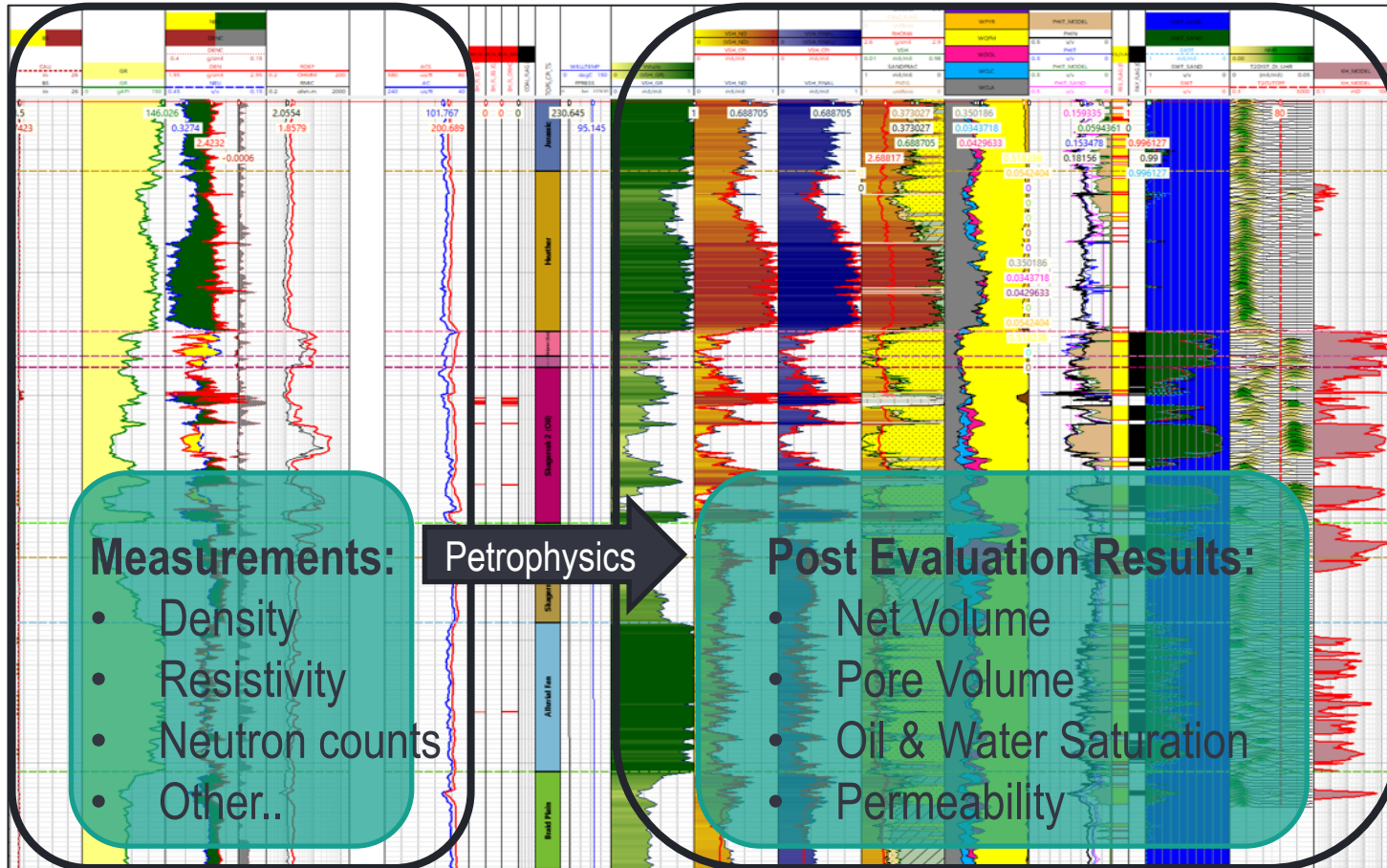
DELFI Wellbore Interpretation Insights – Results from a Formation Evaluation Pilot Project

DELFI cloud app project

- Introduction
- Today's status vs Preferred Status
- Solutions – Cloud native app with AI algorithms
- AkerBP Test of the DELFI Wellbore Interpretation Insights App
- Conclusions and the way forward



