The application of seismic analysis techniques for the identification of structural and stratigraphic features in carbonate environments

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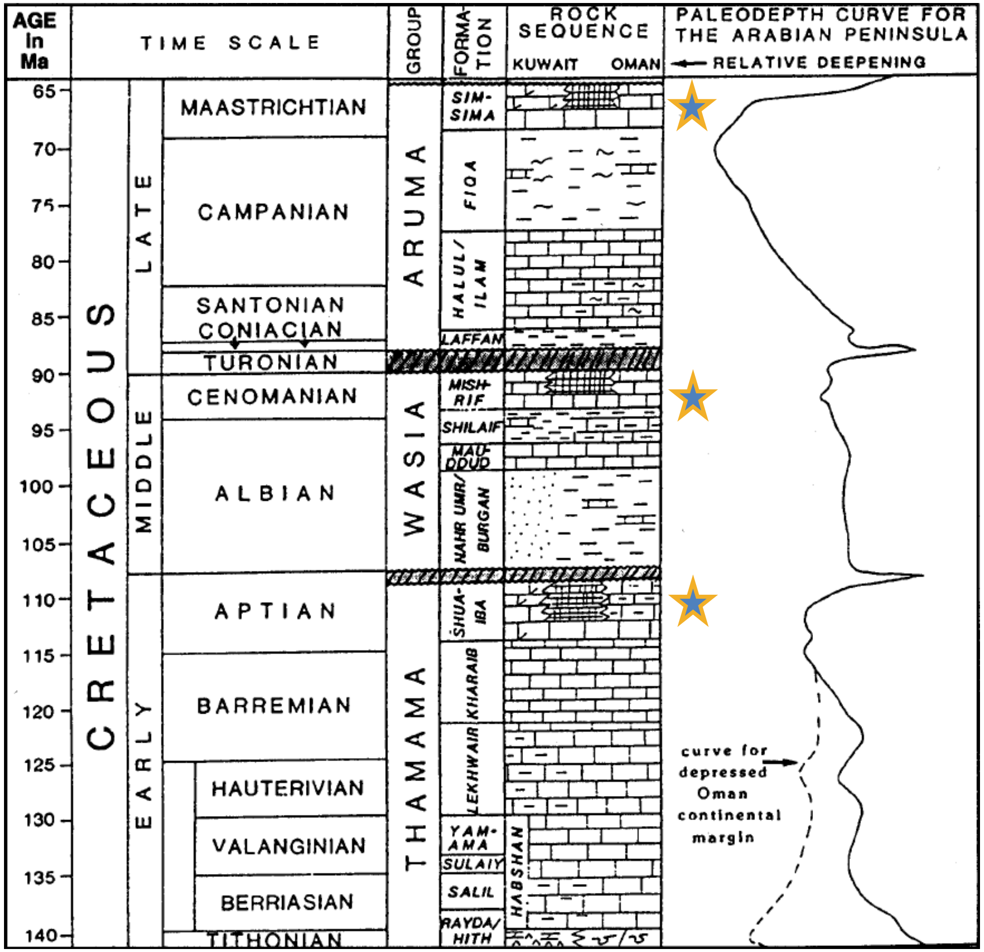
Project Area

Geology



Rudist reef-bioherms in the Shuaiba, Mishrif and Simsima

- Cretaceous is split into 3 cycles separated by regional unconformities
- Sedimentary succession influenced by sea level fluctuations.
- Shallow marine carbonates accumulation.

