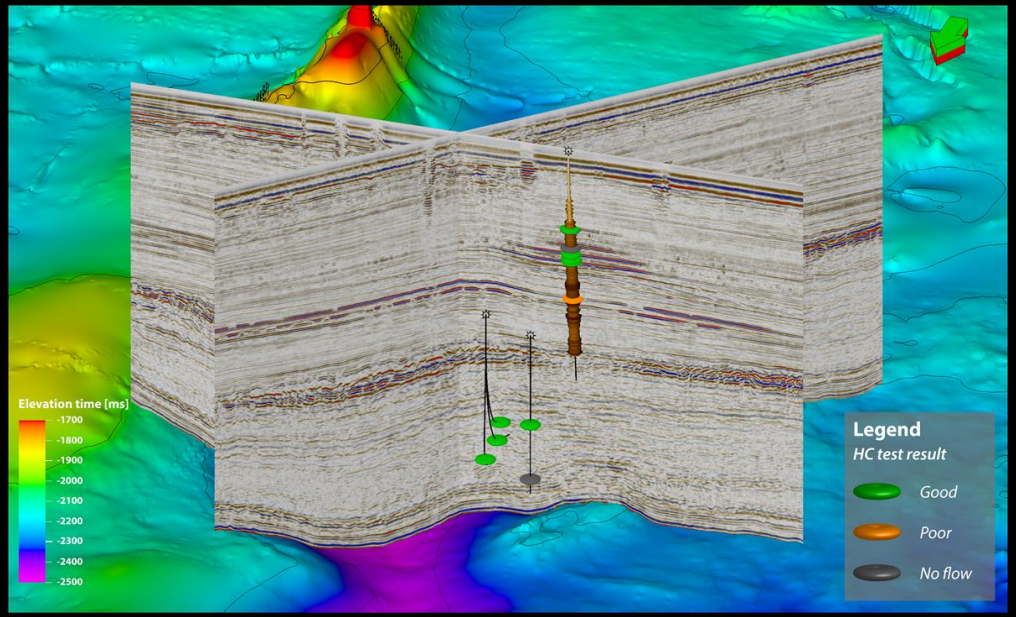

Unleashing Hydrocarbon Shows for Exploration & Well Planning

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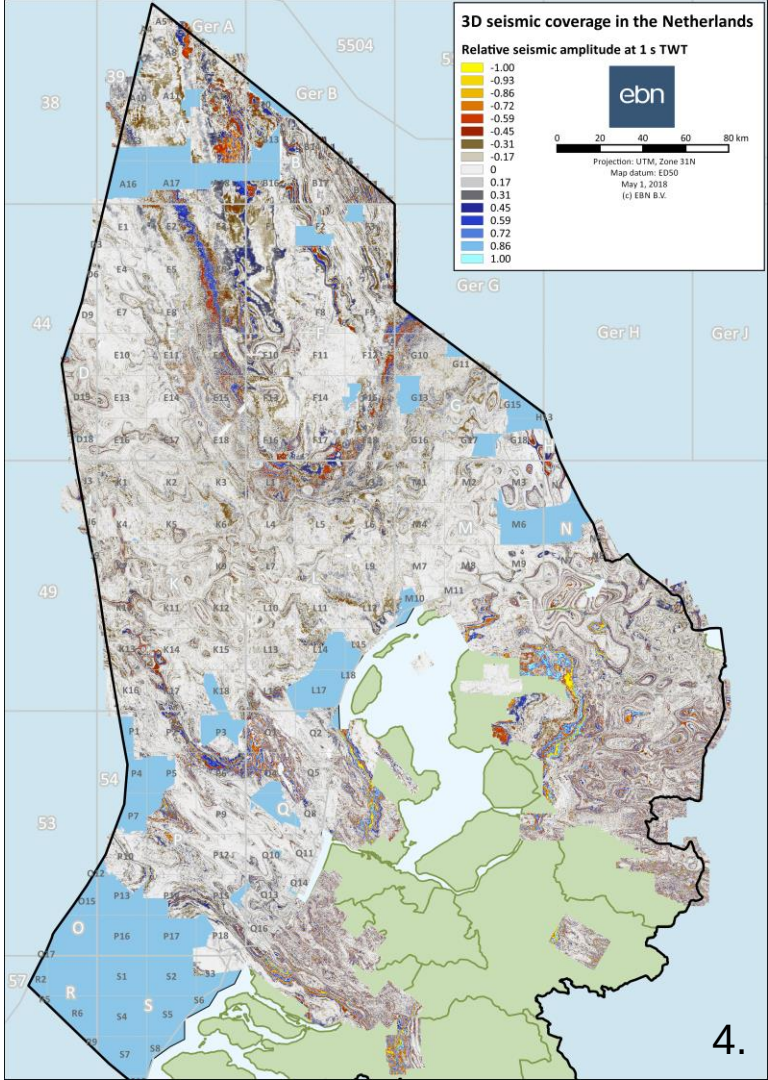
Sabine Korevaar *Geoscientist*