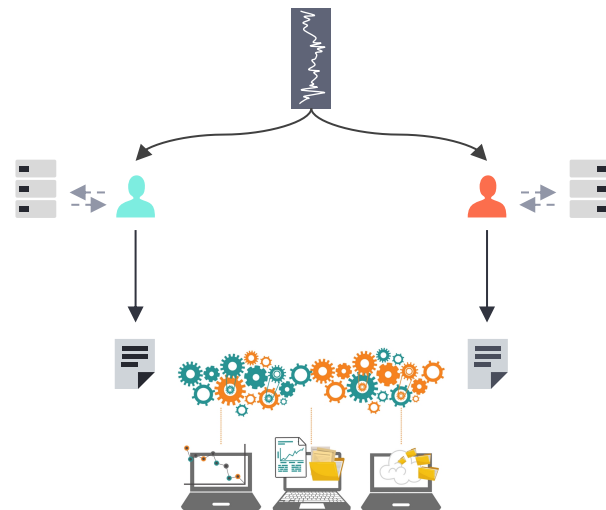
Introduction- Formation Evaluation



Today's status vs Preferred status

➤ Today's Formation Evaluation Workflow

- Siloed data and expertise
- Subjectivity in parametrization and answers
 - Experts like different data/wells
 - Experts like different methods
- Time consuming - case by case data mining



- ## ➤ Why is this unwanted?
- Poor reproducibility
 - Large variance in quality
 - Poor Standardization
 - **Expensive and slow**
 - **Missed opportunities**



Today's status vs Preferred status

➤ Preferred Formation Evaluation Workflow

- All data at fingertips (No silos)
- Objectivity in answers
- Efficient mining of data
 - Mine more data (not only favorite well)
 - Raw data
 - Expert behavior (Parametrization)
 - Use weighted averages from multiple experts

➤ Why is this wanted?

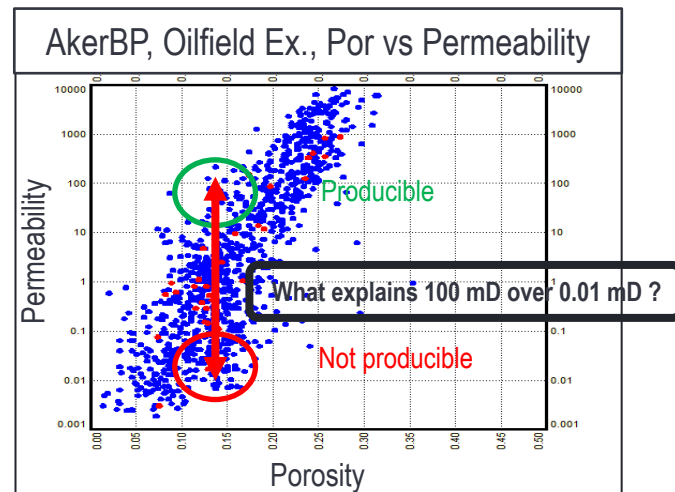
- Reduced variance in formation evaluation quality
- Standardized and digestible
- **Fast and reproducible answers**
- **More opportunities**



Solutions- Why Augmented Learning ? Why a cloud native app with AL algorithms ?

➤ Machine Learning

- Mine trends from a perfect database
 - Requires good structure
 - Requires a perfect set of relevant meta data
 - It's hard to build a perfect database
- If not perfect, big data can reduce precision

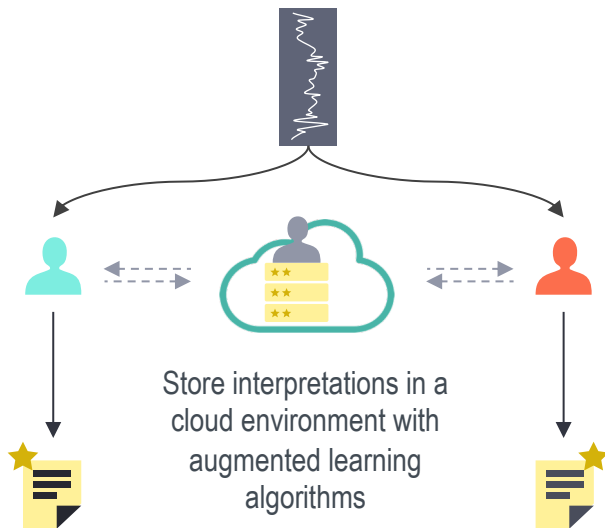


➤ Augmented Learning

- Learn from experts
 - Mine behavior, model choices and parametrization from experts
 - Tap into a large amount of meta data on which experts base parameters on
- Apply expert consensus methods semi automatically on new wells



