

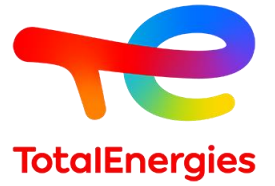
Big Data: Big Responsibility

Conditioning Corporate Well Repositories with Machine Learning and Confidence Ranking *An Innovation Journey between TotalEnergies & Schlumberger*

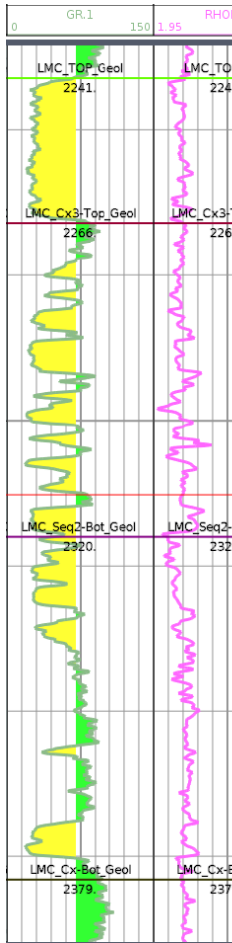
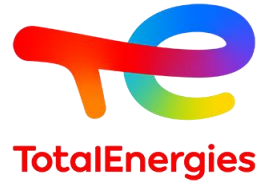
Instilling Trust to Automation & Machine Learning on Basin Scale Well Data

Emmanuel CAROLI, Olivier SICCARDI, Kaveh DEGHAN, Renata ALVES SANTOS, TotalEnergies
Stuart FORSYTH, Sylvain WLODARCZYK, Schlumberger MpTC

Well Data – Somewhere between Mess and Chaos



Ideal Objective: a Formal French Garden









Objective
Easy, ex
outliers, re

and analyse

Challenge Overview



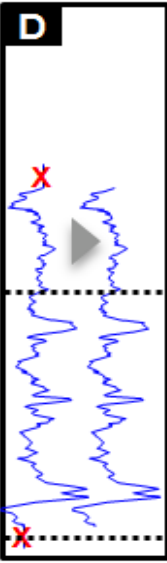
1 region = **280000** files for **20000** wells

Storage type	Sources	#Files	Metadata quality (context)
Structured 	Corporate Database	150000	
Semi-Structured 	Study project	10000	
Unstructured 	User disks	120000	

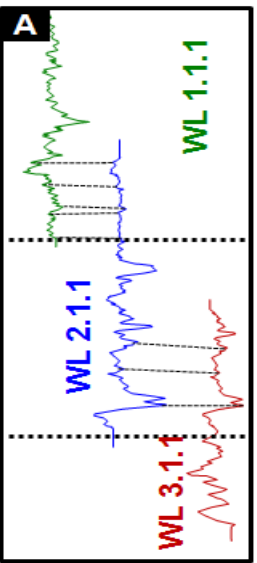


6-12 months of data management work for manual data preparation!