Objectives

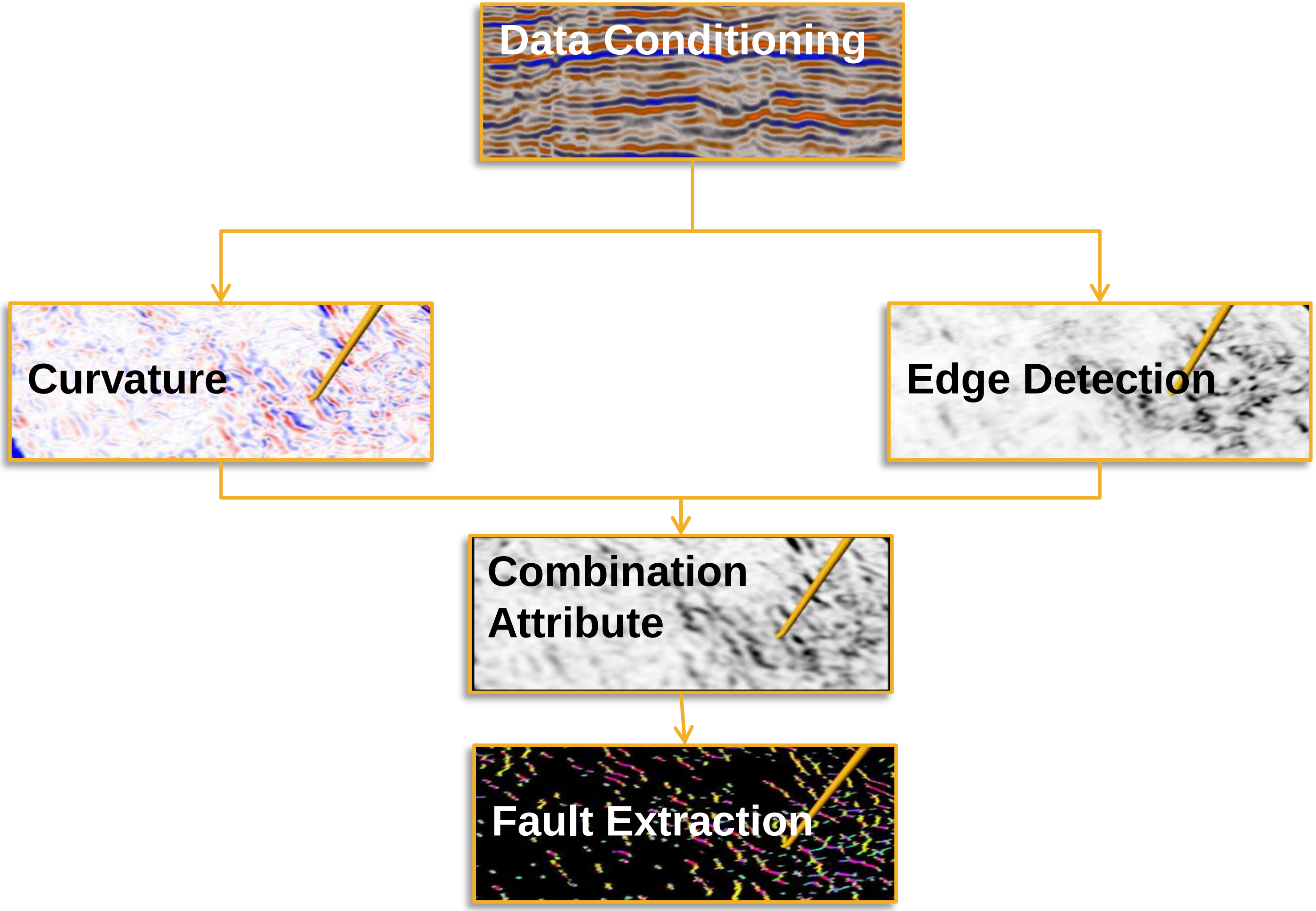
Part 1: Structural

- Lower Cretaceous – Thamama complex
- Fault Analysis