Concept– Store method and parameter choices of Experts



Store interpretations in a cloud environment with augmented learning algorithms



Easily find legacy interpretations

Wells interpreted in the past in a similar context, geological and depositional environment

Mine interpretation parameters

Display smart dashboards, view historical records

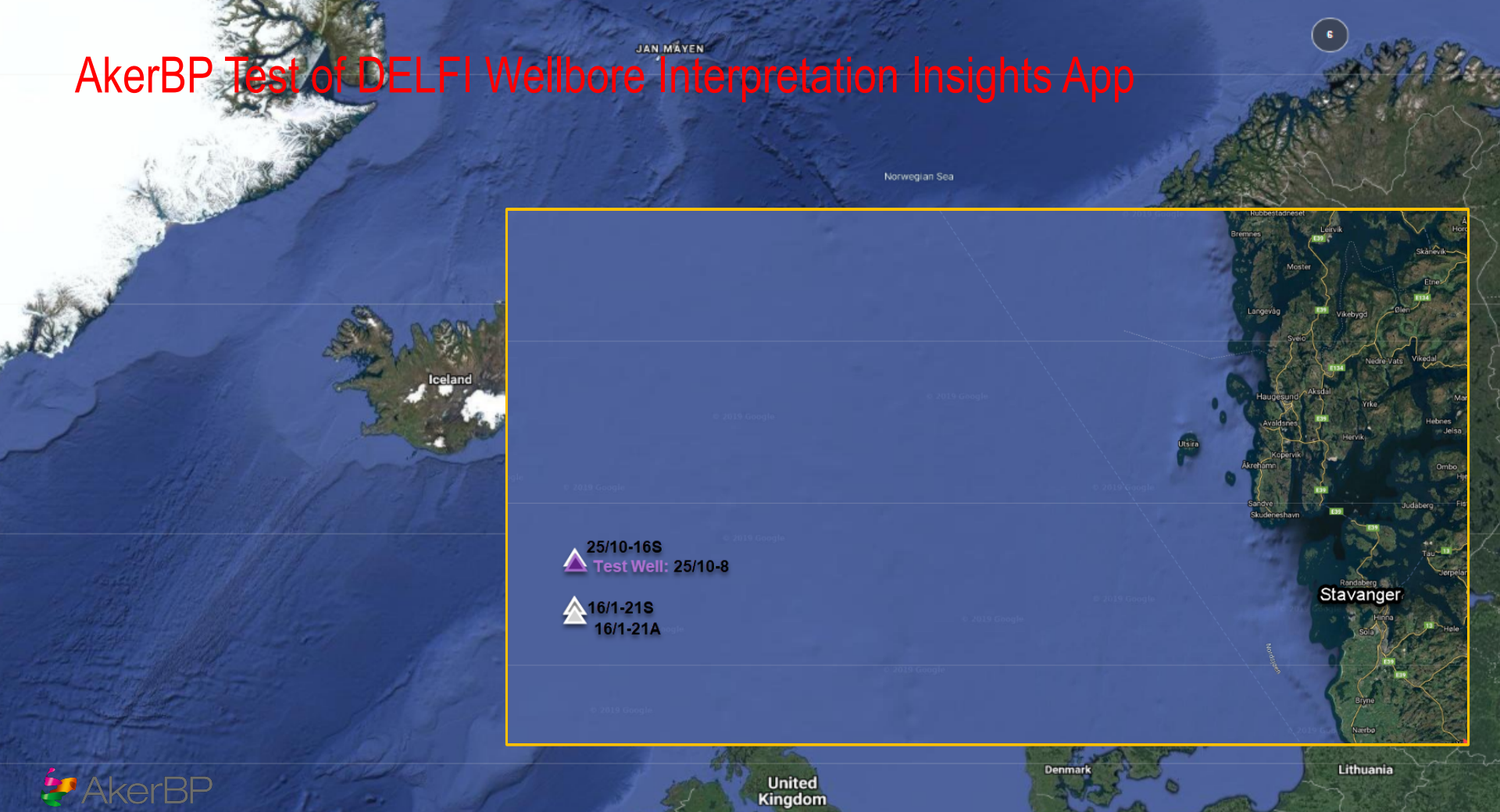
Intelligent statistics

Intelligent statistics for the well of interest based on offset wells – distance averaged etc.

