Deriving Lithofacies from Multiple Seismic Attributes

GEOPHYSICAL INSIGHTS
FROM INSIGHT TO FORESIGHT

In 1991….

Operation Desert Storm begins with air strikes against Iraq.

The South African parliament begins to dismantle the laws defining Apartheid.

Tim Berners-Lee announces the World Wide Web project and software on the alt.hypertext newsgroup.

US long jumper Mike Powell jumped 8.95m in Tokyo, a record that still stands today.

A young BP geophysicist inverted the seismic data over the Clyde Field to show the variation of porosity over the field.

The problem with Inversion

Seismic inversion is the process of transforming seismic reflection data into a quantitative rock-property description of a reservoir.

While it is very useful at describing the subsurface, it suffers from three fundamental issues, non-linearity, non-uniqueness, and instability.

As a result, there is a trade-off between method/cost/time and the quality of inversion results.

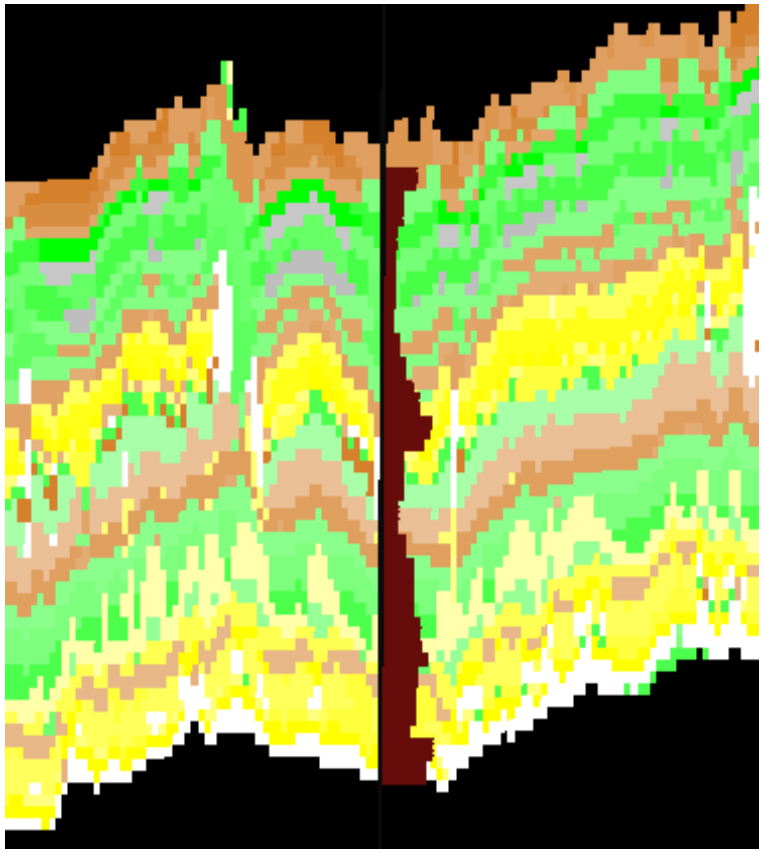
Adequate data preconditioning is a prerequisite for quantitative interpretation of the end results and care should be taken when interpreting the inversion results.

It typically requires a specialist geophysicist to perform it.

Self Organising Maps (SOM)

Self Organized Maps (SOM) - Multi-dimensional clustering of seismic attributes

- It is not a deterministic process
- Multi-dimensional clustering of seismic attributes – addresses non-uniqueness of inversion solutions
- Multi-dimensional samples are assigned to clusters sample by sample
- SOM neurons have some of the properties of inverted data