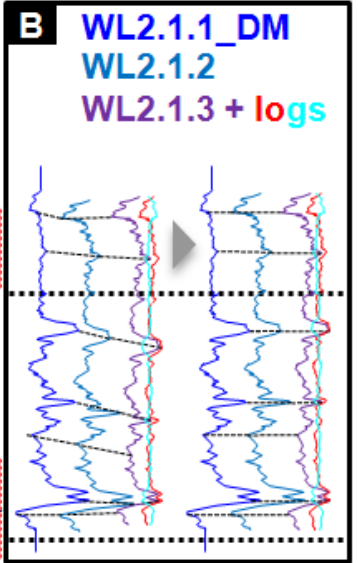
Cleaning 1st & last readings



1st WL GR of each section + Depth Match



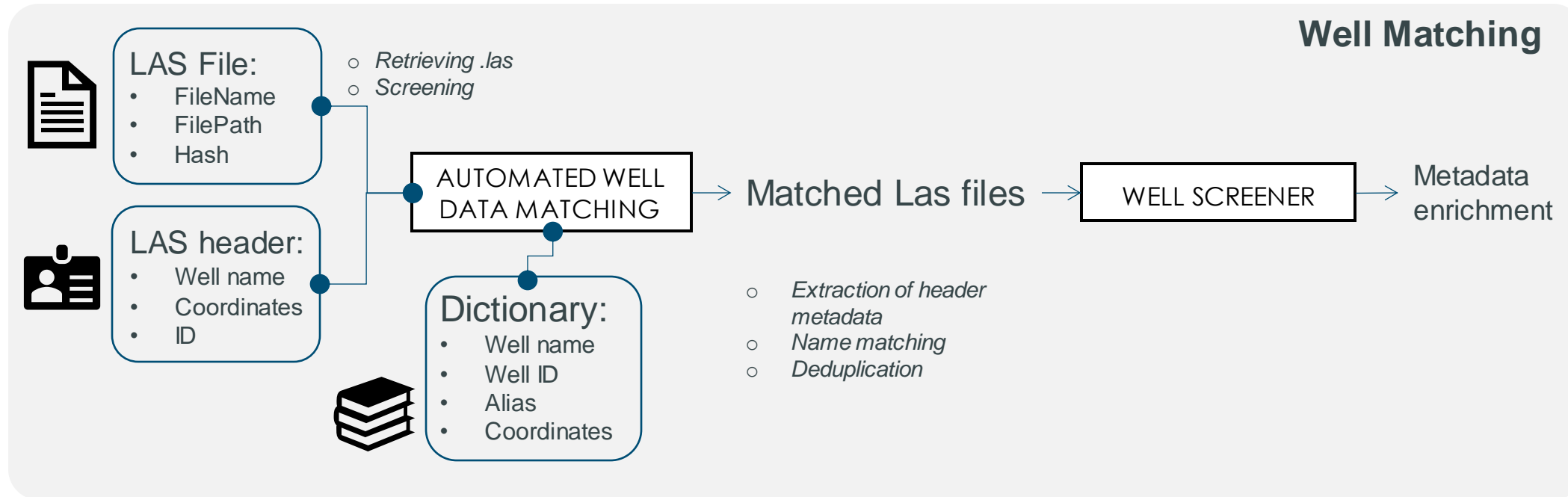
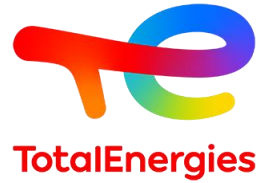
Depth Match of runs in a section



01.

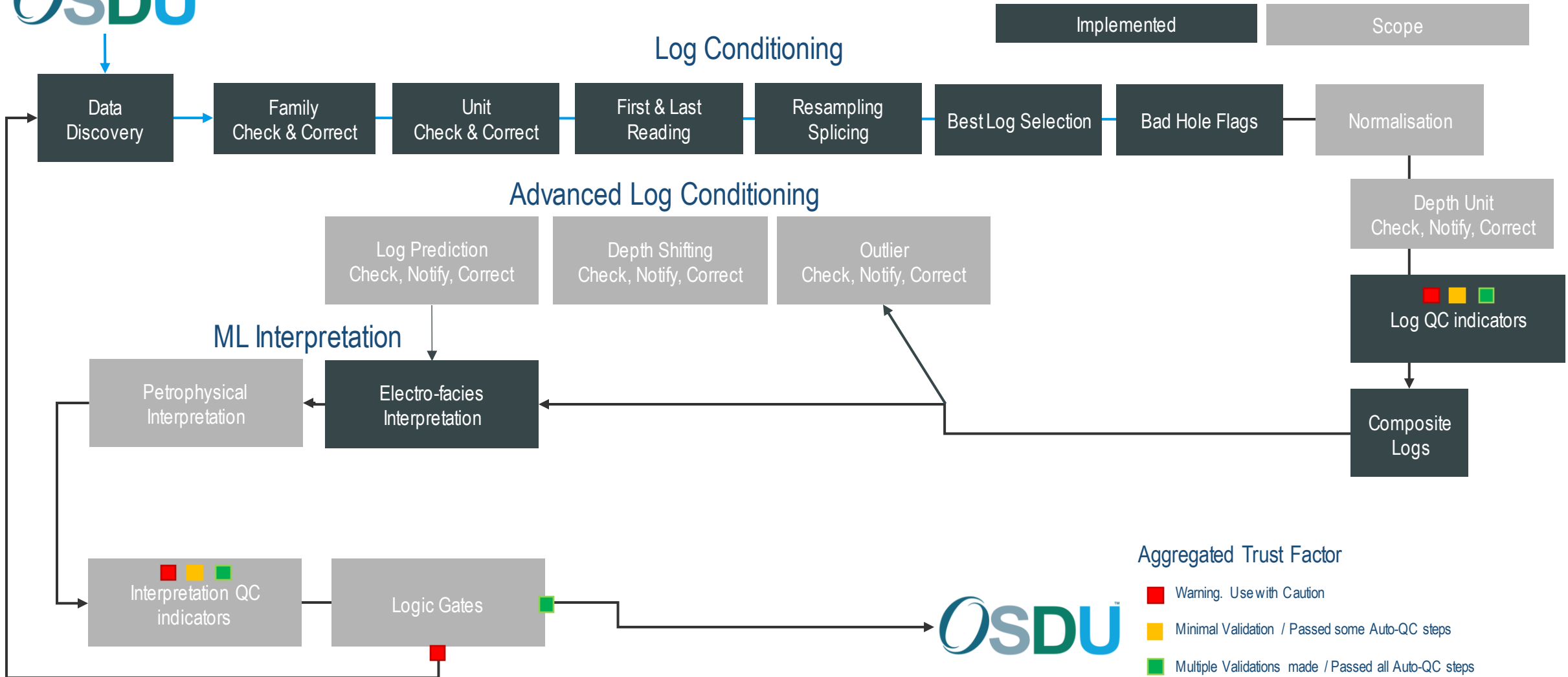
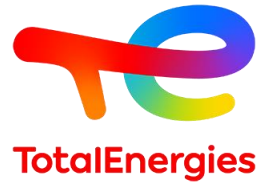
Data conditioning