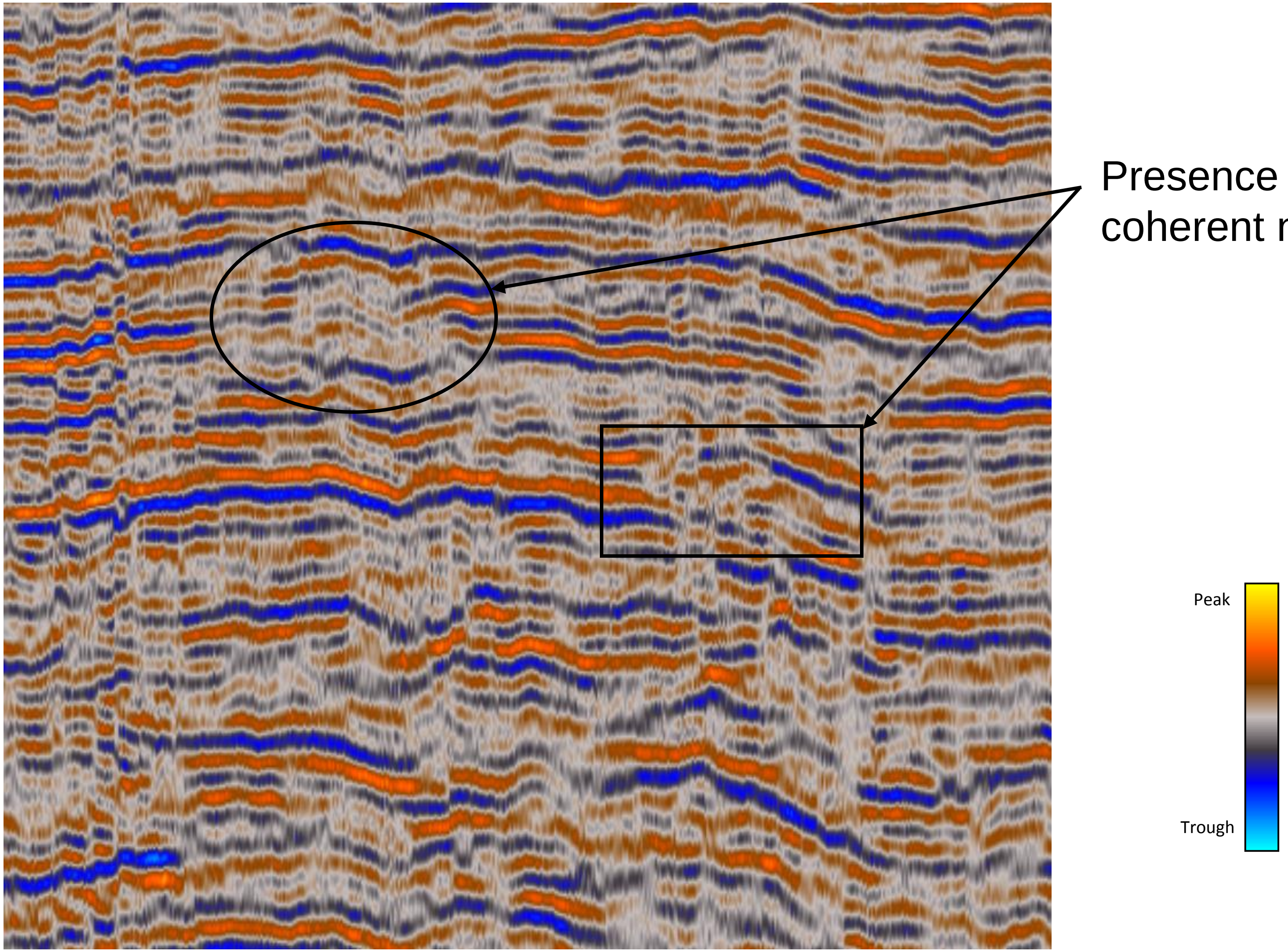
Part 2: Stratigraphic

- Middle Cretaceous – Mishrif buildup
- Pinchout investigation