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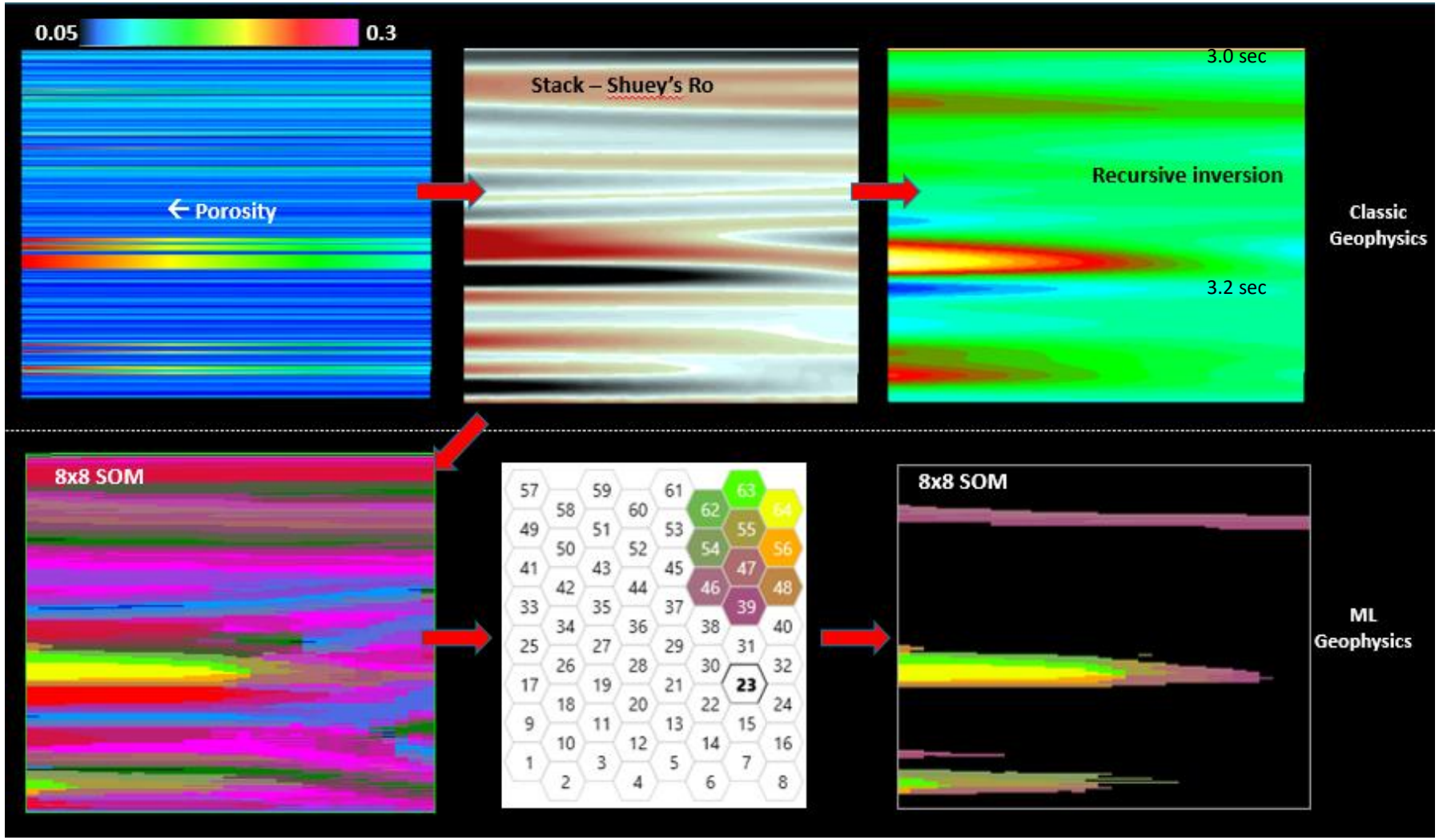