Well Data Inventory & Orchestration



Sources	Screened data	Prepared data	not-LAS compliant data	16,997 Wells ...	16,329 loaded wells
Corporate DB	118,447	105,054	13,393	C1: 568	C1: 555
Project DB	7,400	7,313	87	C2: 1476	C2: 1204
Unstructured repository	118,057	82,233	35,824	C3: 6370	C3: 6255
				C4: 2309	C4: 2278
				C5: 3283	C5: 3167
				C6: 2991	C6: 2870
Total	243,904	194,600	49,304		

Log Conditioning Workflow



Aggregated Trust Factor

- Warning. Use with Caution
- Minimal Validation / Passed some Auto-QC steps
- Multiple Validations made / Passed all Auto-QC steps



02.

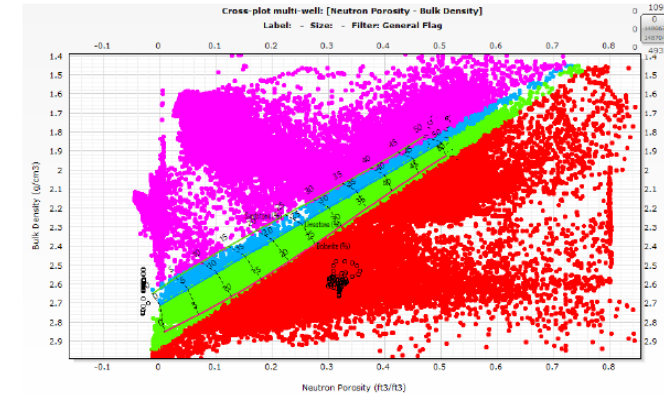
Composite Validation

Log Conditioning Validation

Compute

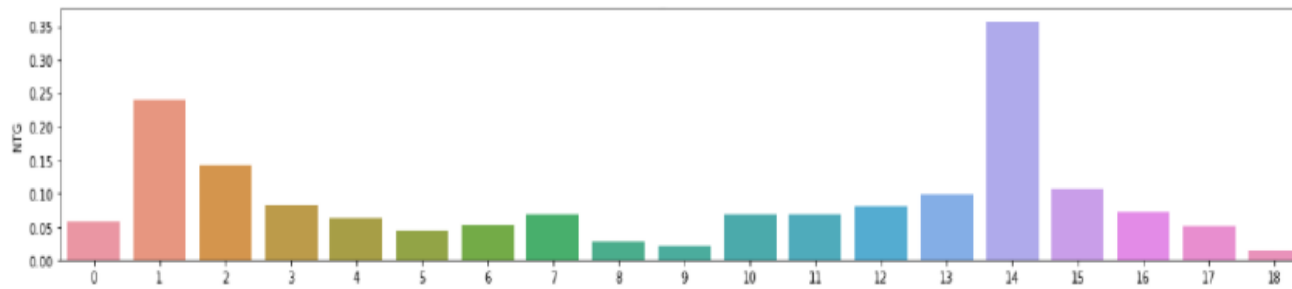
- Simplified interpretation to check log consistency

$$\begin{cases} GR_{meas} = GR_{EDP} * V_{MAT} \\ RHOB_{meas} = RHOB_{EDP} * V_{MAT} + (1 - V_{MAT}) * RHOB_{FL} \\ NEUT_{meas} = NEUT_{EDP} * V_{MAT} + (1 - V_{MAT}) * NEUT_{FL} \end{cases}$$