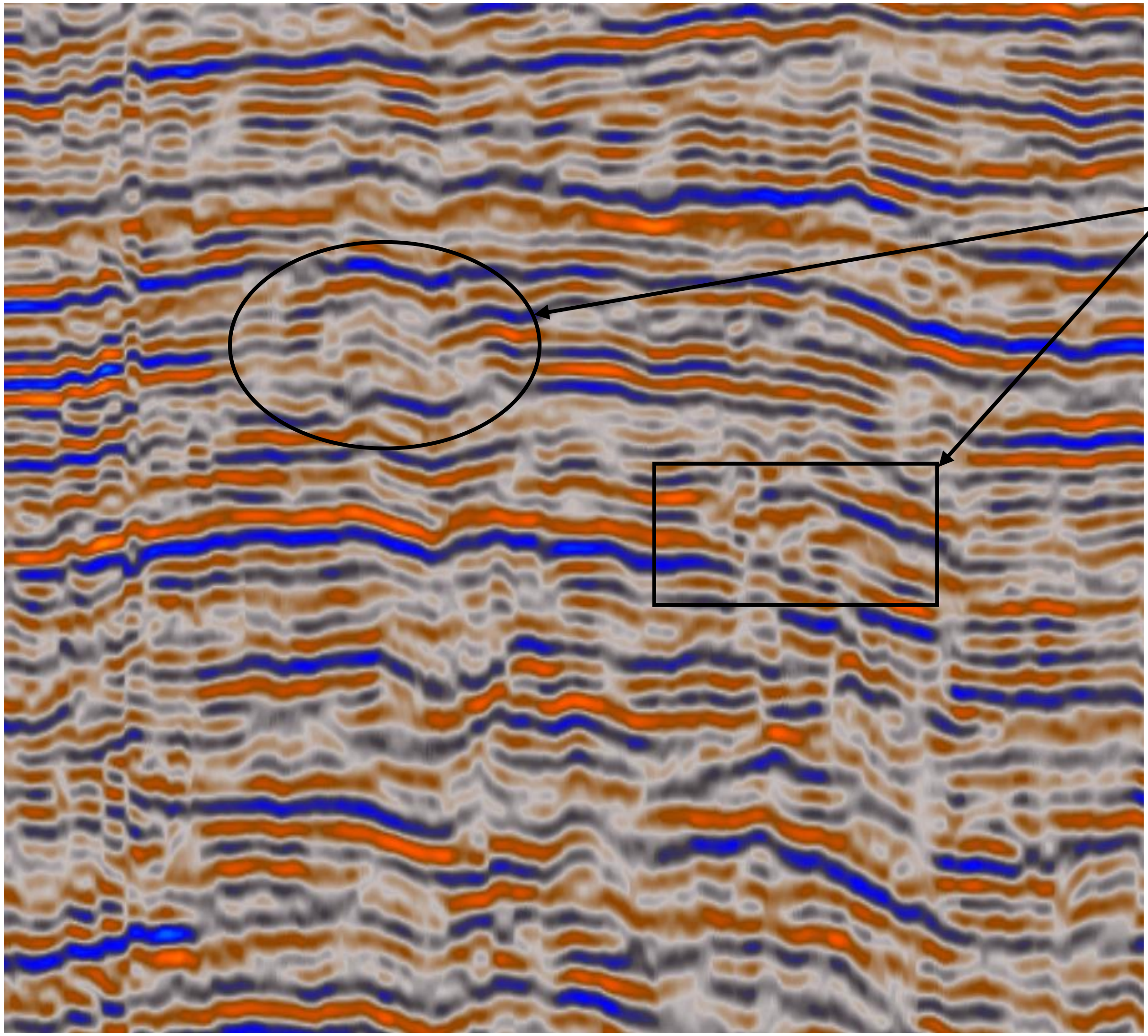
Part 1: Structural workflow



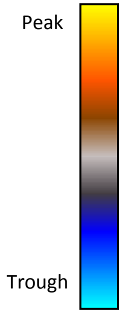