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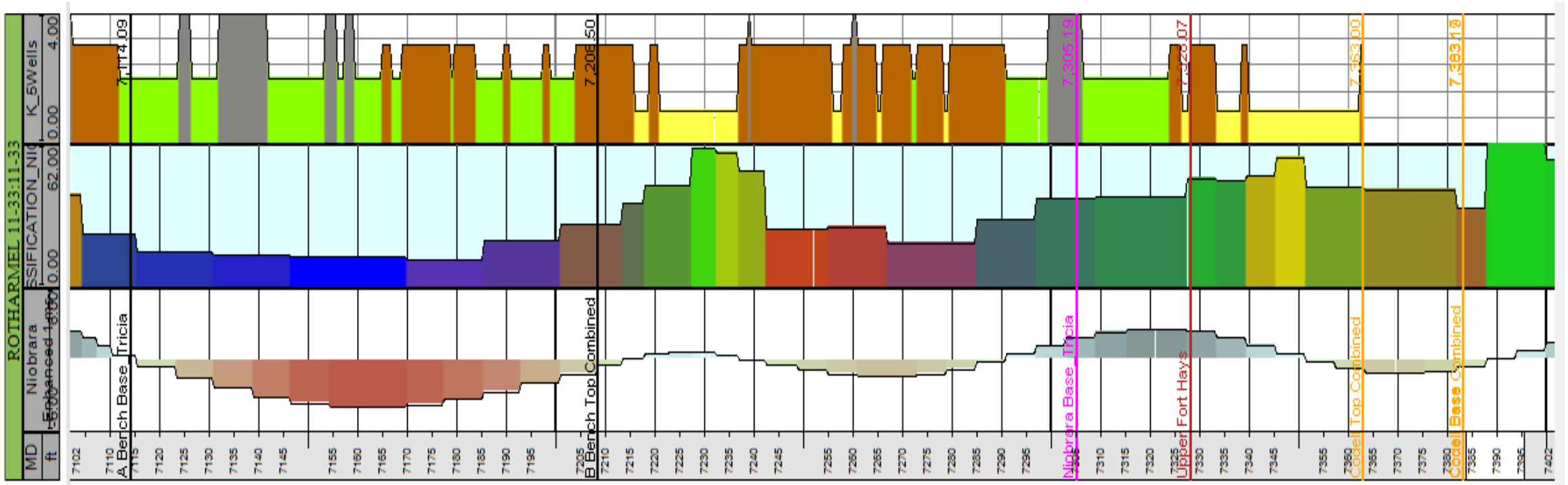
Machine Learning Lithofacies Prediction



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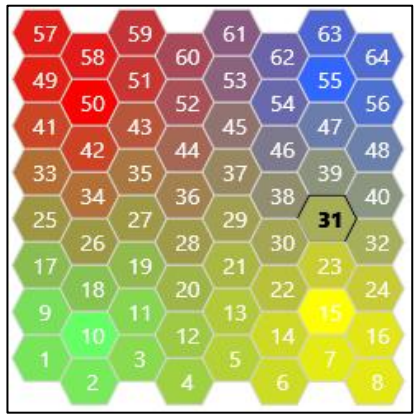
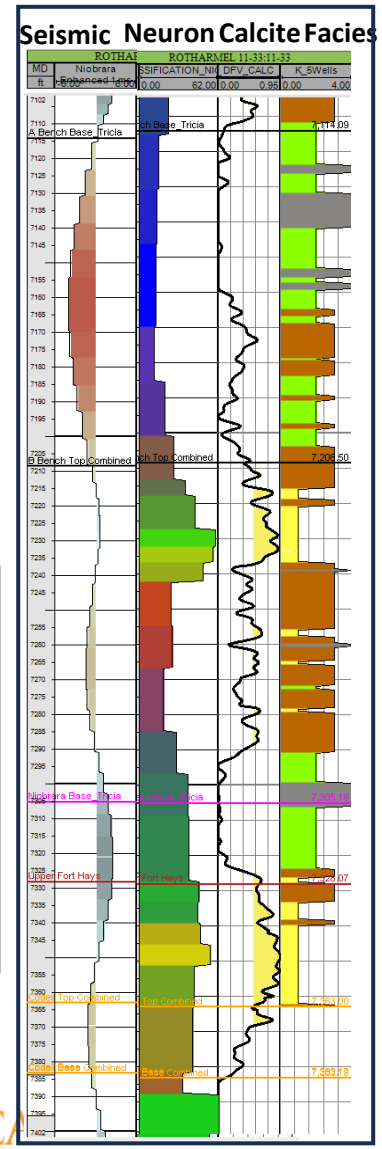
Example