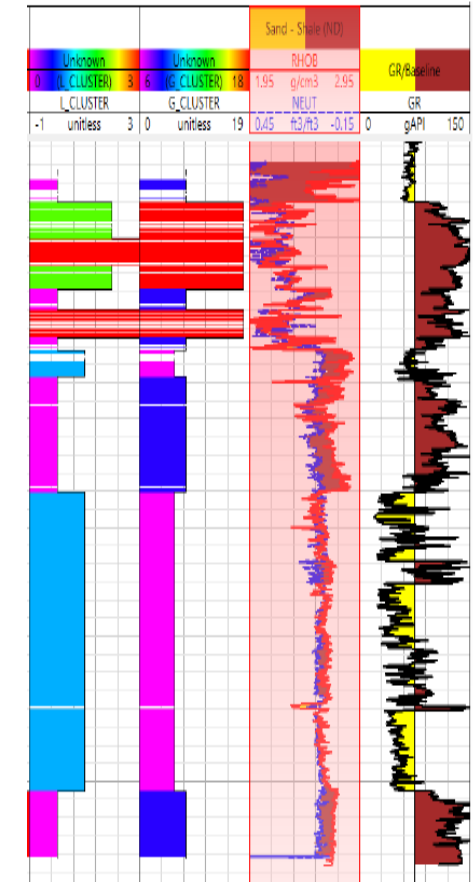
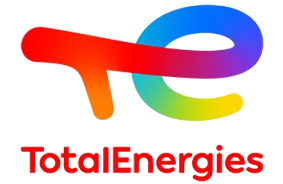
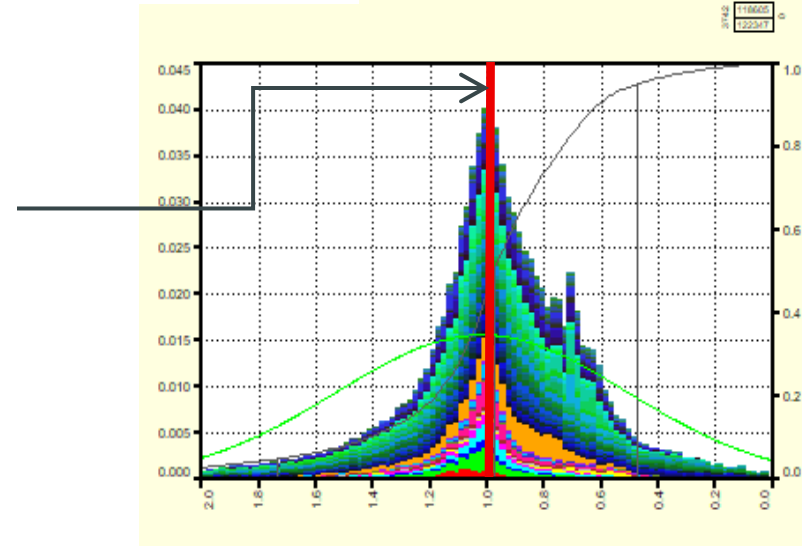
Evaluate

- Clustering of results to make statistics

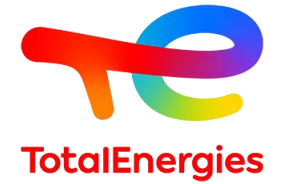


Screen

- Simplified, **qualitative** log interpretation
- Check outputs consistency per cluster
- Map and isolate outliers for investigation

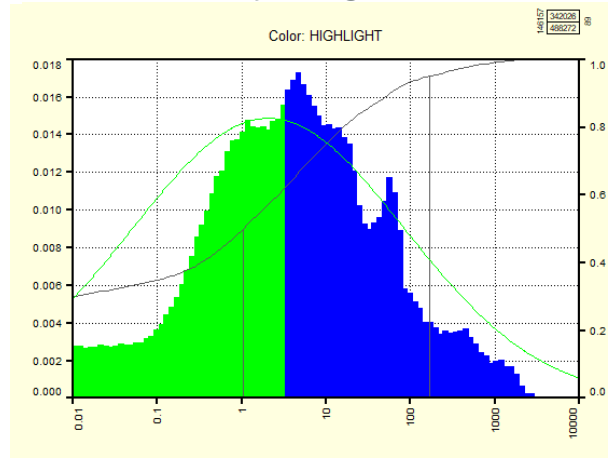


Is the QC Indicator Unbiased ?