Content

- Introduction
- Value of HC Show data
- HC Show Attributes & Classifications
- Applications: Exploration & Well planning
- Demo

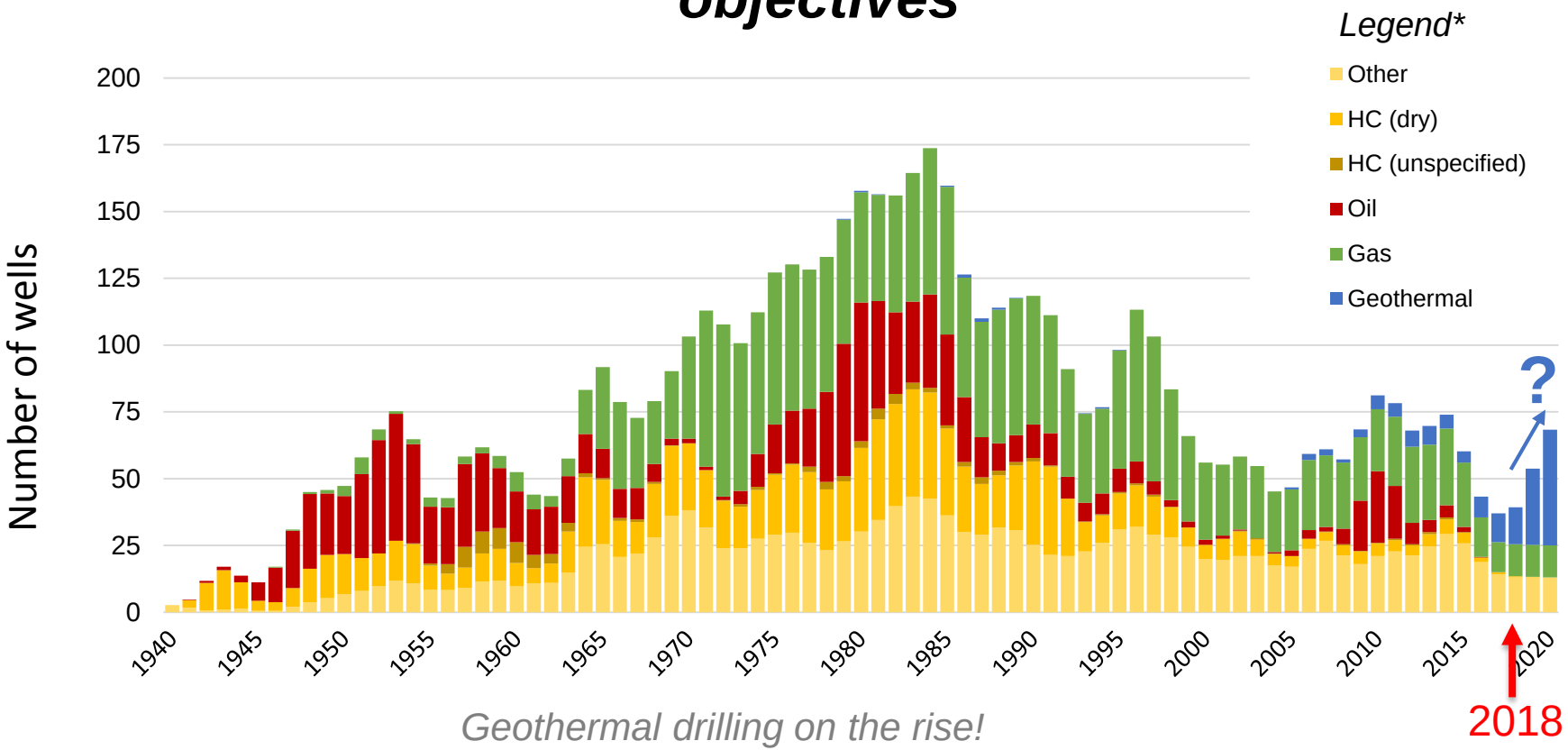
Lots of data…

- 2D & 3D seismic coverage
- 3000+ wells (O&G)



Drilling in The Netherlands

objectives



Geothermal drilling on the rise!

**Information from NLOG*

Questions:

1. What exactly have we learned from our wells?
2. Do we understand the occurences of hydrocarbons given the structural setting?
3. Is there *missed pay* out there?
4. Can geothermal projects assume hydrocarbon-free trajectories & reservoirs?

→ ***Comprehensive HydroCarbon Occurrence database***

Unleashing Hydrocarbon Shows in Exploration and Well Planning

Value of HC Show data

Until recently

- Well results in existing database lack detail

  → *single value defined for all stratigraphy (oil/gas/dry)*

- Detailed well results ‘’hidden’’ in well reports (NLOG)