Lithofacies

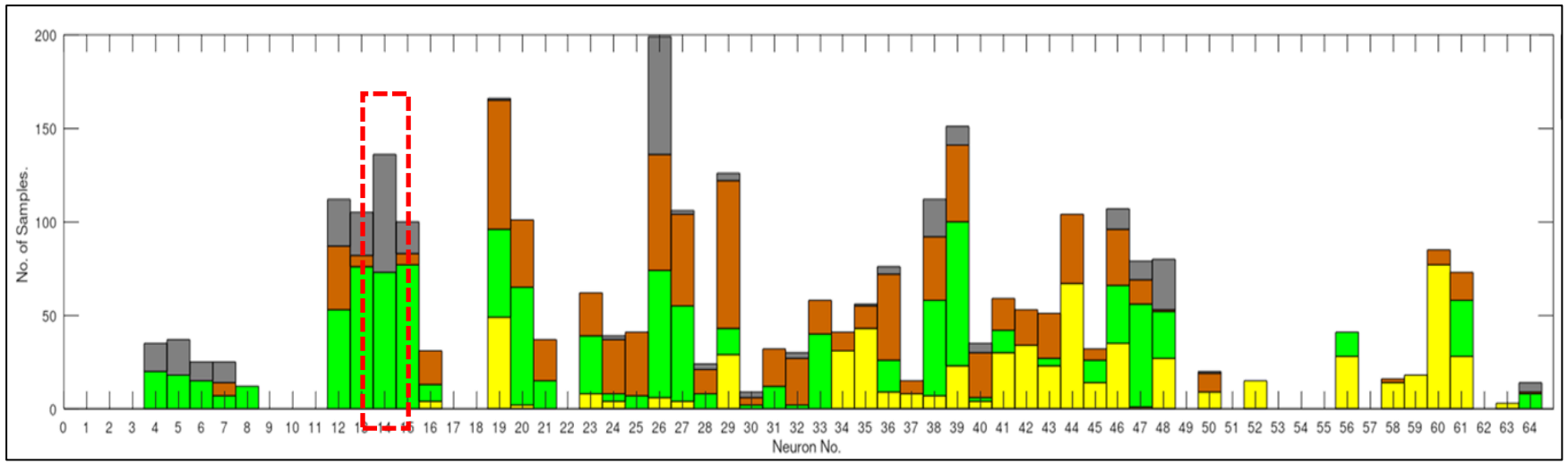
- Calcite
- Dolomite
- Mixed Carbonate
- Clay

Neuron Topology





MD
7100’



Neuron 14

- 145 hits
- 78 hits correspond to dolomite
- Dolomite probability = 78/145 = 0.54

7400’

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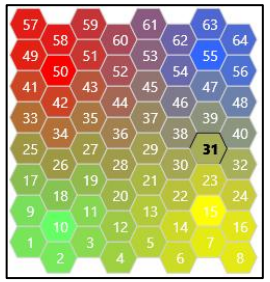
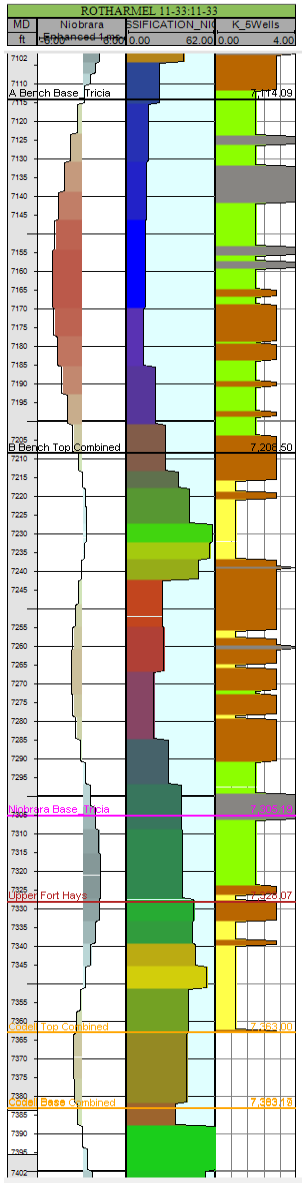