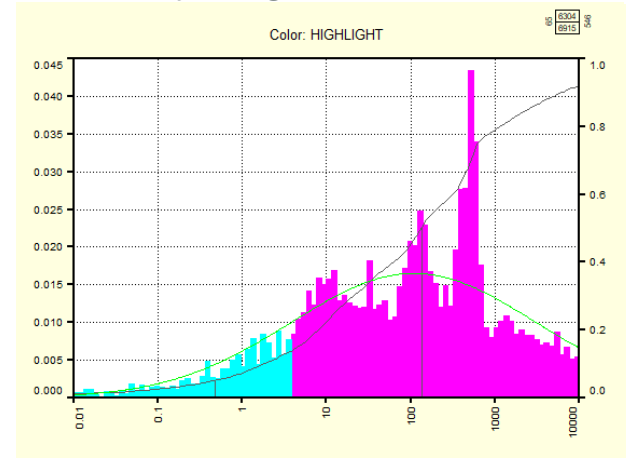
Log difference distribution on reference wells, filtered by Quality Flag

Quality flag = 0



Hand - Auto
0 - 0 1 - 0

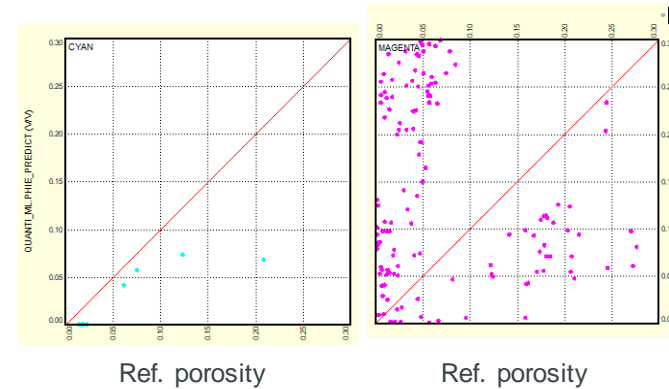
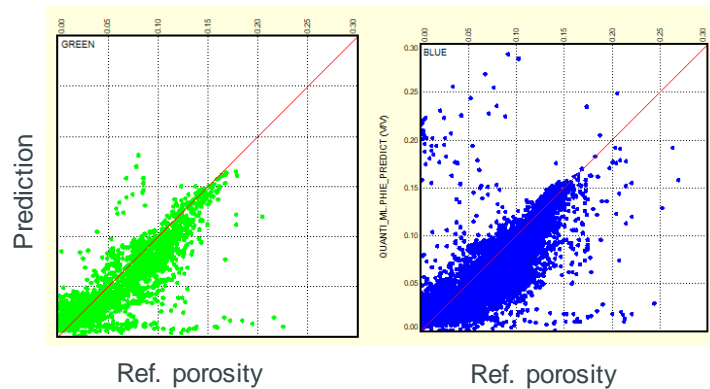
Quality flag = 1



Hand - Auto Hand - Auto
0 - 1 1 - 1



The Quality Flag is able to detect obvious anomalies and, conversely, isolate good composites



The QL indicator is too conservative

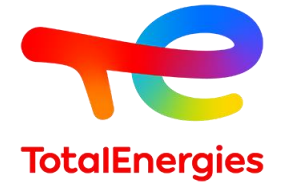
- Poor logs may not be classified systematically as poor



03.

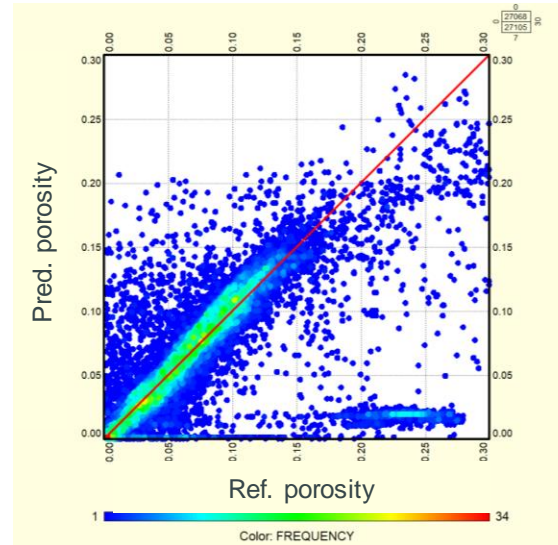
Conditioning leads to AI
Applications
&
Real Collaborative Work