Value of HC Show data

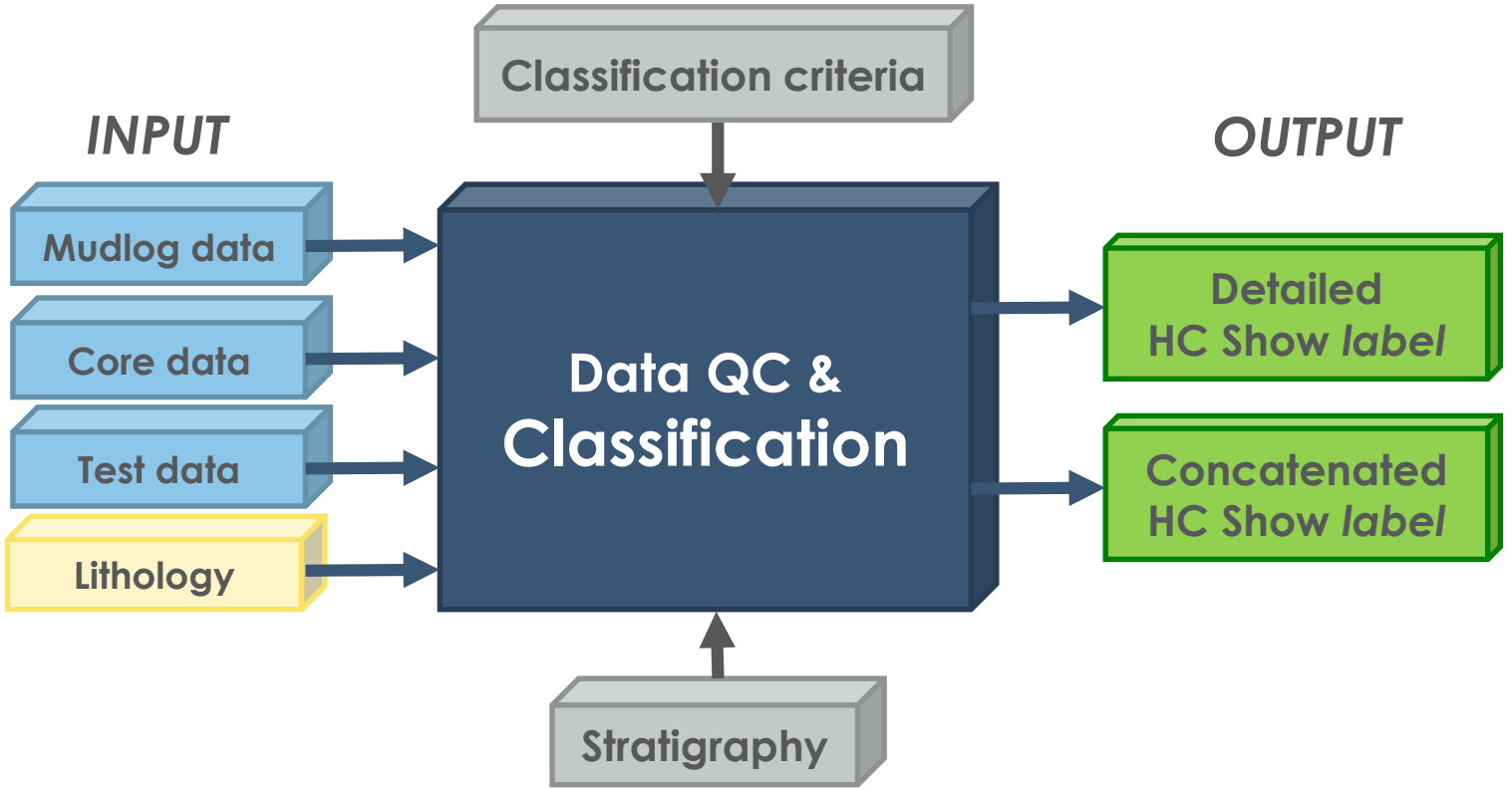
New situation

All observations of hydrocarbons:

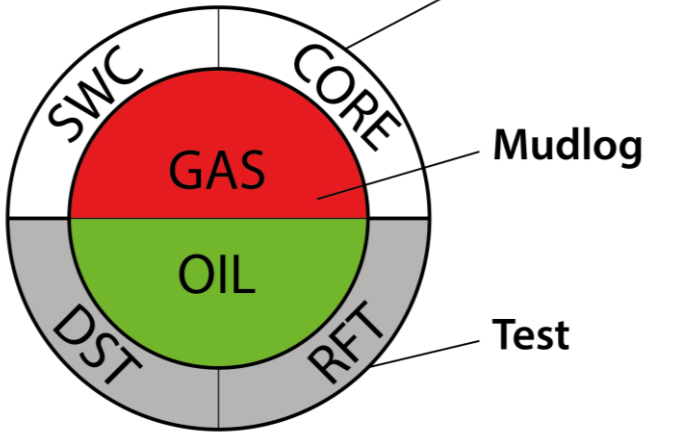
- Quantified & Classified
- 3D geo-referenced
- Easily accessible – workstation including other subsurface data

