**SUBSURFACE CLARITY**

INTEGRATED 3D SEISMIC DATA INTERPRETATION WORKFLOWS

Ken Abdulah and Clémence Prazuck

URTeC 2018
July 23-25, 2018

- ❑ As interpreters, we are often tasked with predicting rapid changes in lithology and reservoir properties across stratigraphically complex basins and their sub-basins.
- ❑ Our presentation steps through workflows focused on delivering integrated interpretation products in greatly reduced cycle time.
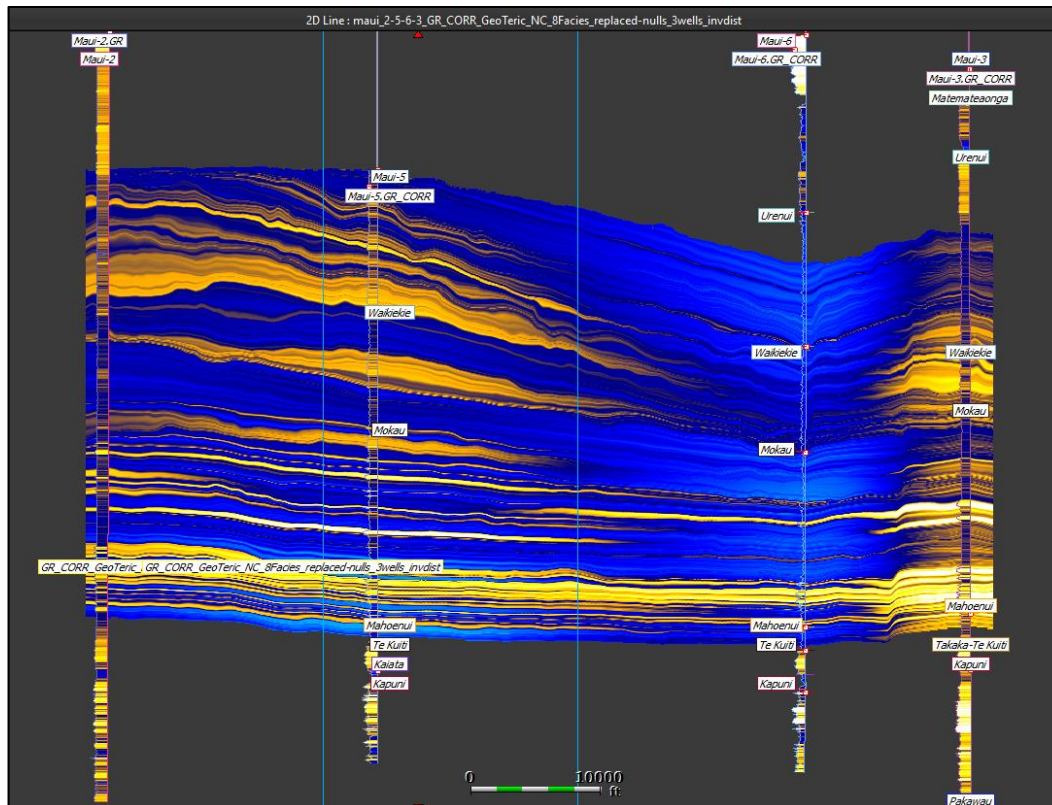
- Lithostratigraphy
- Chronostratigraphy
- Seismic stratigraphy
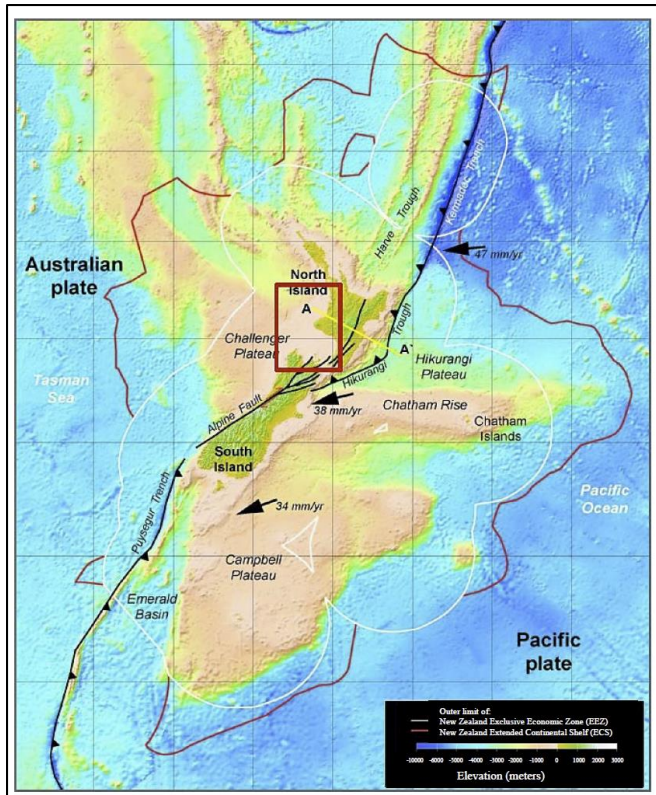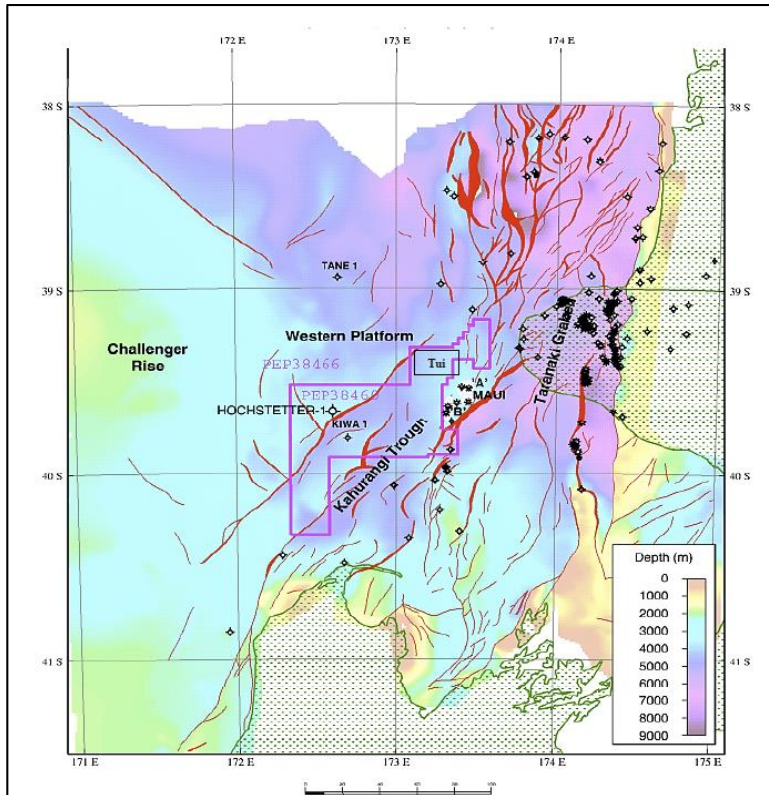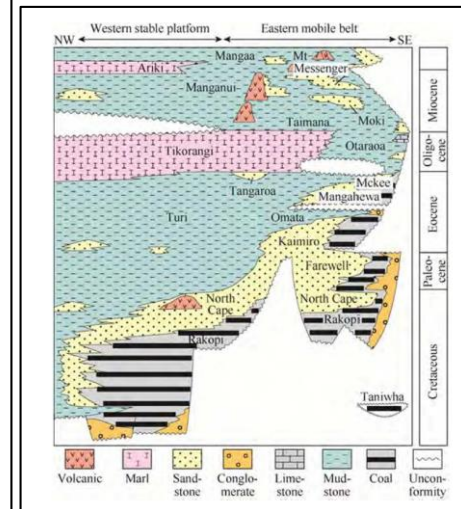- Sequence stratigraphy

Plate setting and location map
from Yagci, 2016 (after Stogen et al., 2012)

Basement structure map of the Taranaki Basin
from Yagci, 2016

Generalized stratigraphic column
from Haque et al., 2016

SUBSURFACE CLARITY

MAUI Seismic Acquisition Parameters

Area: 1000 km^2
Inline spacing: 25m
Xline spacing: 25m
Trace length: 3 Sec
Sample interval: 3ms
Size: 6.2 GB
Data: *New Zealand Petroleum and Minerals*