Effective Model Training

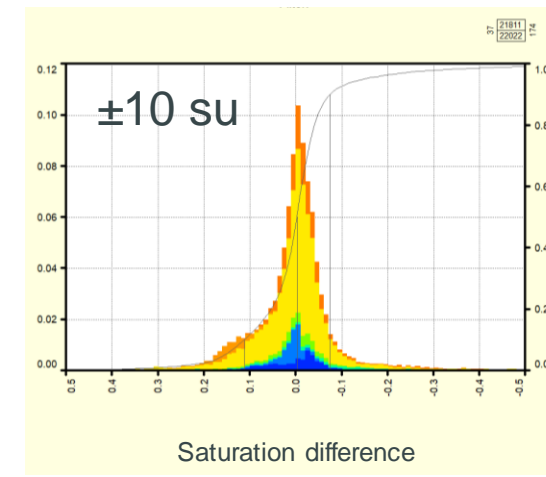
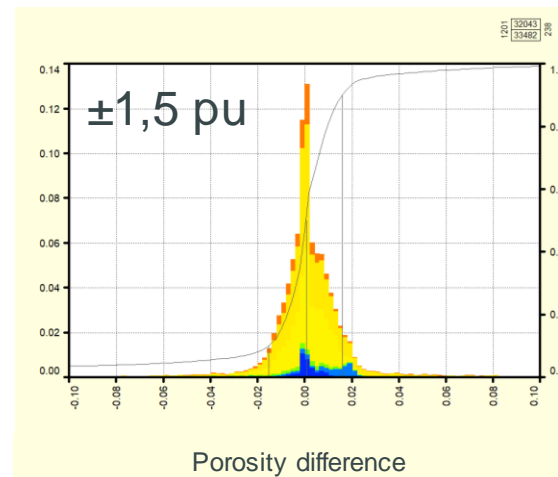
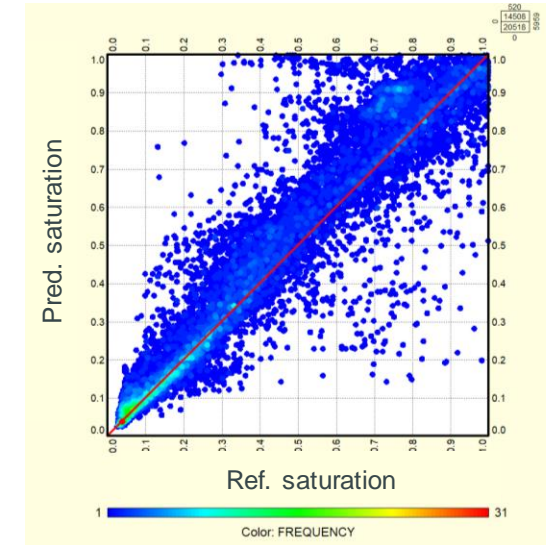


- Worldwide database with same inputs and outputs
- ~5 million frames (points)
- Covering 20 countries