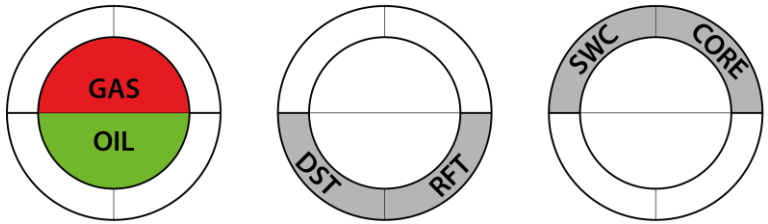
  Incl. seismic and well data

HC Show data: Classification workflow

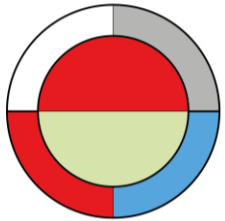


Detailed HC Shows: comprehensive symbols

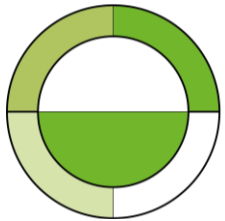




Examples:

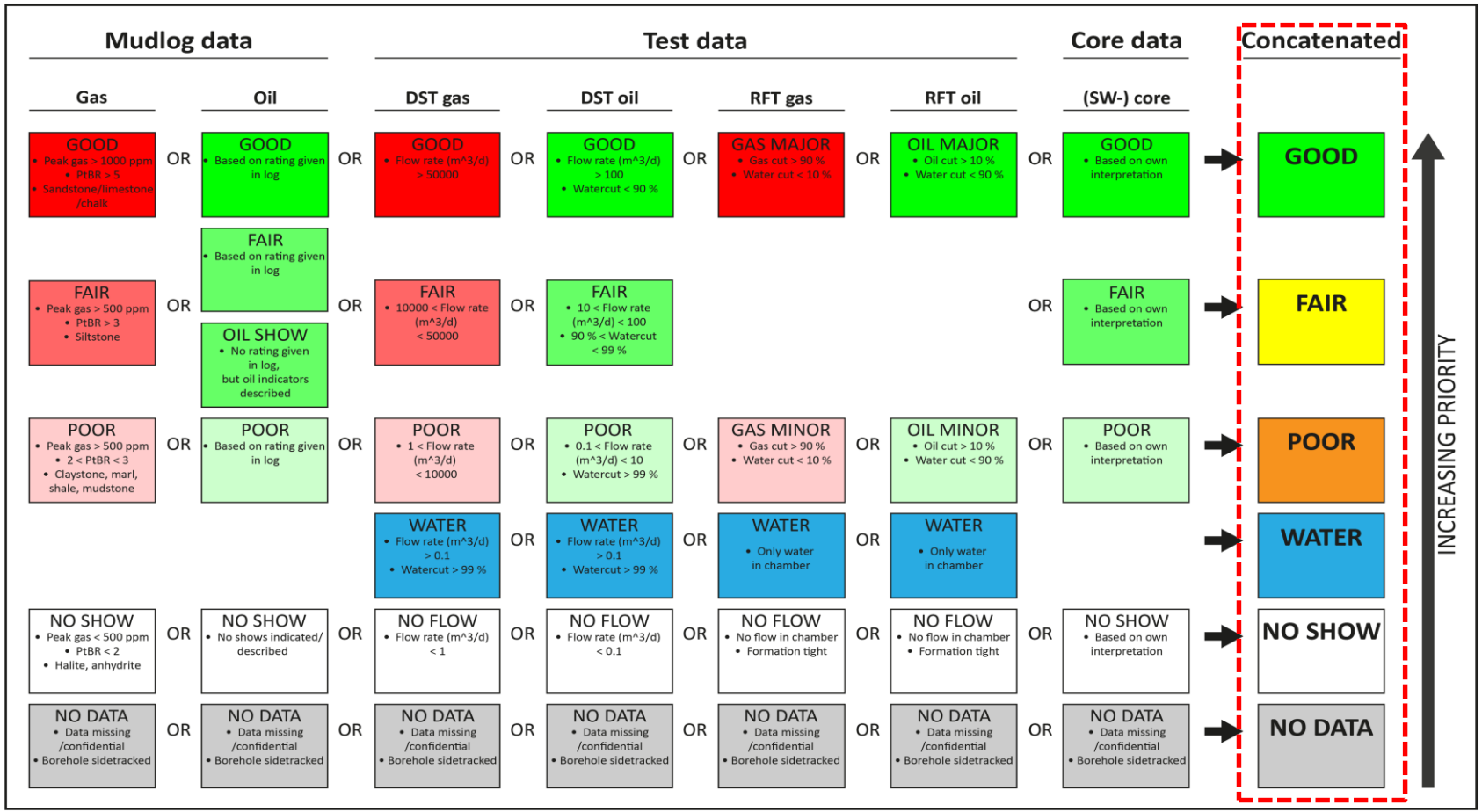


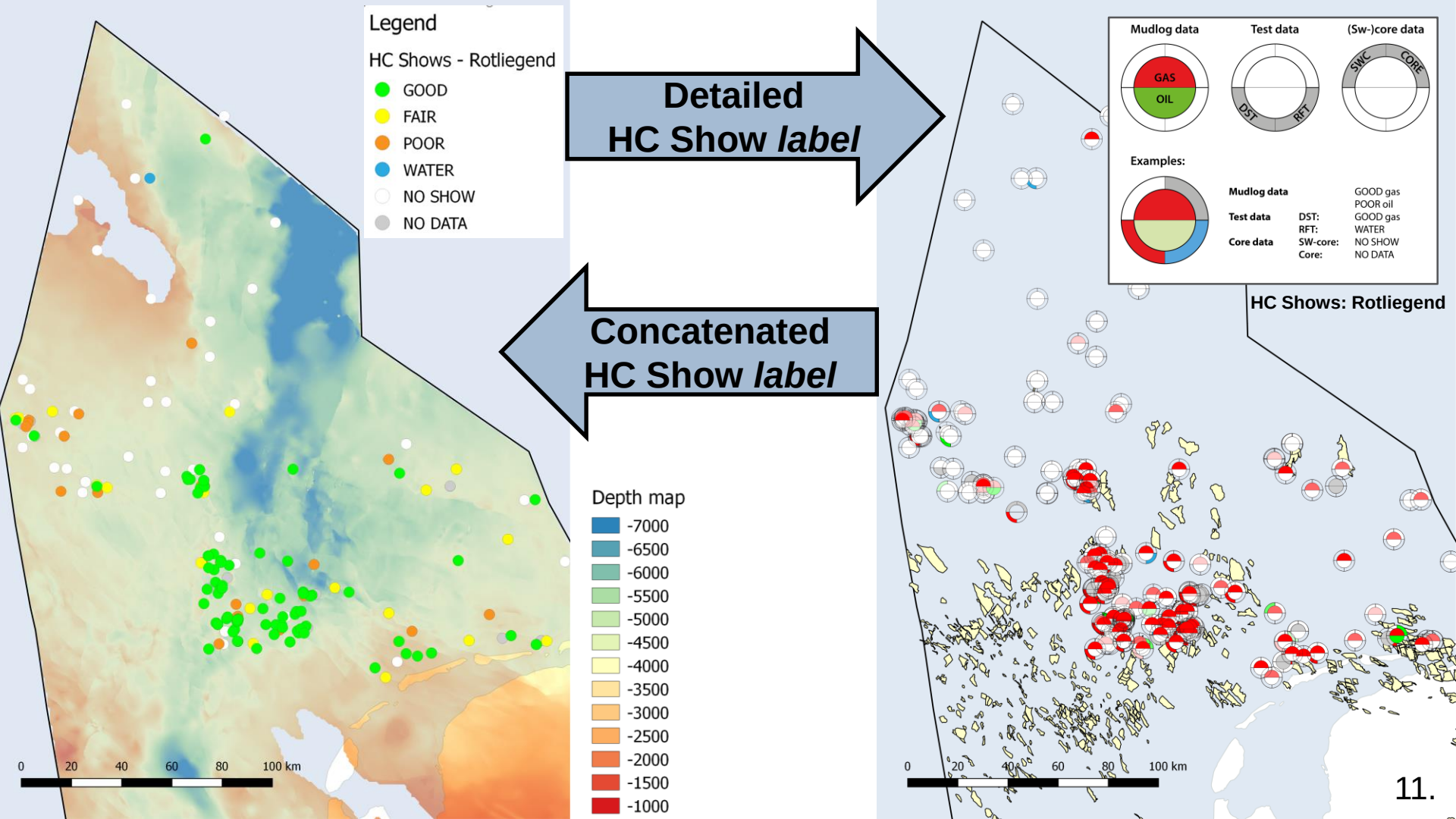
Mudlog data		GOOD gas — *e.g. Peak gas > 1000 ppm*
		POOR oil — *PtBR >5*
Test data	DST:	GOOD gas — *Sandstone/limestone/chalk*
	RFT:	WATER — *e.g. Flow rate (m³/day) > 50000*
Core data	SW-core:	NO SHOW
	Core:	NO DATA



Mudlog data		NO SHOW gas — *e.g. Peak gas < 500 ppm*
		GOOD oil — *PtBR < 2*
Test data	DST:	POOR oil — *Claystone/Marl/Shale/Mudstone*
	RFT:	NO FLOW — *e.g. 0.1 < Flow rate (m³/day) < 10*
Core data	SW-core:	FAIR — *Watercut > 99%*
	Core:	GOOD

Rule-based HC Show classification




Legend
HC Shows - Rotliegend
GOOD
FAIR
POOR
WATER
NO SHOW
NO DATA
Detailed
HC Show label
Concatenated
HC Show label
Depth map
-7000
-6500
-6000
-5500
-5000
-4500
-4000
-3500
-3000
-2500
-2000
-1500
-1000
0 20 40 60 80 100 km
Mudlog data
Test data
(Sw-)core data
GAS
OIL
DST
RFT
SWC
CORE
Examples:
Mudlog data
GOOD gas
POOR oil
Test data
DST:
GOOD gas
RFT:
WATER
Core data
SW-core:
NO SHOW
Core:
NO DATA
HC Shows: Rotliegend
0 20 40 60 80 100 km