Volume Interpretation Workflows
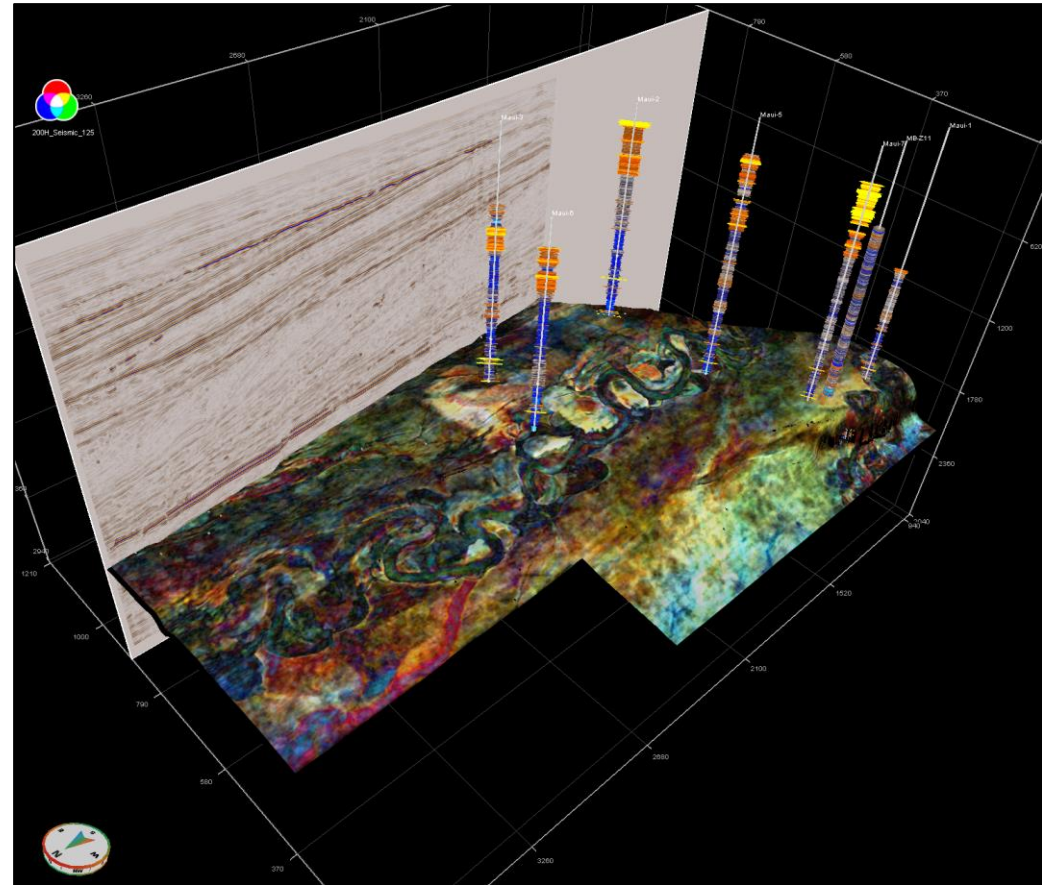
PRE-CONDITIONING
STRATIGRAPHIC INTERPRETATION
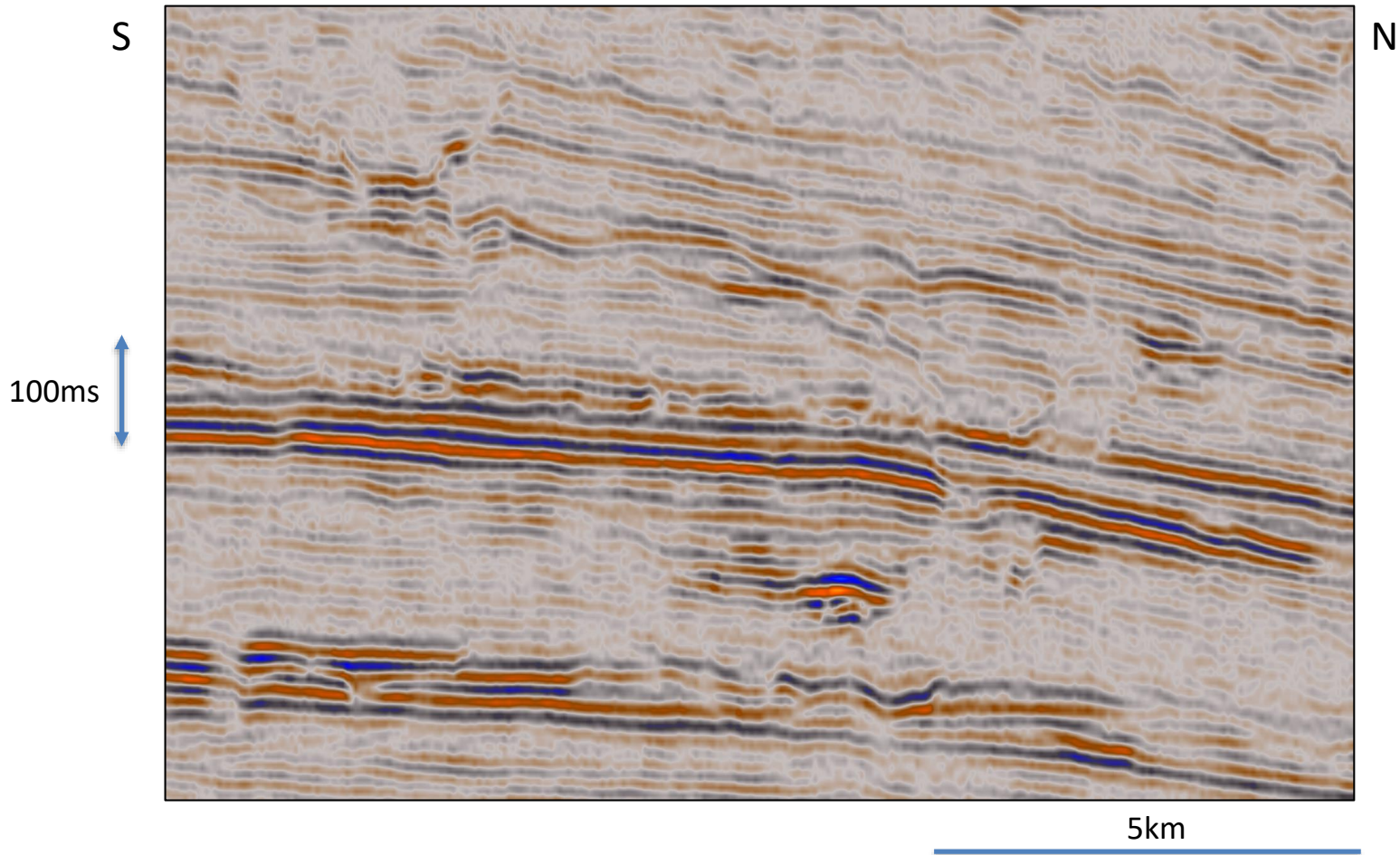WELL ANALYSIS
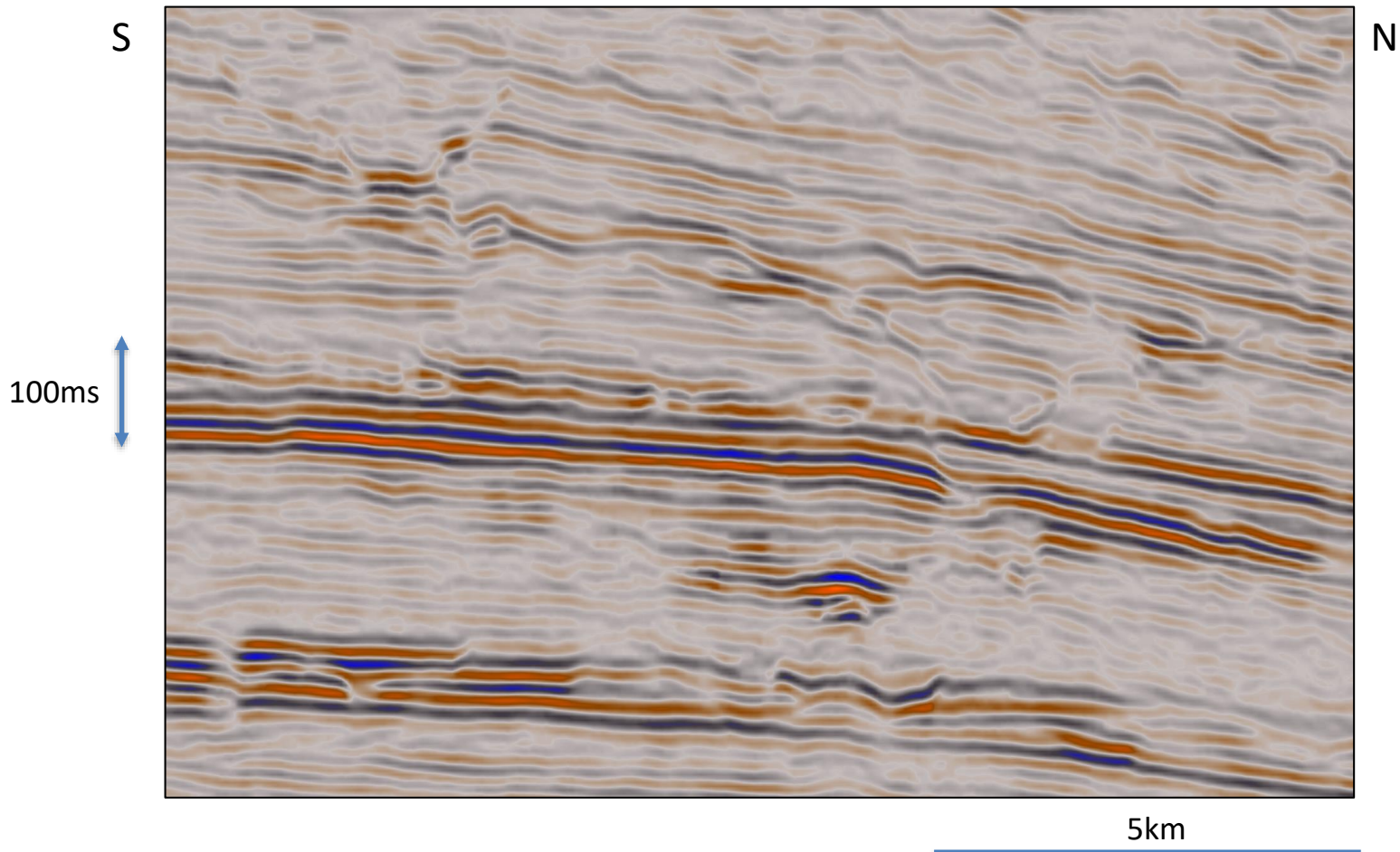SEQUENCE ANALYSIS
FACIES INTERPRETATION
STRUCTURAL INTERPRETATION
3D PROPERTY MODELING

SUBSURFACE CLARITY

❑ Noise Cancellation

  ❖ GeoTeric:

    ➢ Before Post-stack noise cancellation

S   N

100ms

5km
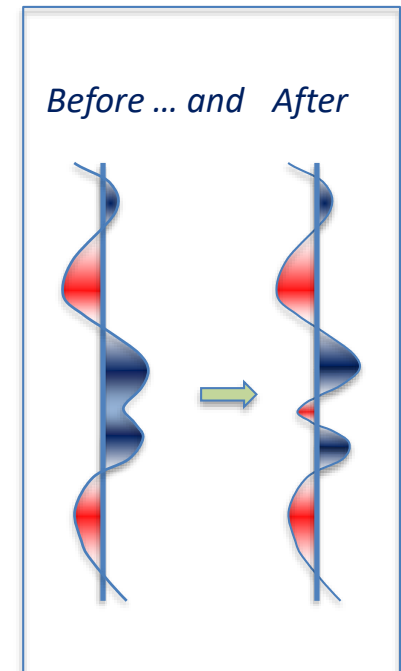
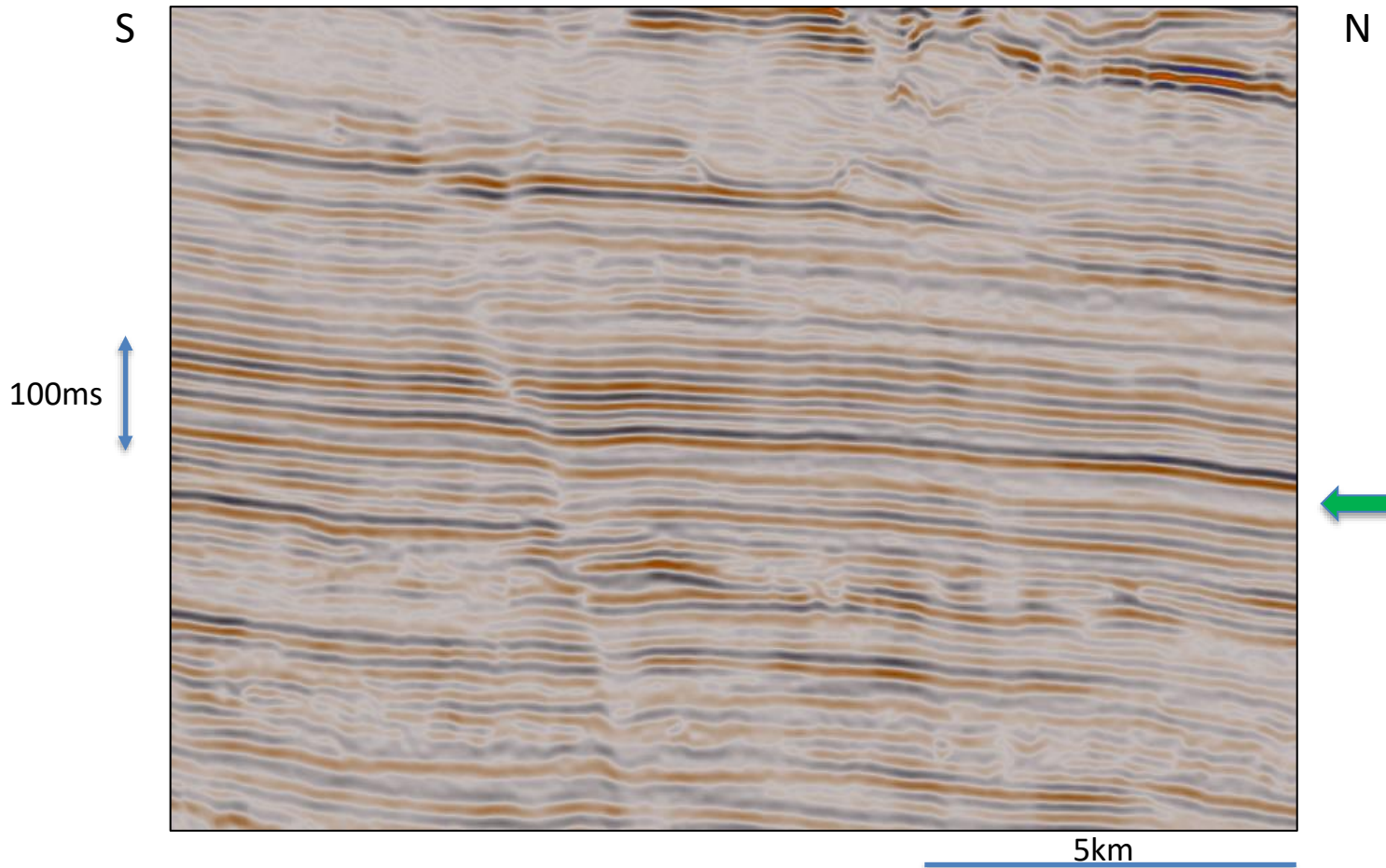❑ Noise Cancellation
  ❖ GeoTeric:
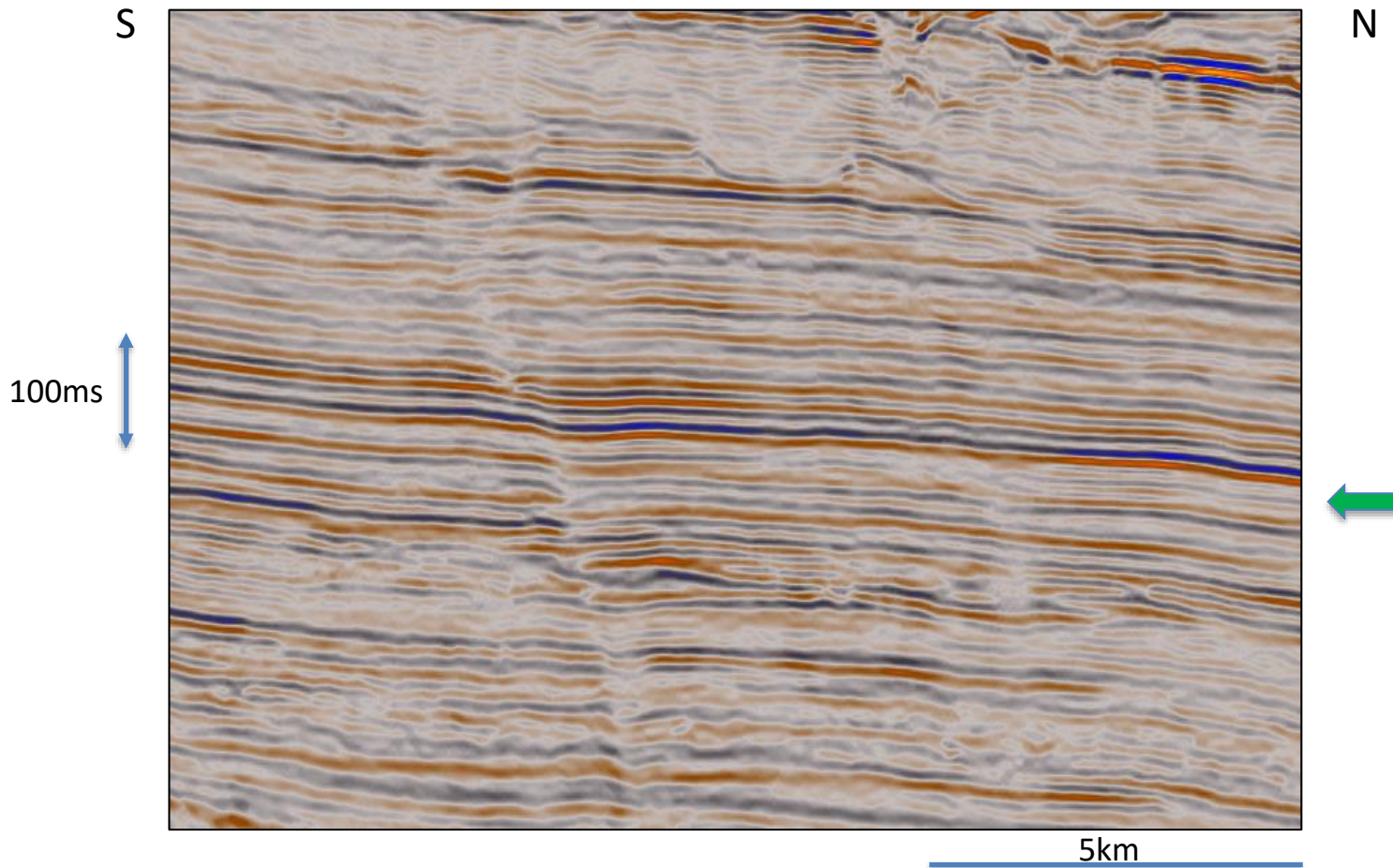   ➢ After Post-stack noise cancellation

❑ Spectral Enhancement
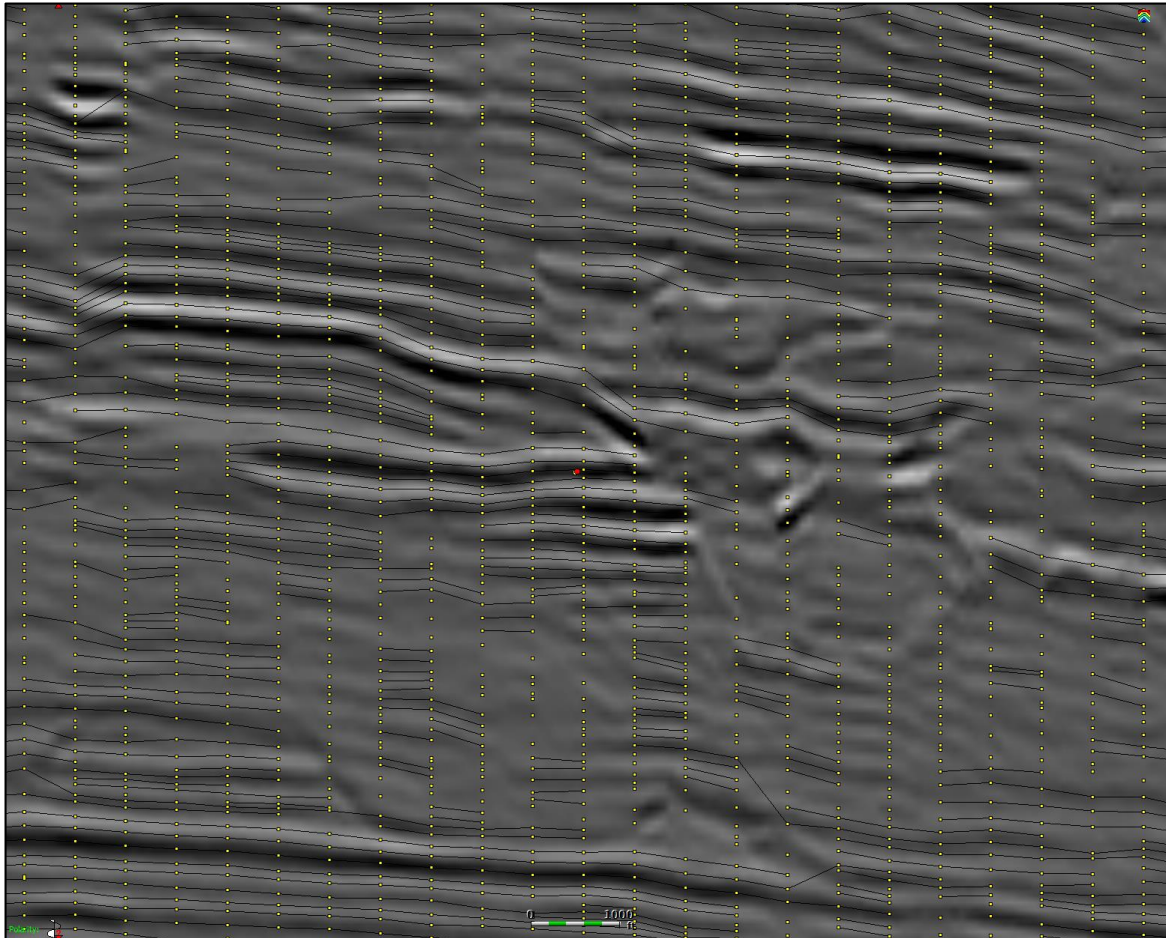   ❖ GeoTeric:
      ➢ Post-stack spectral enhancement

Before … and After

❑ Spectral Enhancement
  ❖ GeoTeric:
    ➢ Before Post-stack spectral enhancement