Advise parameters for key wells

Define the well of interest to advise parameters to be used on a semi-automatic basis based on offset wells

AkerBP Test of DELFI Wellbore Interpretation Insights App



AkerBP Test of DELFI Wellbore Interpretation Insights App

Schlumberger Techlog4 2019.1 (new 23821) Project: Techlog_2019_Testing

Home Plot Data Utility Studio Petrophysics Geology Geomechanics Reservoir Geophysics Unconventionals Wellbore integrity Wellbore Interpretation Insights AkerBP Workflow manager

Send interpretations Open Web app Batch publish User guide Interpretations Advice

Project browser

Search

Technology_2019_Testing Family Unit

- 16/1-21_A
- 16/1-21_5
- 25/10-16_5
- 25/10-8
 - BEST Mea... m
 - Index Mea... m
 - Index_2 Mea... m
 - TOPS_CPI_TS Mea... m
 - TOPS_CPI_TS_old Mea... m
 - TOPS_CPI_TS_withJurassic Mea... m
 - Wellbore Interpretation Insights

Workflow overview

Workflow / Methods

Controller	Input data	Favorite parameters	Outputs	Ap	Mc
Formation pressure				✓	✓
Bad hole flag (Caliper)				✓	✓
Bad hole flag (DRHO)				✓	✓
Python: CPI_BadHole_Combiner				✓	✓
Coal flag				✓	✓
Carbonate flag				✓	✓
25_10-8_VSH				✓	✓
Vsh gamma ray				✓	✓
Vsh neutron-density				✓	✓
Vsh final				✓	✓
25_10-8_Core Correction				✓	✓
Python: CPI_deanstark_correction				✓	✓
25_10-8_TS				✓	✓
Python: CPI_ts_johansen				✓	✓
Python: CPI_ts_support_computations				✓	✓
25_10-8_Well Statistics				✓	✓
Summaries				✓	✓
25_10-8_CPI OUTPUT DATASET				✓	✓
Python: CPI_create CPI_OUT				✓	✓