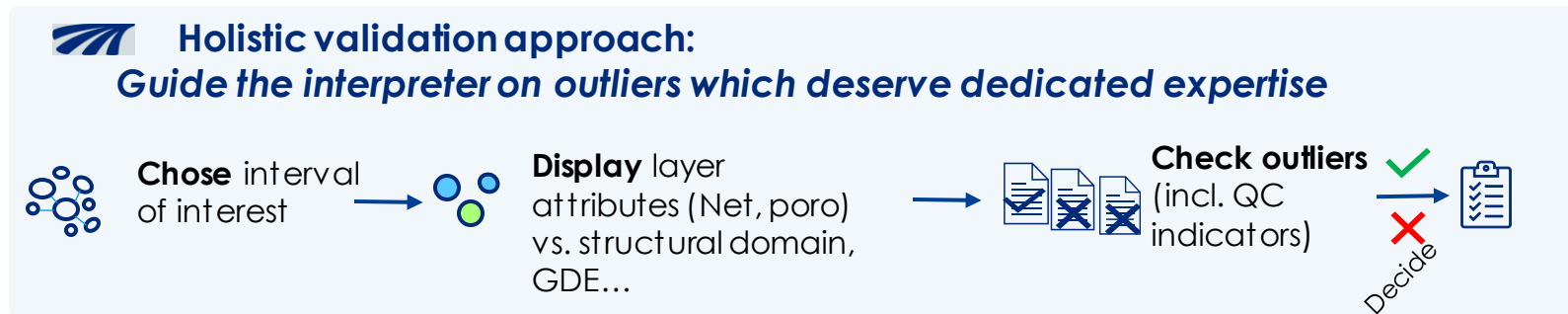
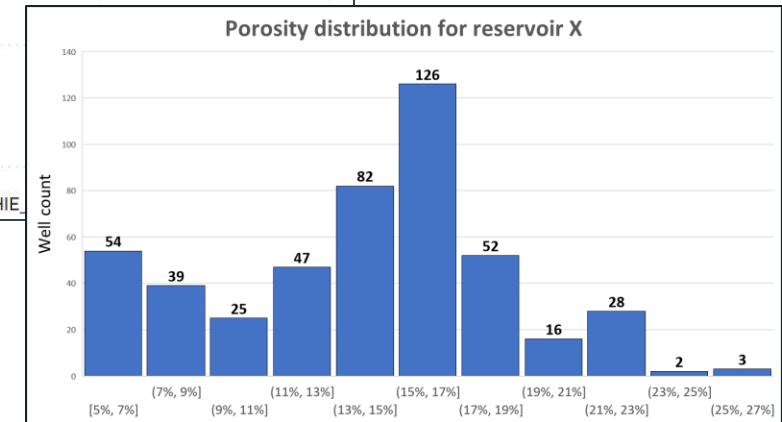
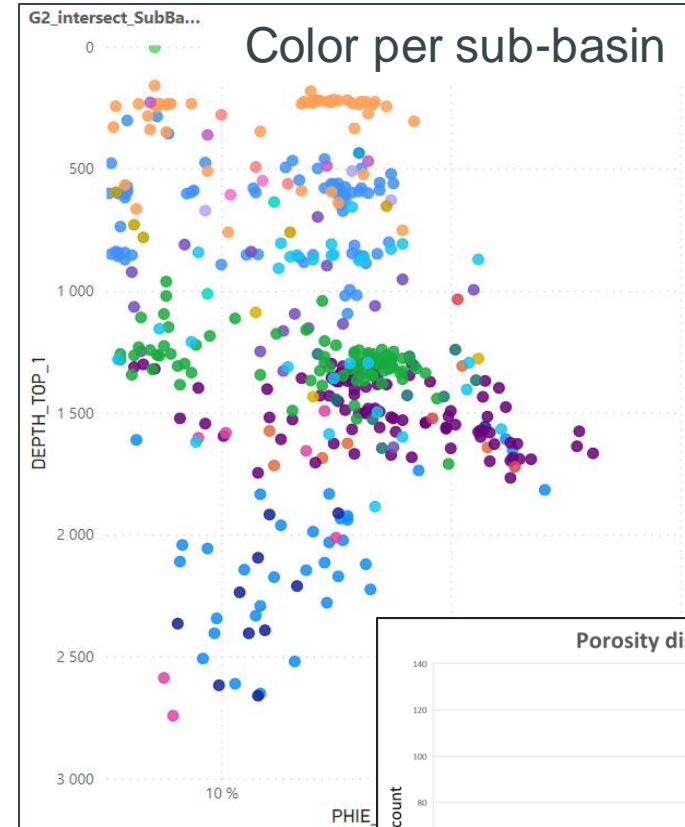
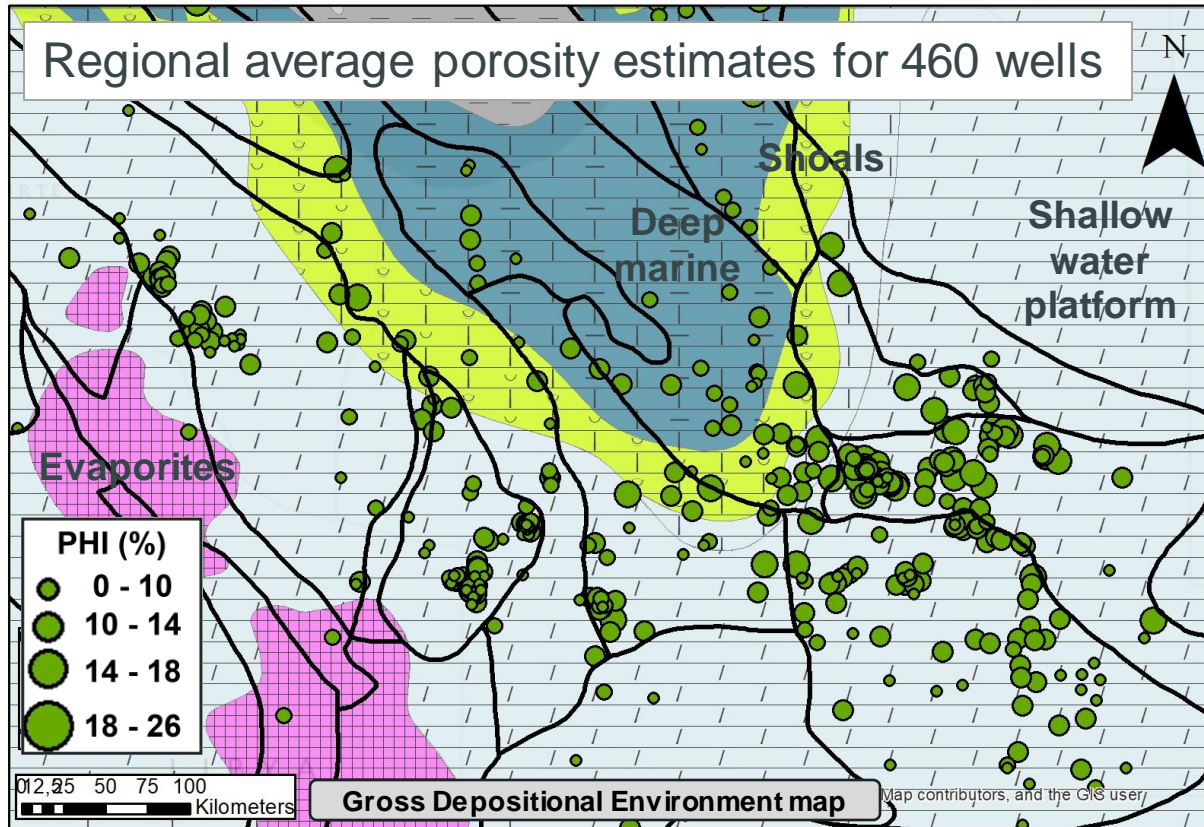
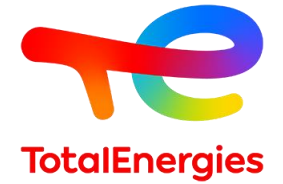
Porosity