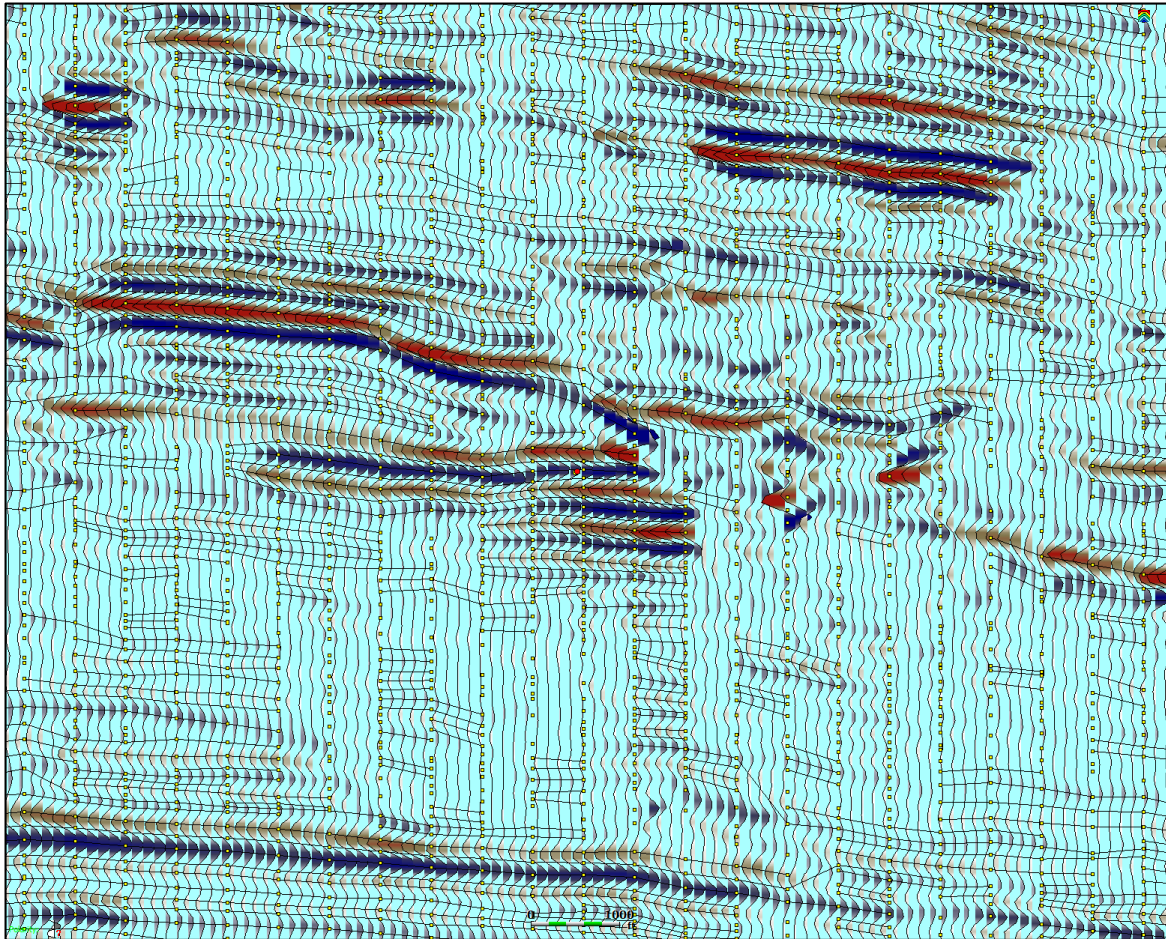S   N

100ms

5km

❑ Spectral Enhancement
- ❖ GeoTeric:
  - ➤ After Post-stack spectral enhancement

❖ PaleoScan:
 ➢ Model Grids are created on select combinations of peaks, troughs, zero-crossings, and/or inflection points

❖ PaleoScan:

➢ The initial Model Grid shown with variable-area wiggle trace display together with horizon patches.

SUBSURFACE CLARITY

❖ PaleoScan:
  ➢ The Model Grid forms the basis for an initial 3D Geomodel.