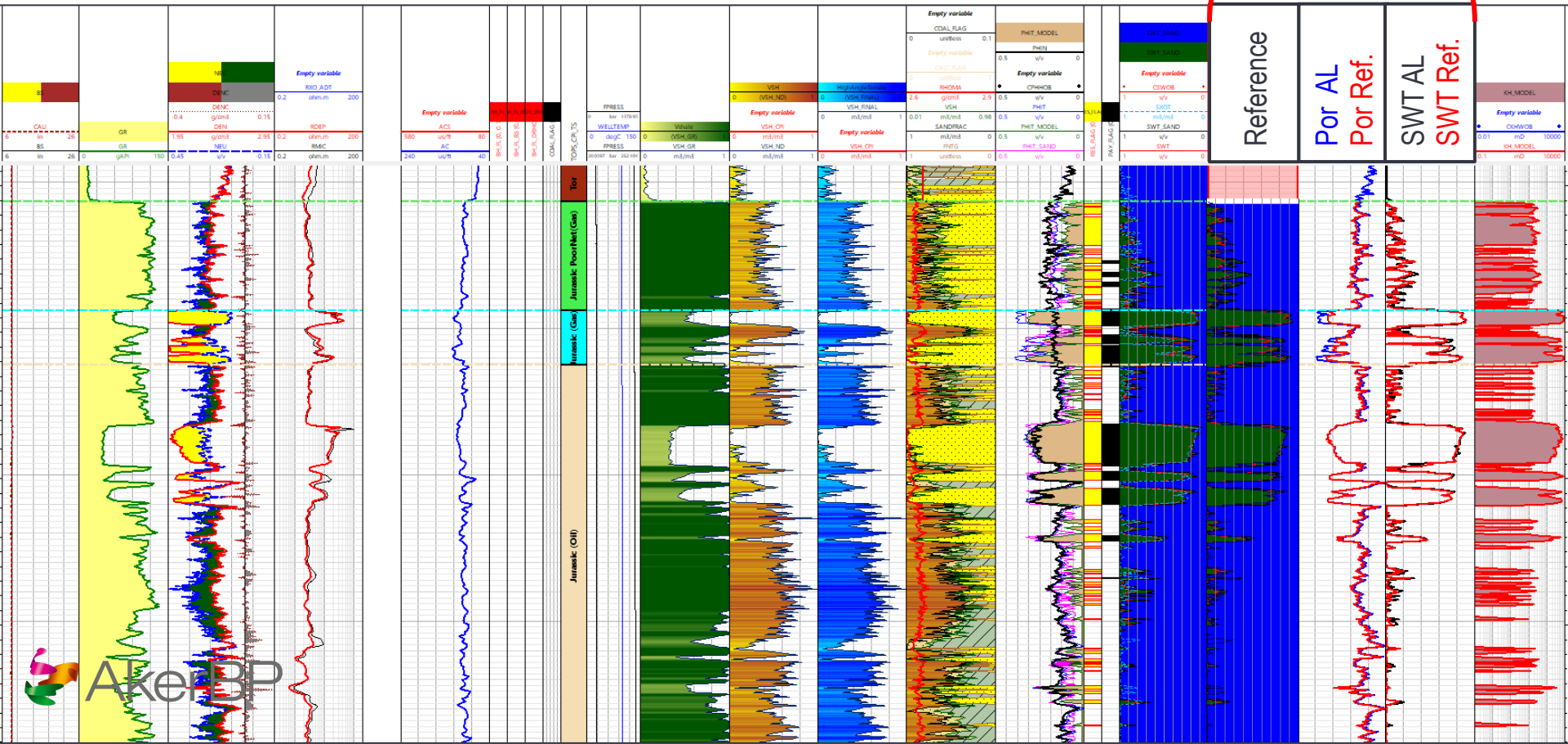
Method settings

Python: CPI_ts_johansen

Inputs	Zonation	Borehole	Porosity	VSH	Saturation	TBA	NMR
1	25/10-8	BEST	Seabed	225.3	455.2	Oil Based	100
2	25/10-8	BEST	Nordland	455.2	662	Oil Based	100
3	25/10-8	BEST	Utsira	662	846	Oil Based	100
4	25/10-8	BEST	Stade	846	1107	Oil Based	100
5	25/10-8	BEST	Upper Hordaland (OBM)	1107	1551	Oil Based	100
6	25/10-8	BEST	Grid	1551	1777.4	Oil Based	100
7	25/10-8	BEST	Lower Hordaland	1777.4	1941	Oil Based	100
8	25/10-8	BEST	Balder	1941	1987	Oil Based	100
9	25/10-8	BEST	Sele	1987	2047	Oil Based	100
10	25/10-8	BEST	Upper Lista	2047	2077	Oil Based	100
11	25/10-8	BEST	Hordaland	2077	2122	Oil Based	100
12	25/10-8	BEST	Lower Lista	2122	2204	Oil Based	100
13	25/10-8	BEST	Vaale	2204	2209	Oil Based	100
14	25/10-8	BEST	Cretaceous	2209	2265.5	Oil Based	100
15	25/10-8	BEST	Tor	2265.5	2353.3	Oil Based	100
16	25/10-8	BEST	Jurassic PointNet(Gas)	2353.3	2371.8	Oil Based	100
17	25/10-8	BEST	Jurassic (Gas)	2371.8	2381.2	Oil Based	100
18	25/10-8	BEST	Jurassic (Oil)	2381.2	2507	Oil Based	100
19	25/10-8	BEST	Heather	2507	2511	Oil Based	100
20	25/10-8	BEST	Hugin	2511	2535.7	Oil Based	100
21	25/10-8	BEST	Skagerrak 2	2535.7	2567.25	Oil Based	100
22	25/10-8	BEST	Skagerrak 1	2572.5	2578.6	Oil Based	100
23	25/10-8	BEST	Altivier Fan	2578.6	2655	Oil Based	100

Unit system: Company Metric_AkerBP

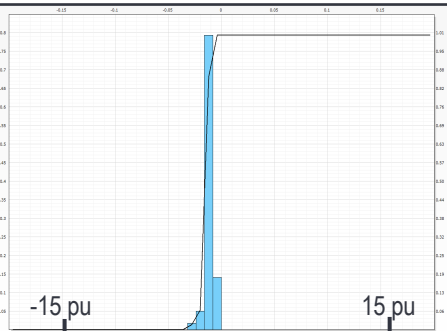
(DELFI Wellbore Interpretation Insights App)