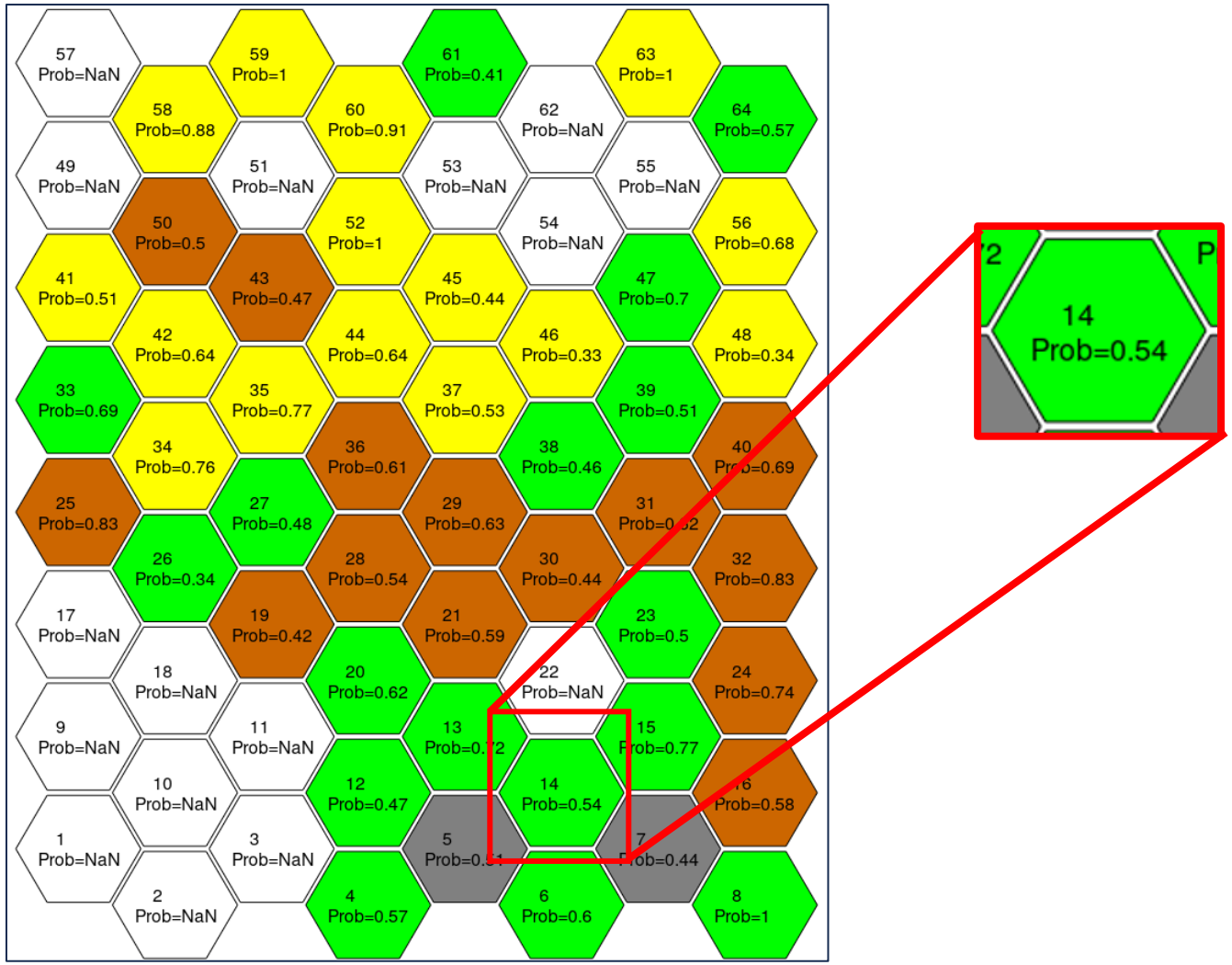
Seismic Neuron Facies



MD 7100'

7400'

Lithofacies Topology



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Seismic Lithofacies

Lithofacies Prediction using Machine Learning results in statistically reliable description of the subsurface

The time and cost of creating a subsurface model are a fraction of those associated to typical impedance inversion-based reservoir characterization

The interpretability of results appear, to date, comparable or better than those expected from typical impedance inversion-based reservoir characterization

Thanks

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