SUBSURFACE CLARITY
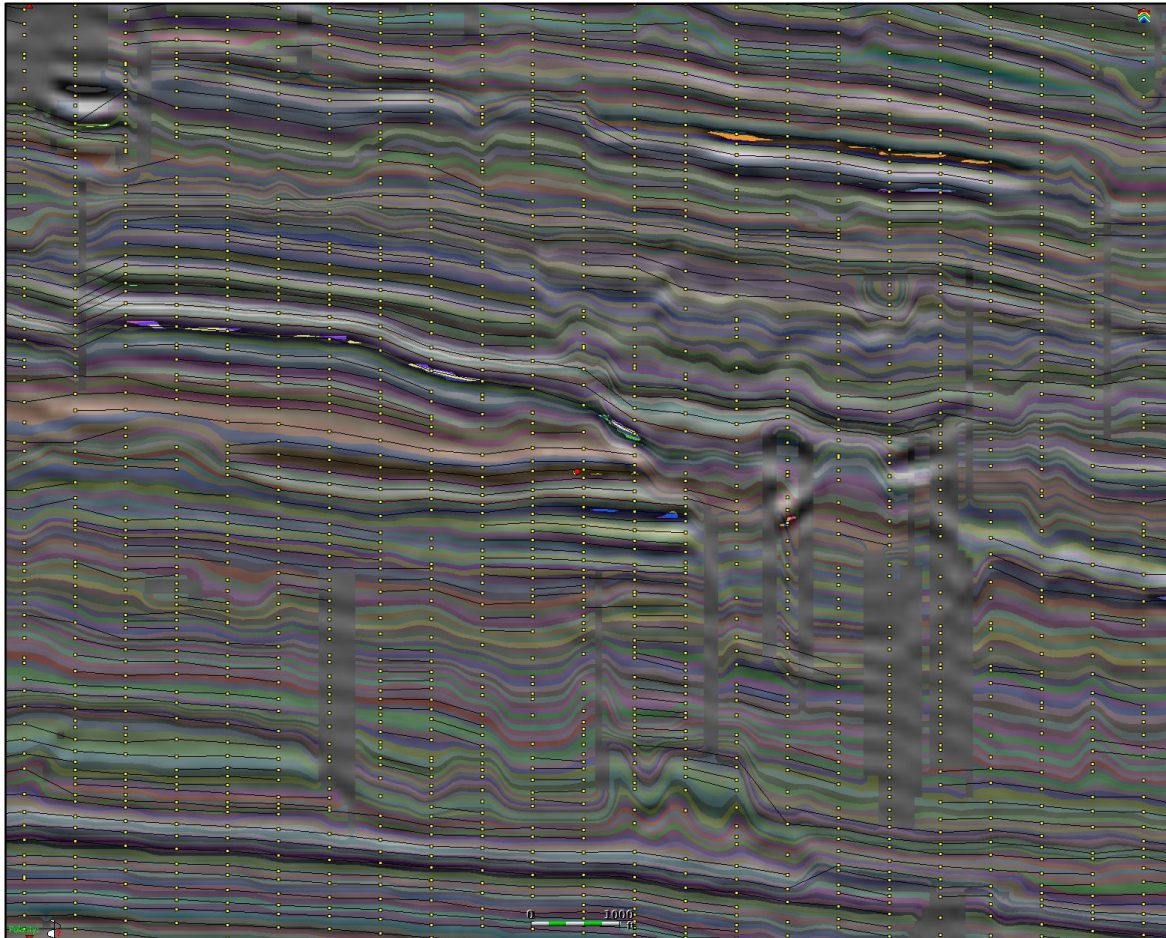
❖ PaleoScan:
  ➢ Careful editing of the model grid leads to a final relative geological time model, i.e., the final 3D Geomodel.
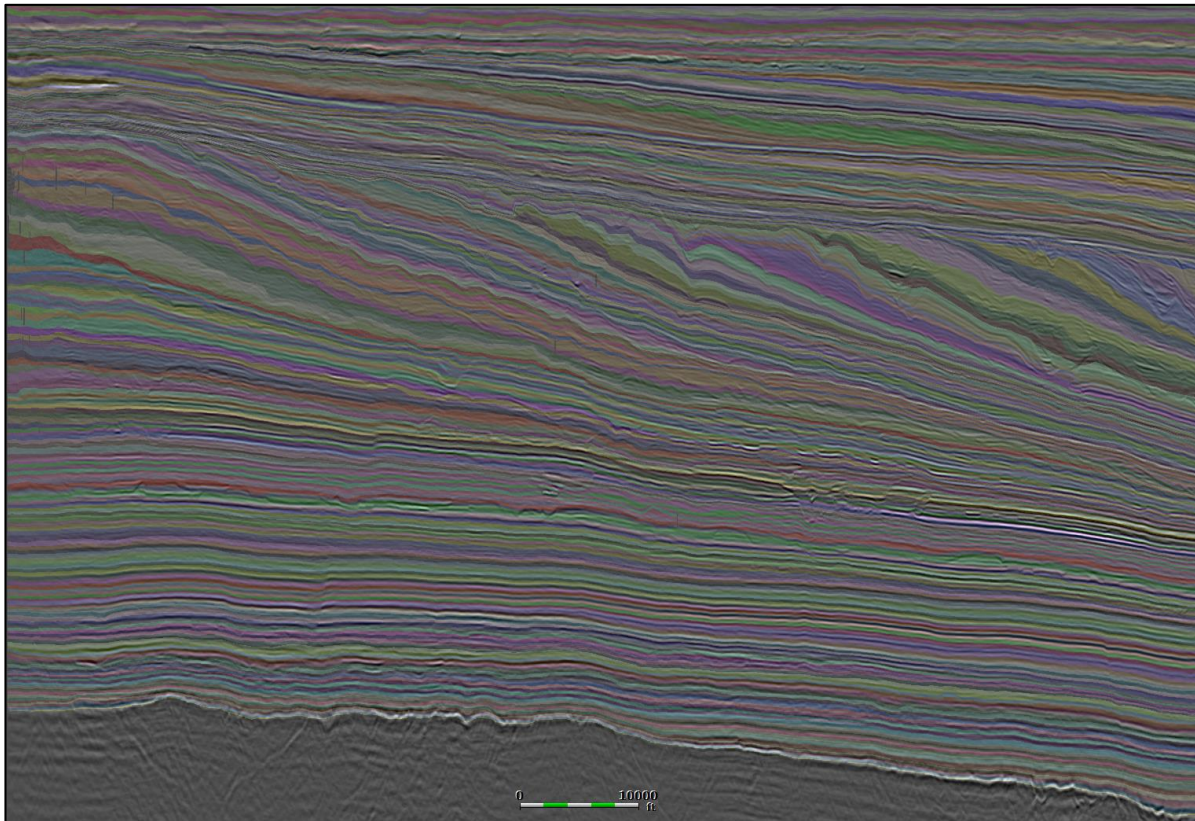
❖ PaleoScan:
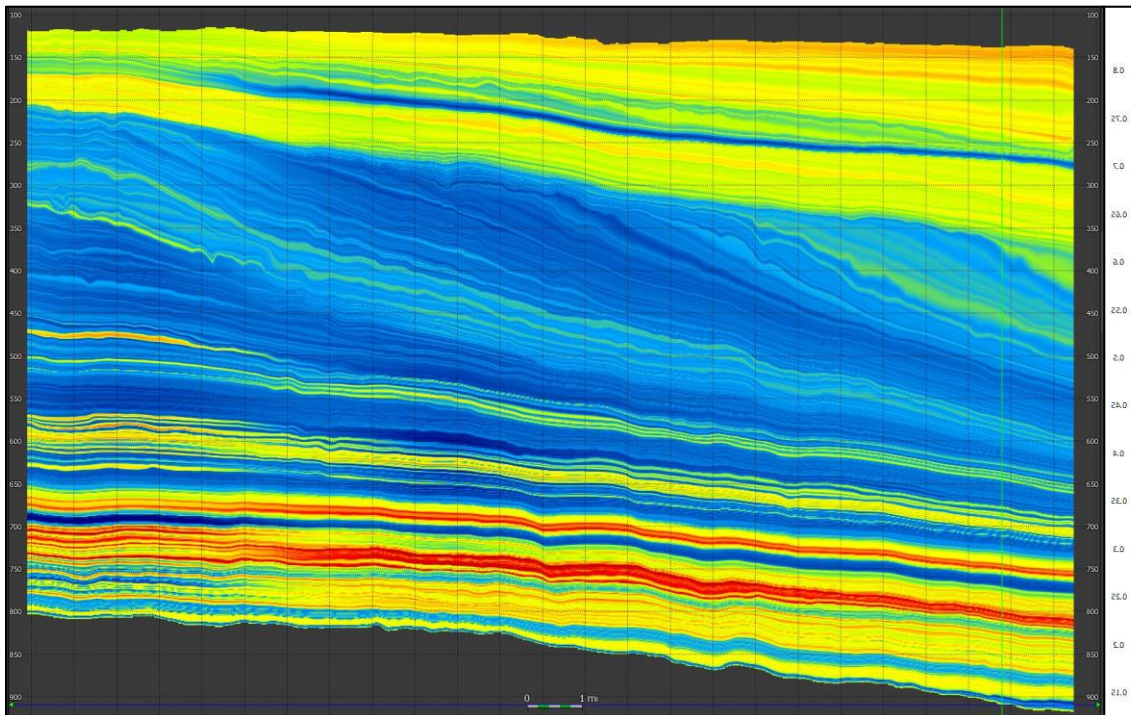 ➢ In turn, the 3D Geomodel forms the basis for creating very detailed Horizon Stacks.
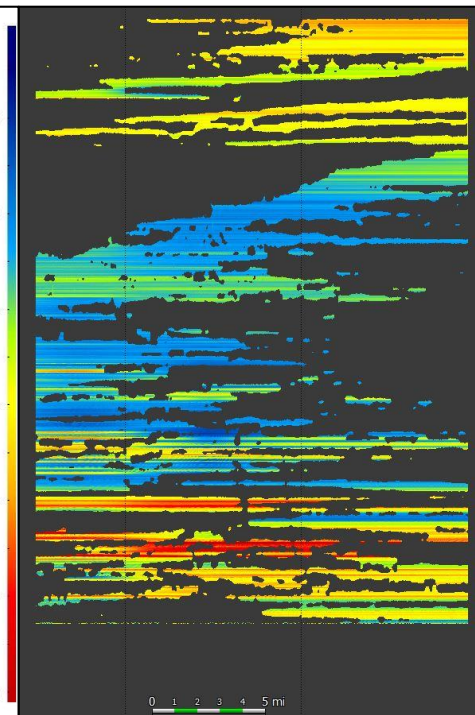
SUBSURFACE CLARITY
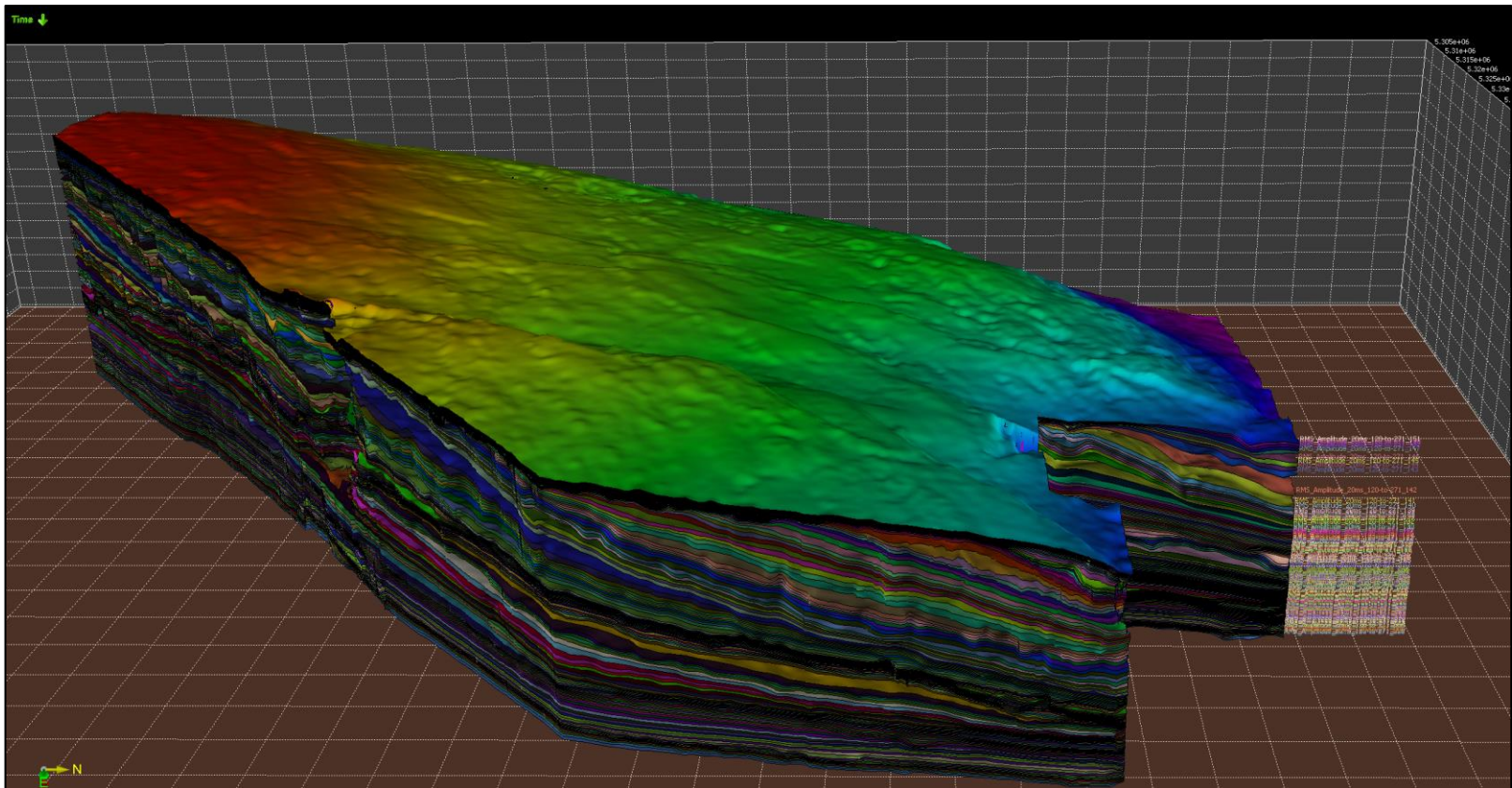
❖ PaleoScan:
  ➢ Wheeler diagrams are used to identify both major and minor unconformities and associated shifts in deposition.
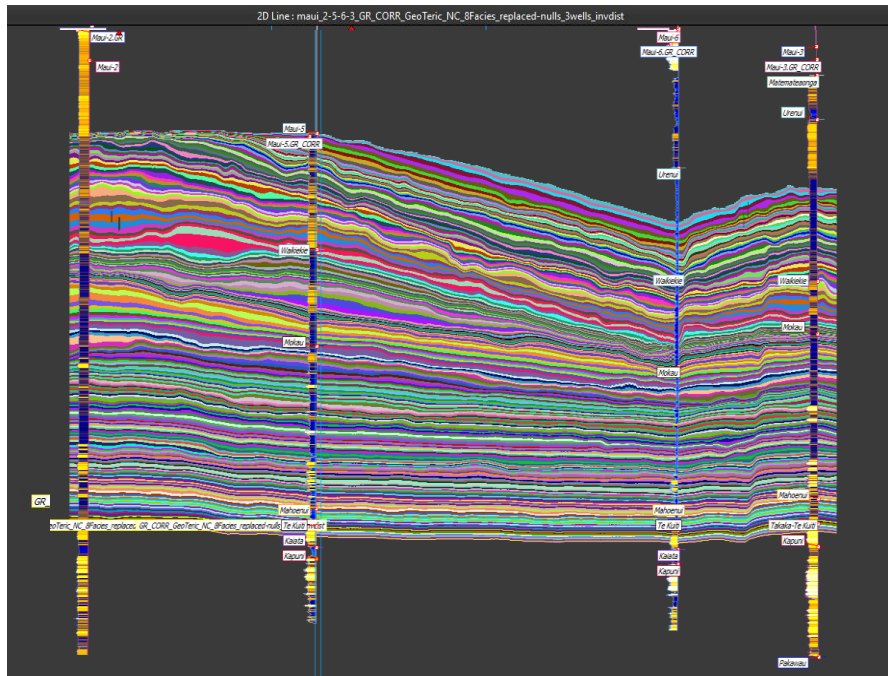
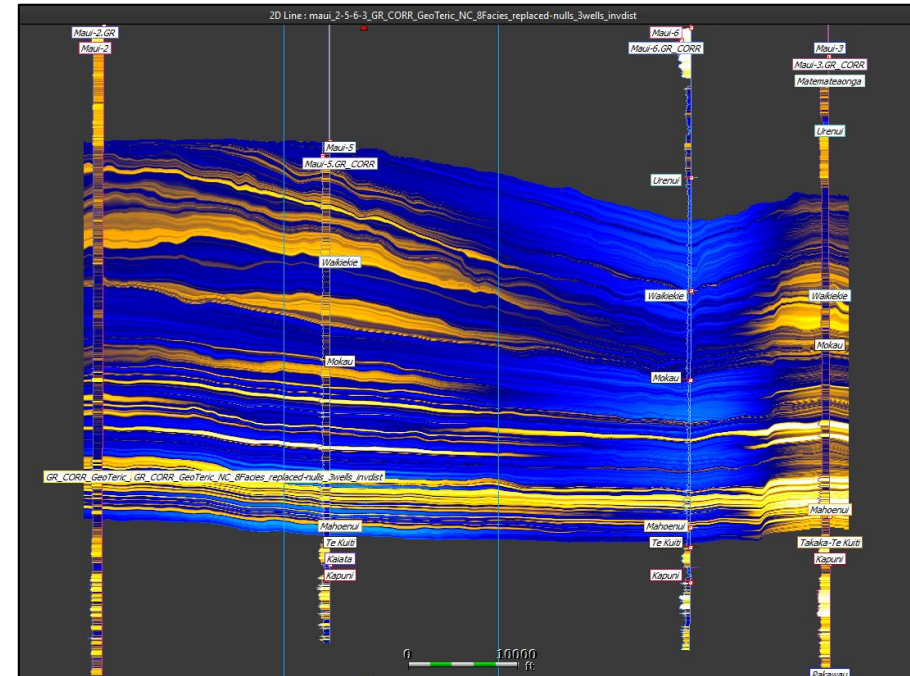3D Property Model based on V-Shale   Wheeler Diagram