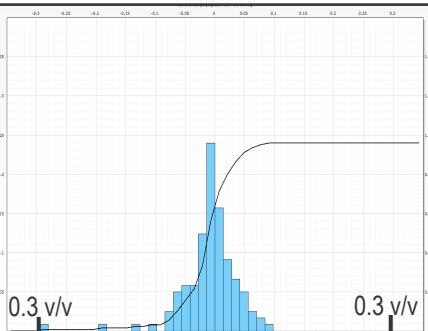
AL based method vs AkerBP Expert

ML based method vs AkerBP Expert

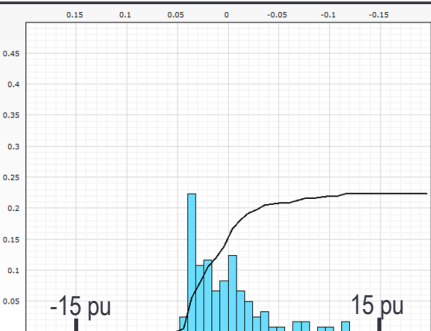
Δ PHIT Jurassic Poor Net



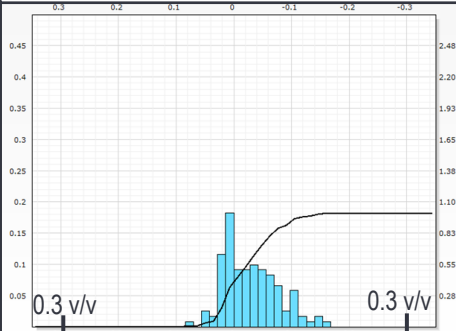
Δ SWT Jurassic Poor Net



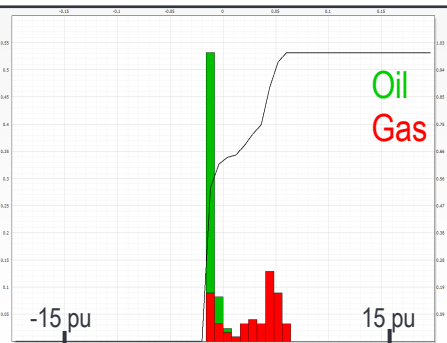
Δ PHIT Jurassic Poor Net



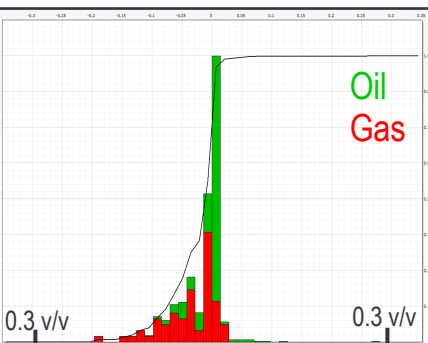
Δ SWT Jurassic Poor Net



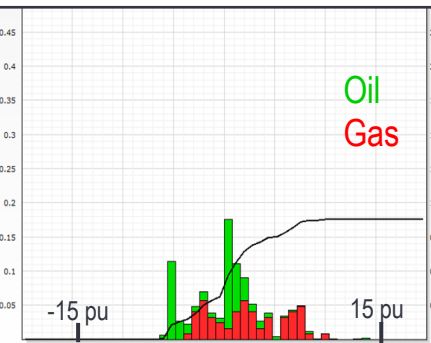
Δ PHIT Jurassic Good Net



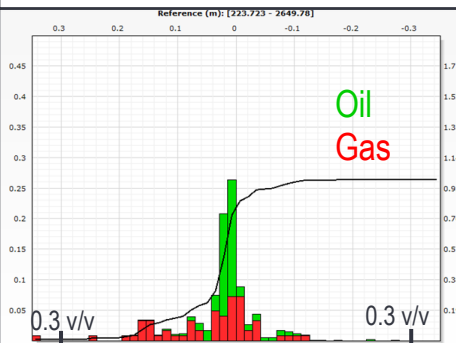
Δ SWT Jurassic Good Net



Δ PHIT Jurassic Good Net



Δ SWT Jurassic Good Net



Conclusions

Cloud Environment

It is perceived as useful to aggregate methods and parameters used by experts



Mining Expert behavior

Adds valuable information on how to do interpretations have been done in the past, and identify inconsistencies



Augmented parameter advisor

Advise parameters to be used when working with new wells.
Reduced interpretation time 90%



AL outperformed ML (NN)

at this specific AkerBP testcase