Applications

Multiple visualization options

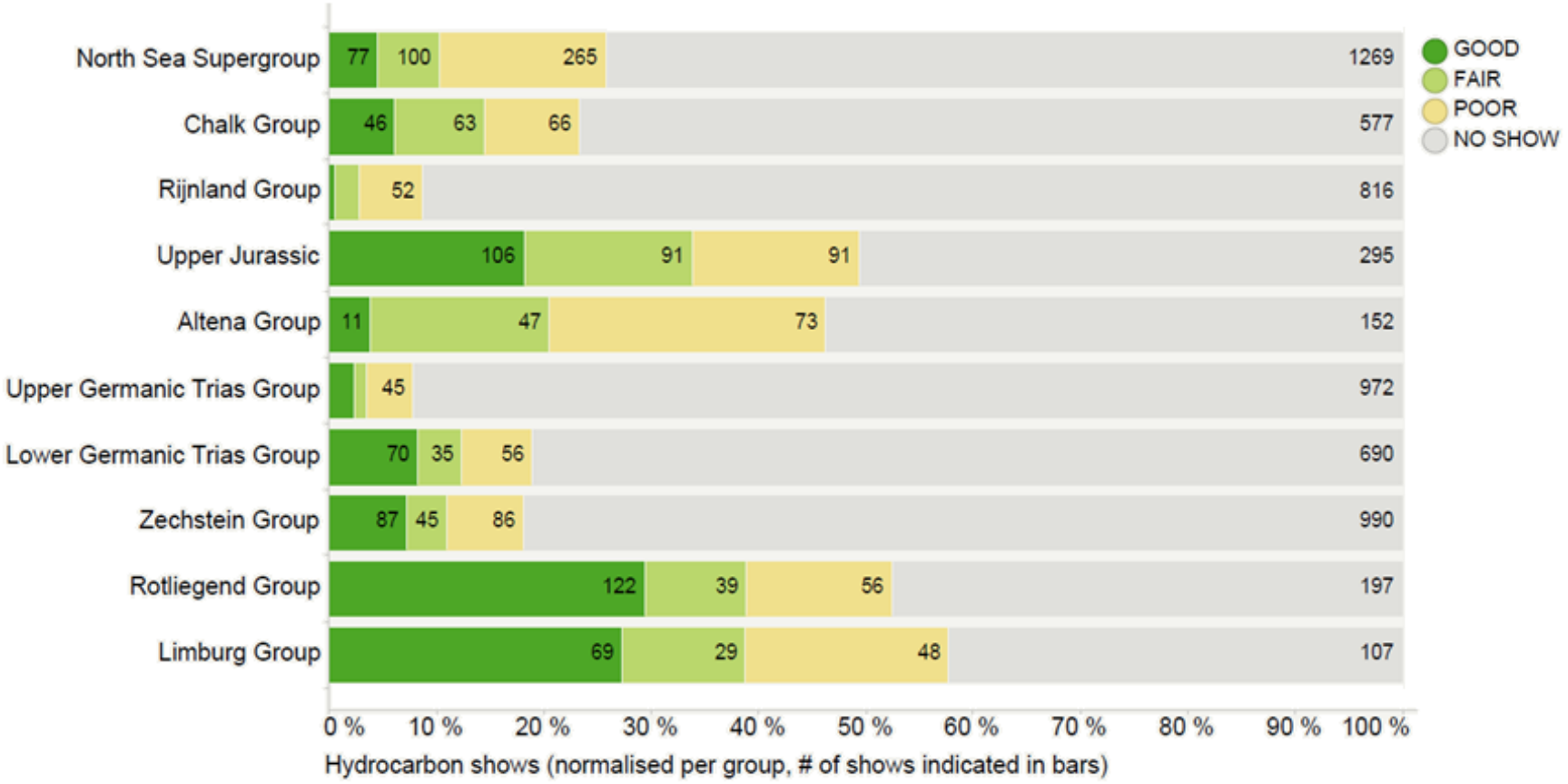
2D – e.g. map view, cross-sections

3D – e.g. seismic cube, along borehole trajectory

→ **Exploration**

→ **Well planning: Oil / Gas / Geothermal**

HC Shows per stratigraphic Group (NL)