SUBSURFACE CLARITY

❖ PaleoScan

> ➢ The relative geological time model provides us with the chronologic framework for the distribution of well-log based properties

> ➢ An arbitrary line through 4 wells with Gamma-logs is shown, below
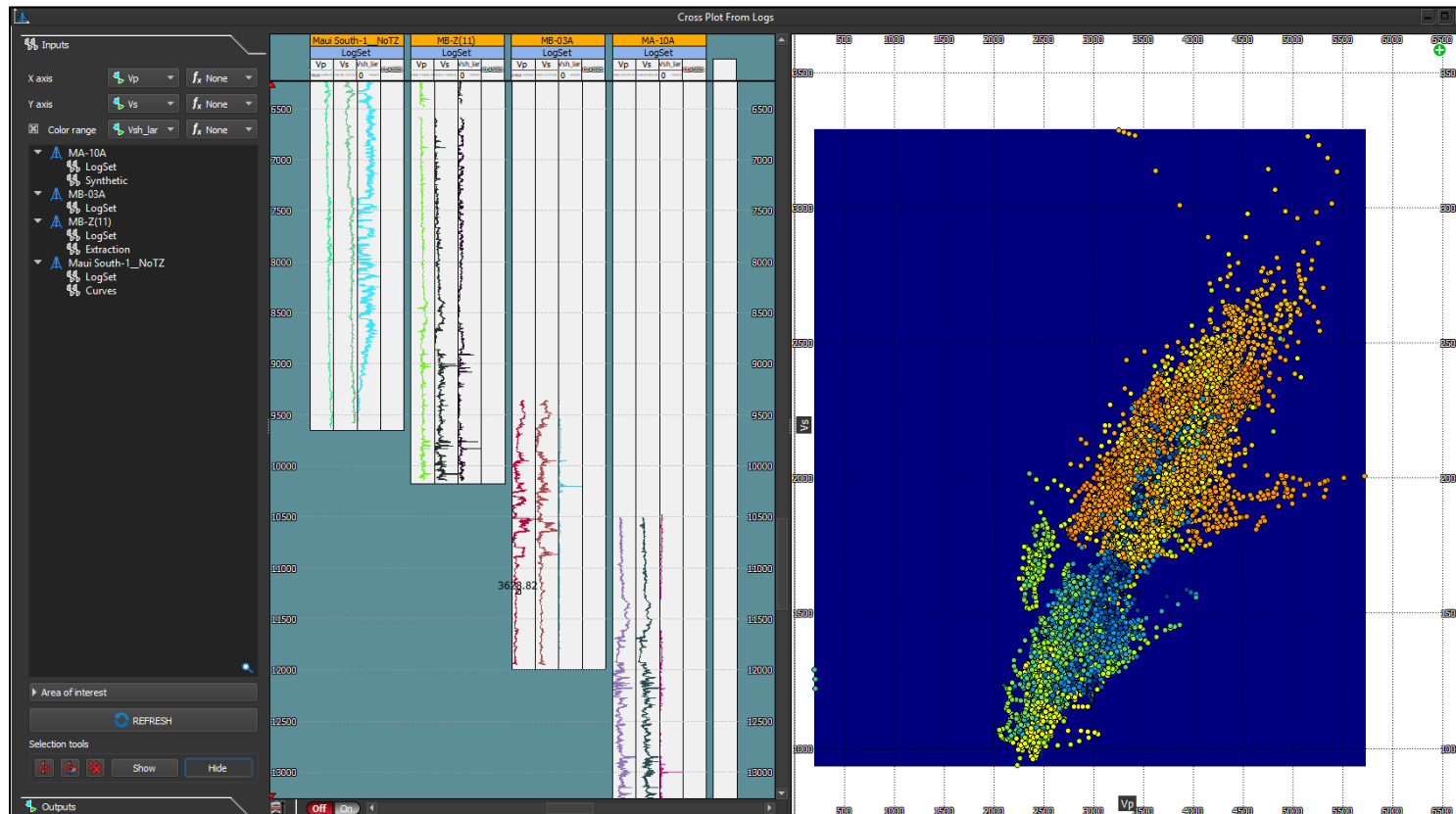
Geomodel

Property Model

❖ PaleoScan
  ➢ Cross plots provide the means to examine relationships between log-based properties
  ➢ For example, the relationship between Compressional (Vp) and Shear (Vs) velocities

❖ PaleoScan
  ➢ We are also able to characterize and define distinct litho-facies based on cross plots
  ➢ In the example below, classes are based on cross plotting Vp/Vs versus Acoustic Impedance
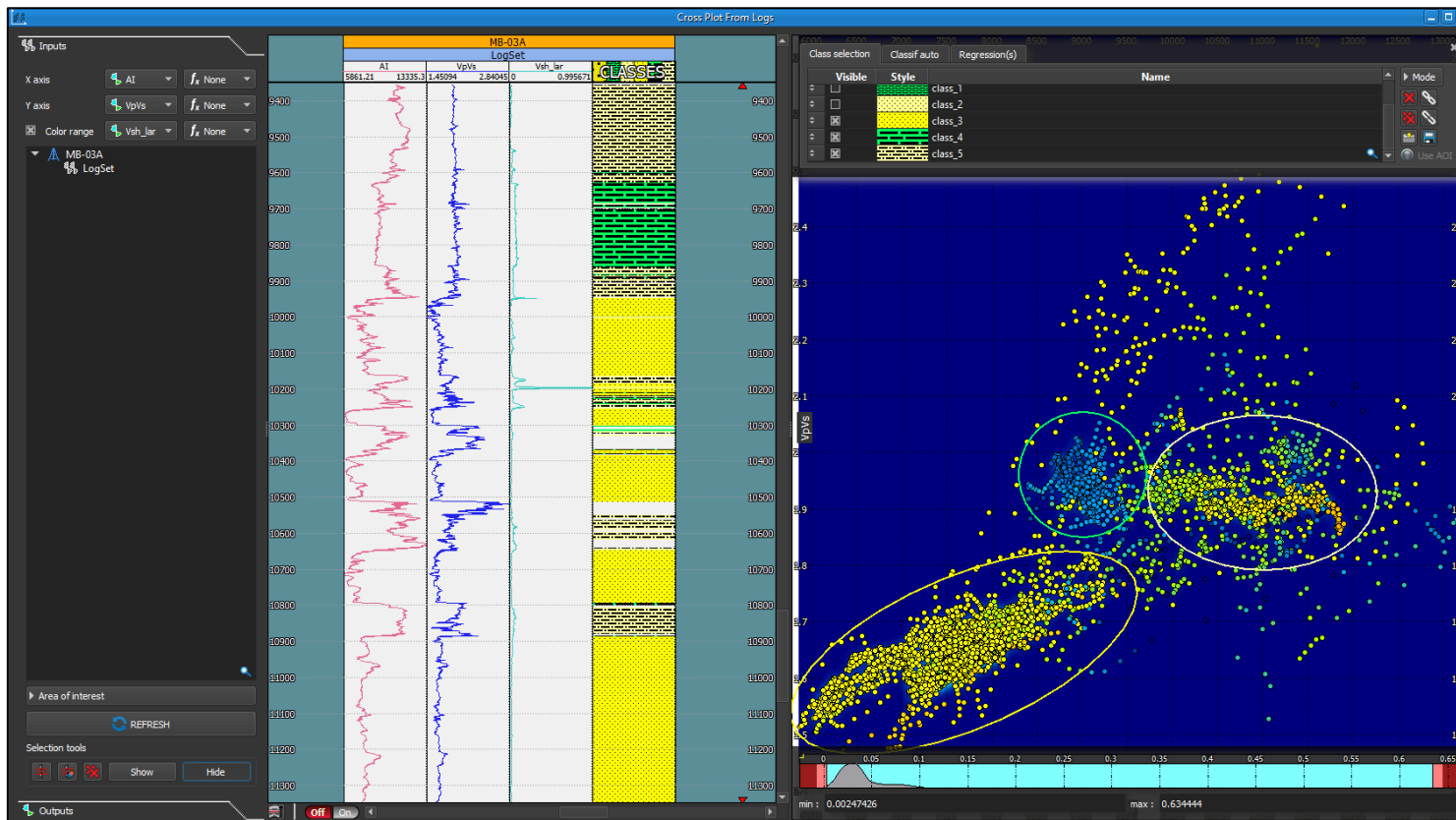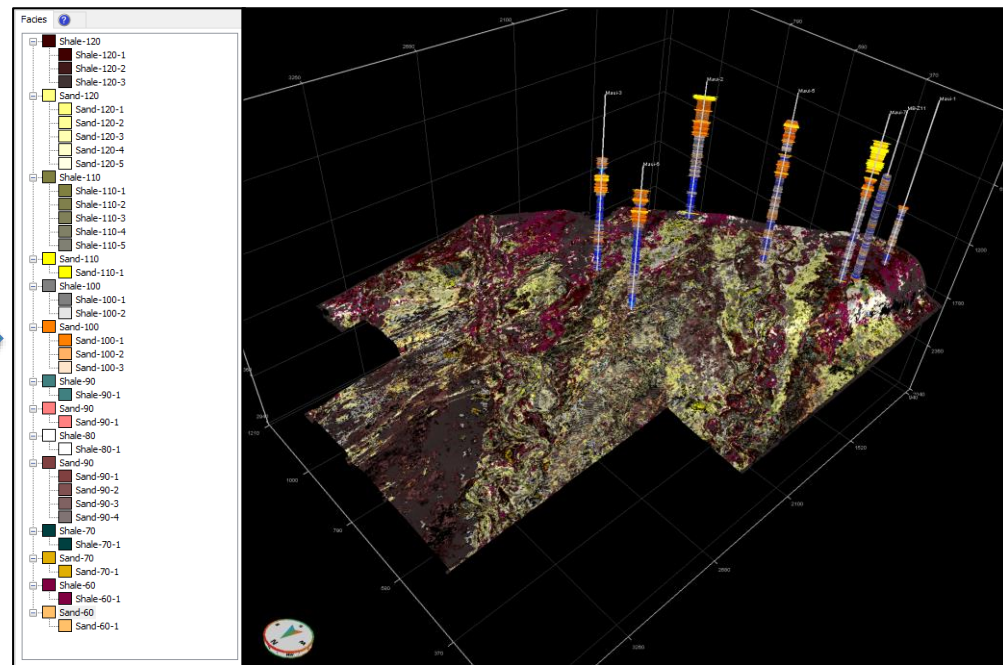
❖ GeoTeric:

➢ Interactive Facies Classification tools allow us to create seismic facies volumes based on high-definition frequency decomposition volumes and well-log facies
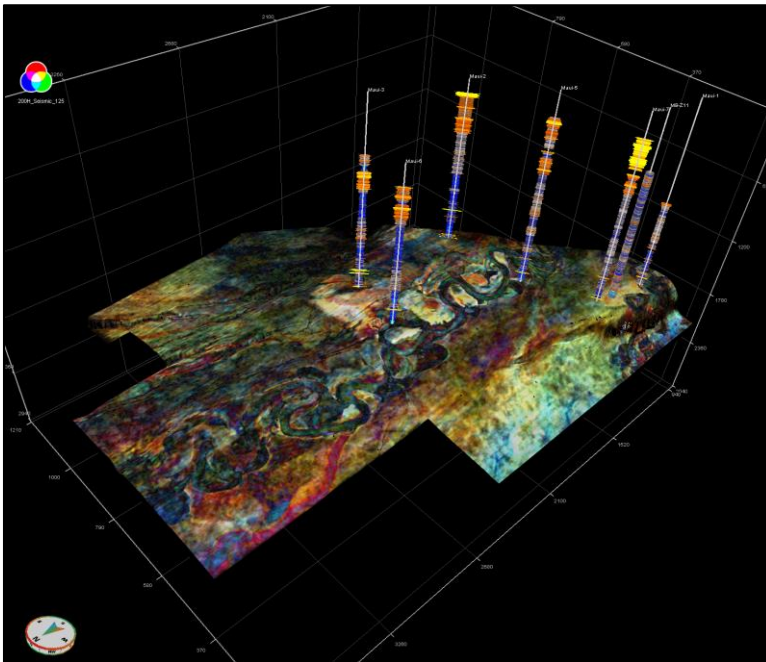
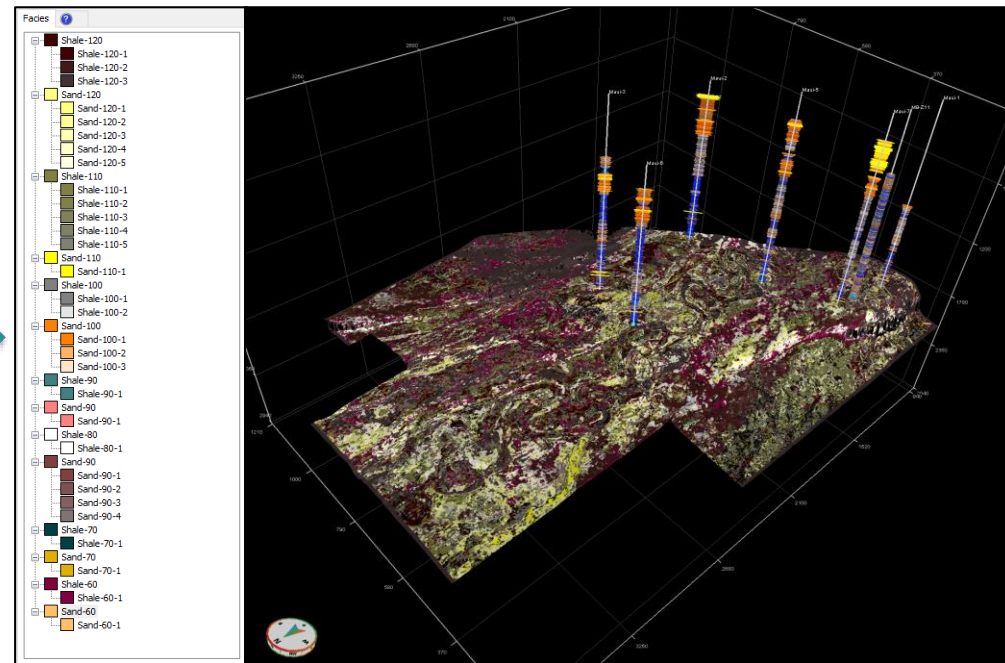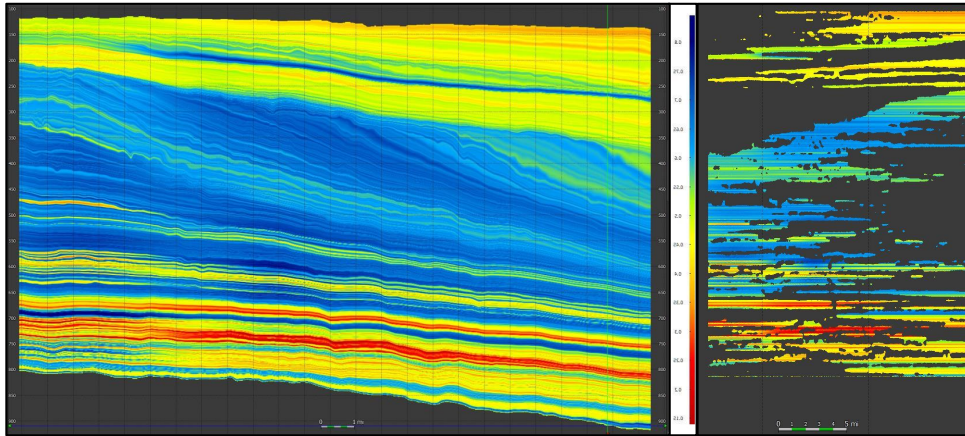Horizon 160 - HDFD display
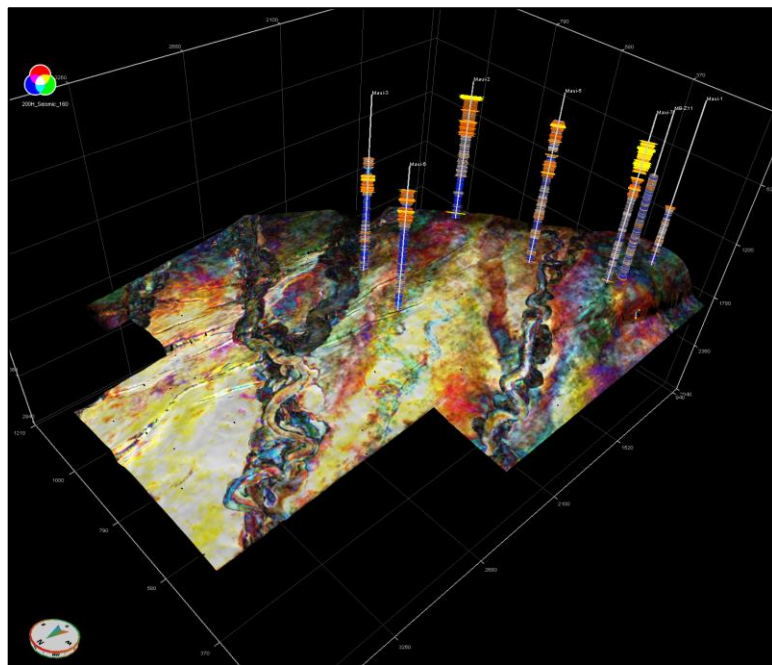
Horizon 160 – Seismic facies classes

❖ GeoTeric:

➤ Interactive Facies Classification tools allow us to create seismic facies volumes based on high-definition frequency decomposition volumes and well-log facies

Horizon 125 - HDFD display
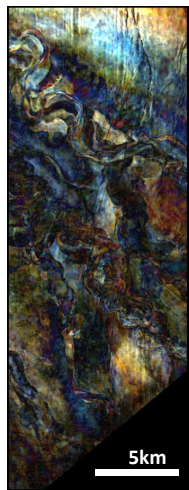
Horizon 125 – Seismic facies classes
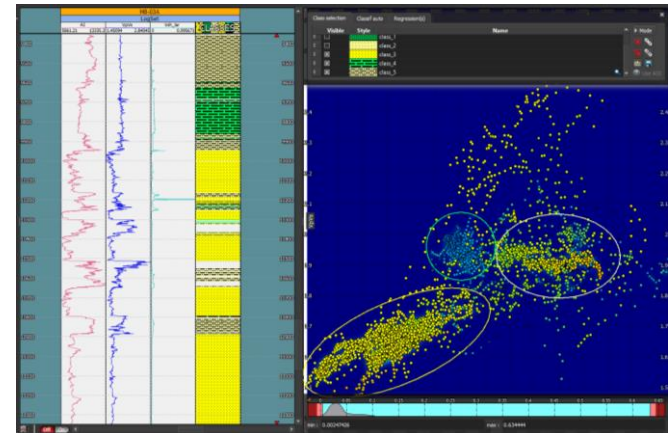
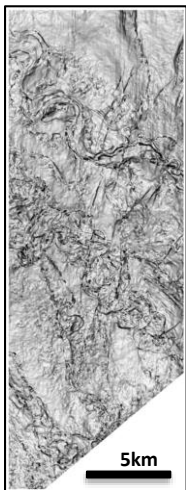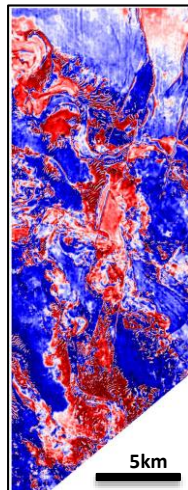SUBSURFACE CLARITY