Saturation

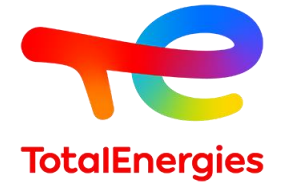


How to check such a mass of data ?





Well Data automation with Machine Learning



Data orchestration

11,703 files
3167 wells

Set	Log	Version	Units	Minimum	Maximum	Mean
LCS	DEPTH		METRES	3318.8148	4080.2052	3699.5100
LCS	AT10	2	OHMM	2.1730	1346.4850	48.7000
LCS	AT20	2	OHMM	1.7630	1950.0000	58.6398
LCS	AT30	2	OHMM	1.6680	1939.8112	68.3372
LCS	AT60	2	OHMM	1.4900	1950.0000	76.2834
LCS	AT90	1	OHMM	1.4250	1950.0000	86.1769
LCS	BADHOLE	1		0.0000	1.0000	0.1942
LCS	BS	2	IN	6.0000	8.5000	6.0290
LCS	CALI	2	IN	5.6644	10.3406	6.4521
LCS	CGR	2	GAPI	8.4119	347.5680	52.0306
LCS	DRHO	2	G/C3	-0.8722	0.2008	-0.0090

Log conditioning

97% success rate

3088 conditioned wells

Mass interpretation

Parameters predictions

Temperature

Salinity

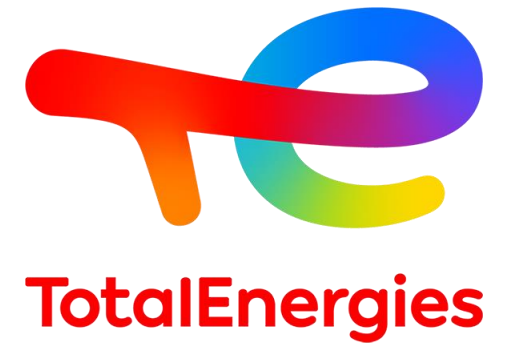
Interpretation

Φ

Sw

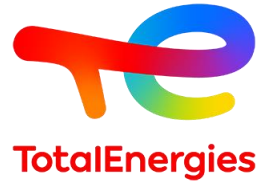
2447 wells consistently interpreted in one shot

- Automation of the most time-consuming steps (10 times faster) allows an **exhaustive use of data**
- Unlocks **iterative work** between teams, **refined mapping** of subtle plays



Thank you

Avertissement - Propriété intellectuelle



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