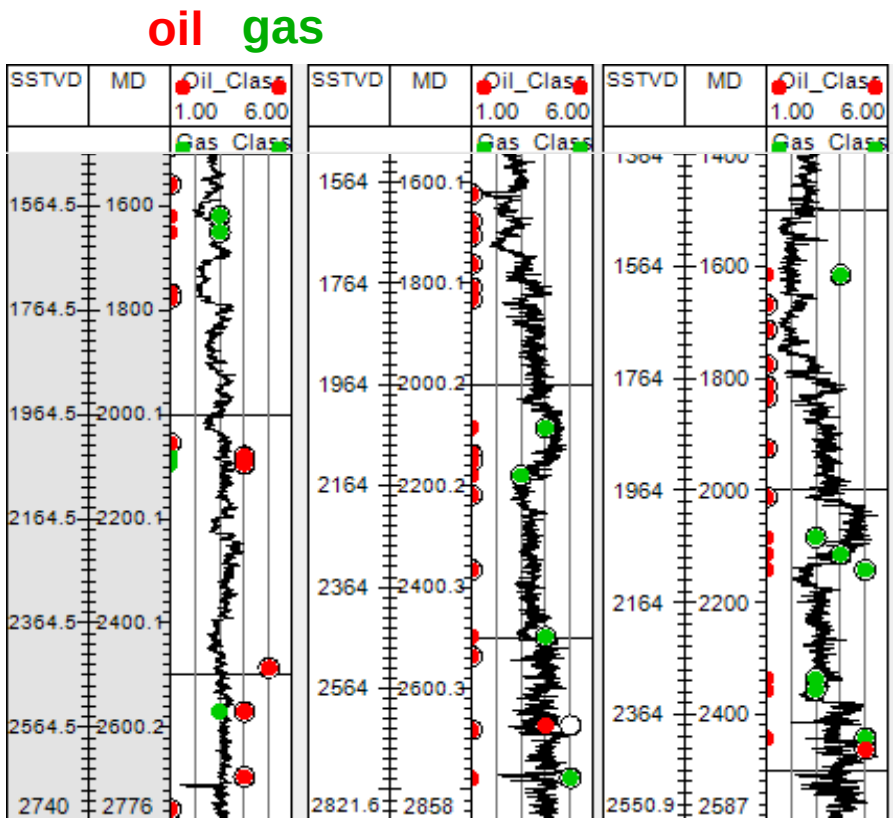


Workstation Visualization

Integration of datatypes

HC Show labels:

displayed as pseudo-log



HC Show coding

1 = NO SHOW
2 = WATER
3 = POOR SHOW
4 = FAIR SHOW
5 = GOOD SHOW

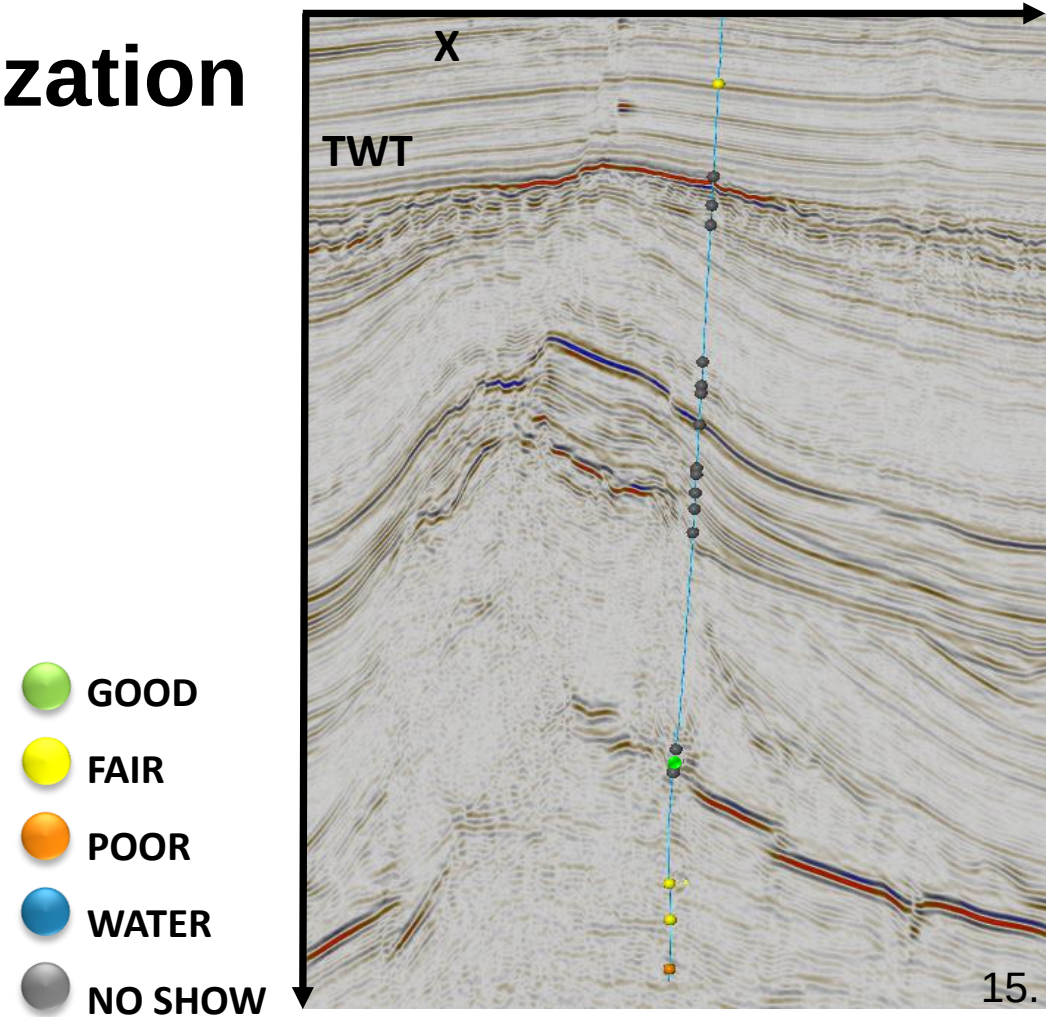
Workstation Visualization

Integration of datatypes

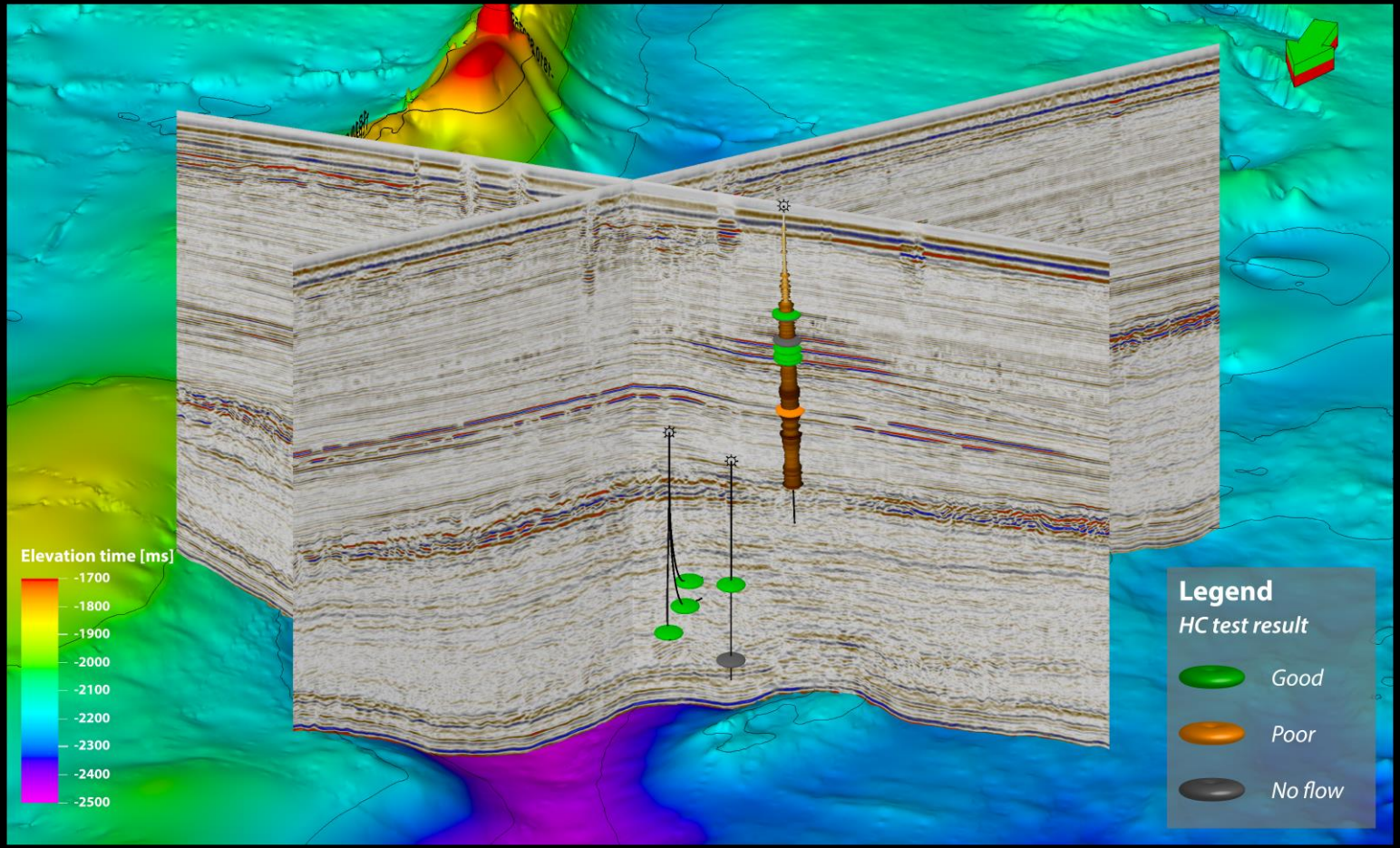
HC Show labels:

displayed as pseudo-log

along 3D well trajectory



Workstation Visualization: 3D GIS



Geothermal well planning

- 17 deep geothermal doublets operational now (>2000m)
- Significant growth in GT activity expected.
- Unexpected hydrocarbons in overburden and reservoir are unwanted

  (one example of high oil cut leading to abandonment!)

- HCS database required for project de-risking

Summary

1. Proven workflow: classify, harmonize and quantify miscellaneous observations on hydrocarbons
2. Multiple attributes on HC Shows allows detailed analysis
3. Concatenation procedure allows quick examination
4. Results visualized on workstation and analyzed in 3D context (incl. seismic data)
5. Applications: dry well analysis, missed pay analysis, charge modeling, well planning (incl. geothermal trajectory derisking)
6. HC Shows database will be made available to EBN partners (2019)

Demo & Questions

by Sabine Korevaar

Acknowledgements:

Special thanks to TNO (NLOG.NL)
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**See also EAGE Annual 80th Conference 2018 Copenhagen for extended abstract*