3D Property Model based on V-shale

Wheeler Diagram

Well-log Facies from Cross Plots

HDFD

Dip

InstPhase

Blend
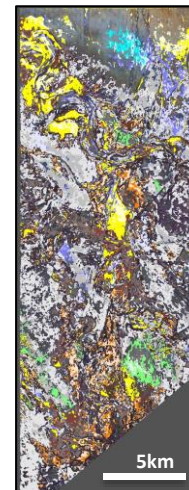
IFC

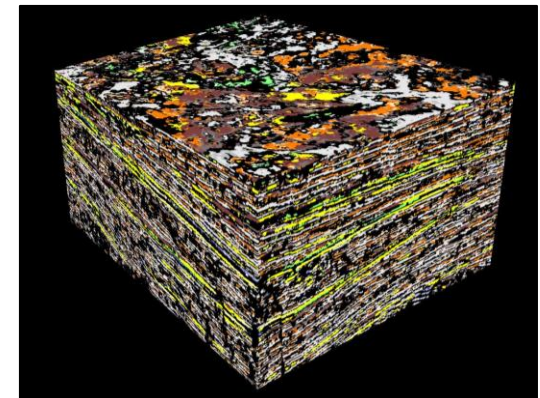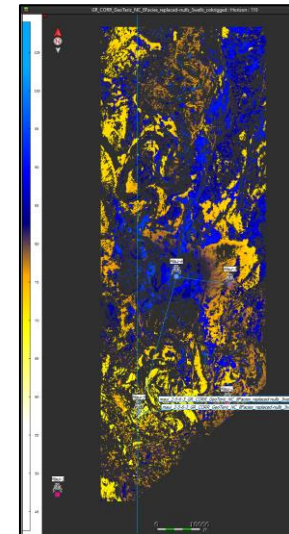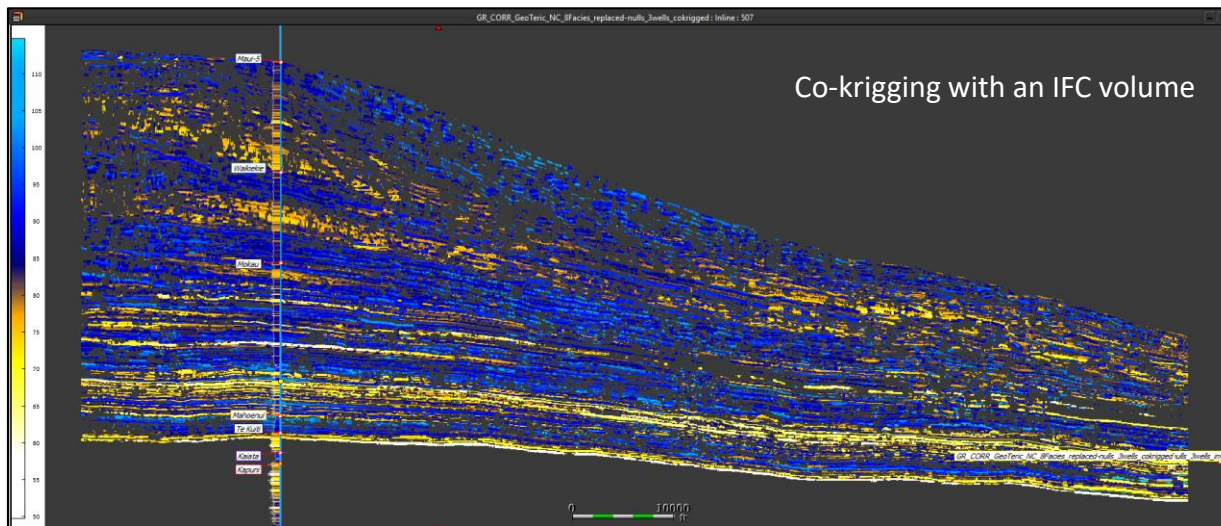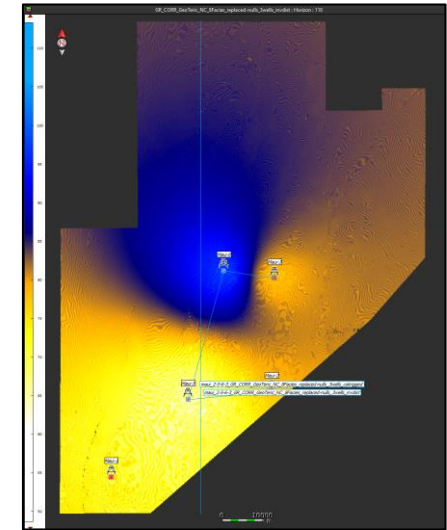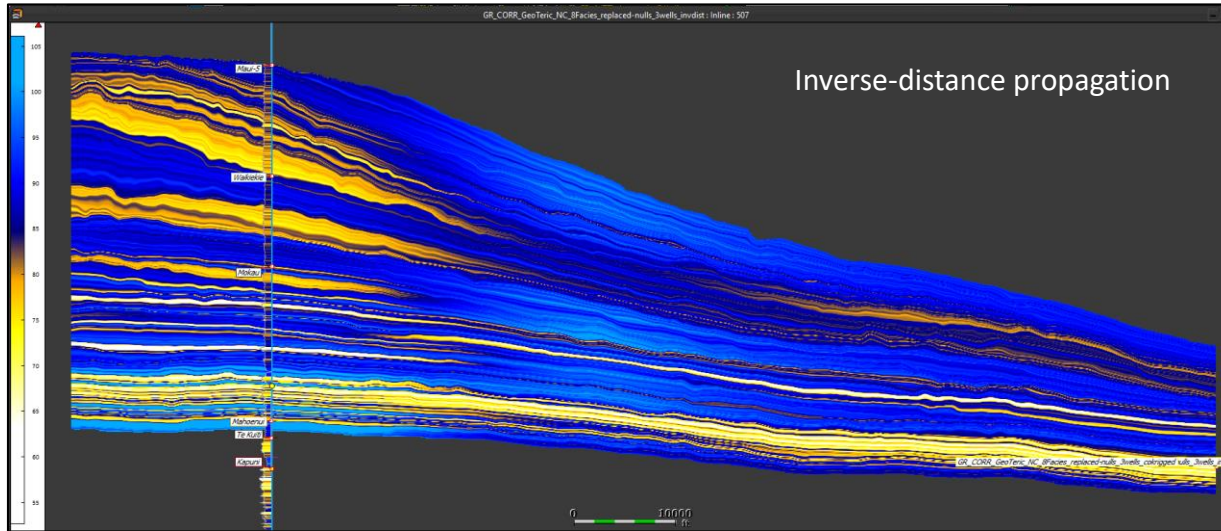IFC Volume with 7 Seismic Facies Classes

❖ PaleoScan
  ➢ An example of gamma-ray values distributed throughout the 3D Geomodel

Inverse-distance propagation

Co-krigging with an IFC volume

SUBSURFACE CLARITY

❖ PaleoScan and GeoTeric:

➤ In addition to detailed stratigraphic analyses, we also provide fault interpretations based on a series of blended attribute volumes and integrated mapping workflows
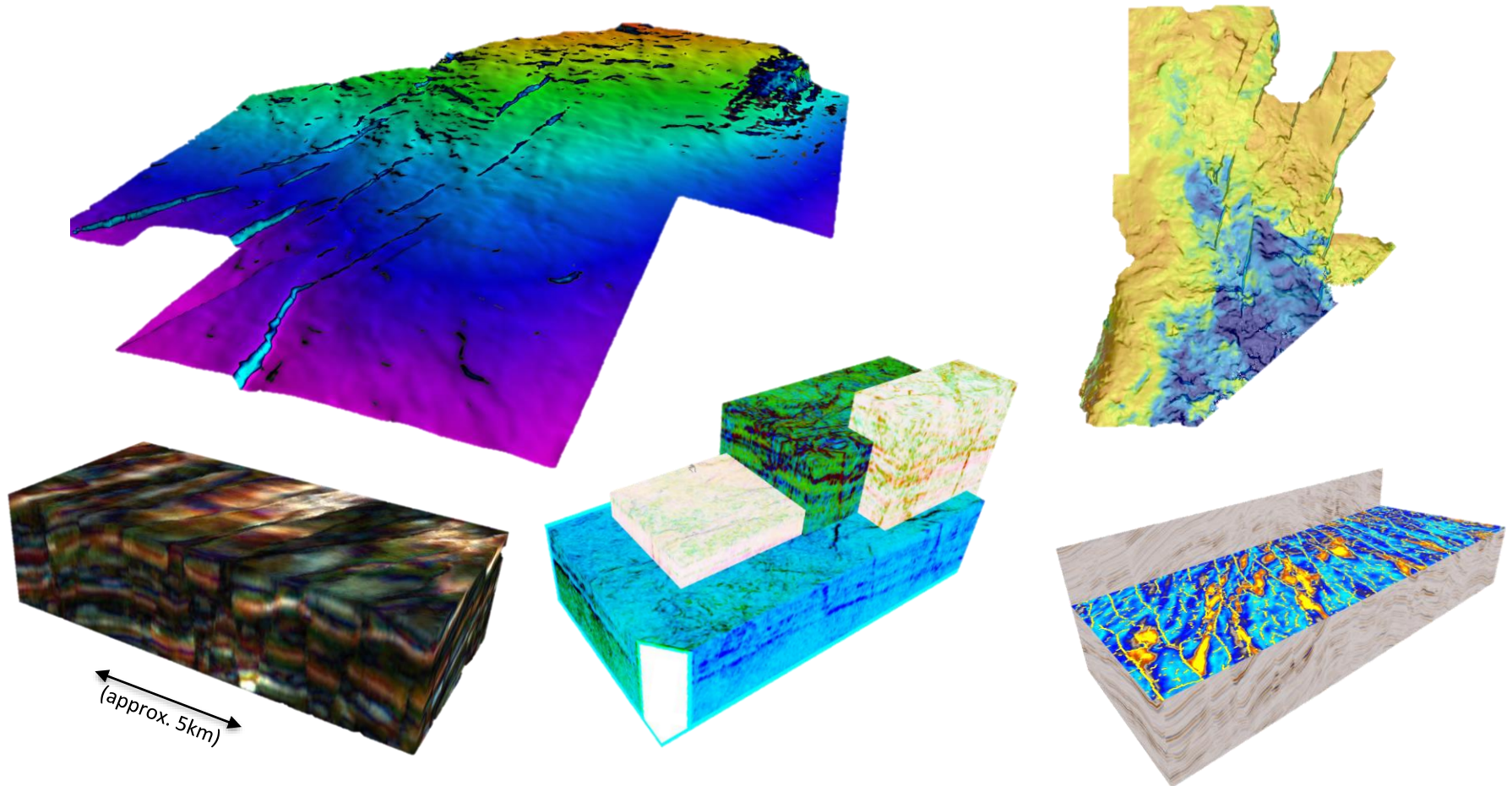
(approx. 5km)

PRE-CONDITIONING
STRATIGRAPHIC INTERPRETATION
WELL ANALYSIS
SEQUENCE ANALYSIS
FACIES INTERPRETATION
STRUCTURAL INTERPRETATION

3D PROPERTY MODELING

Thank you