Noise cancellation: original data



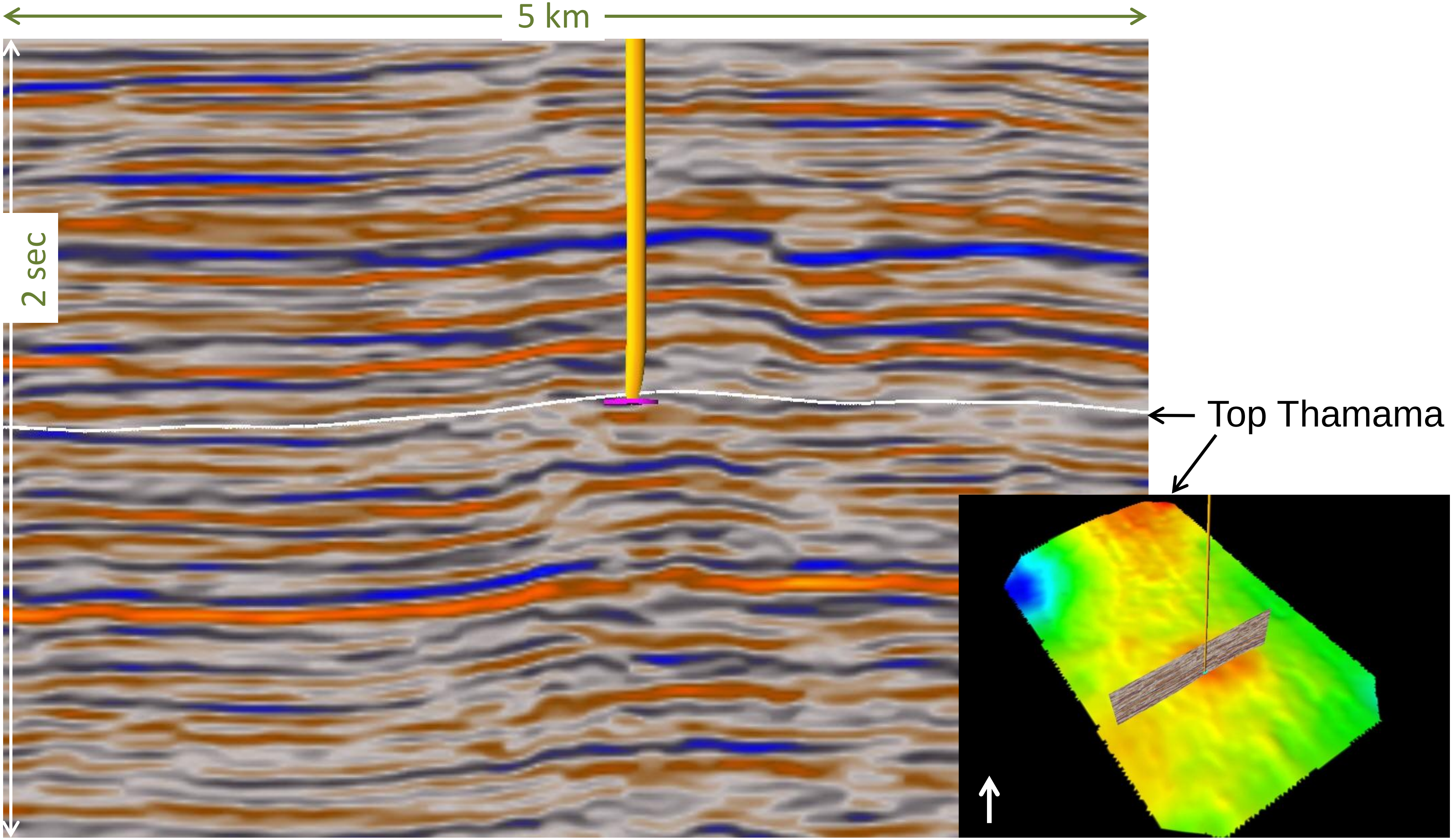
Noise cancellation: conditioned data



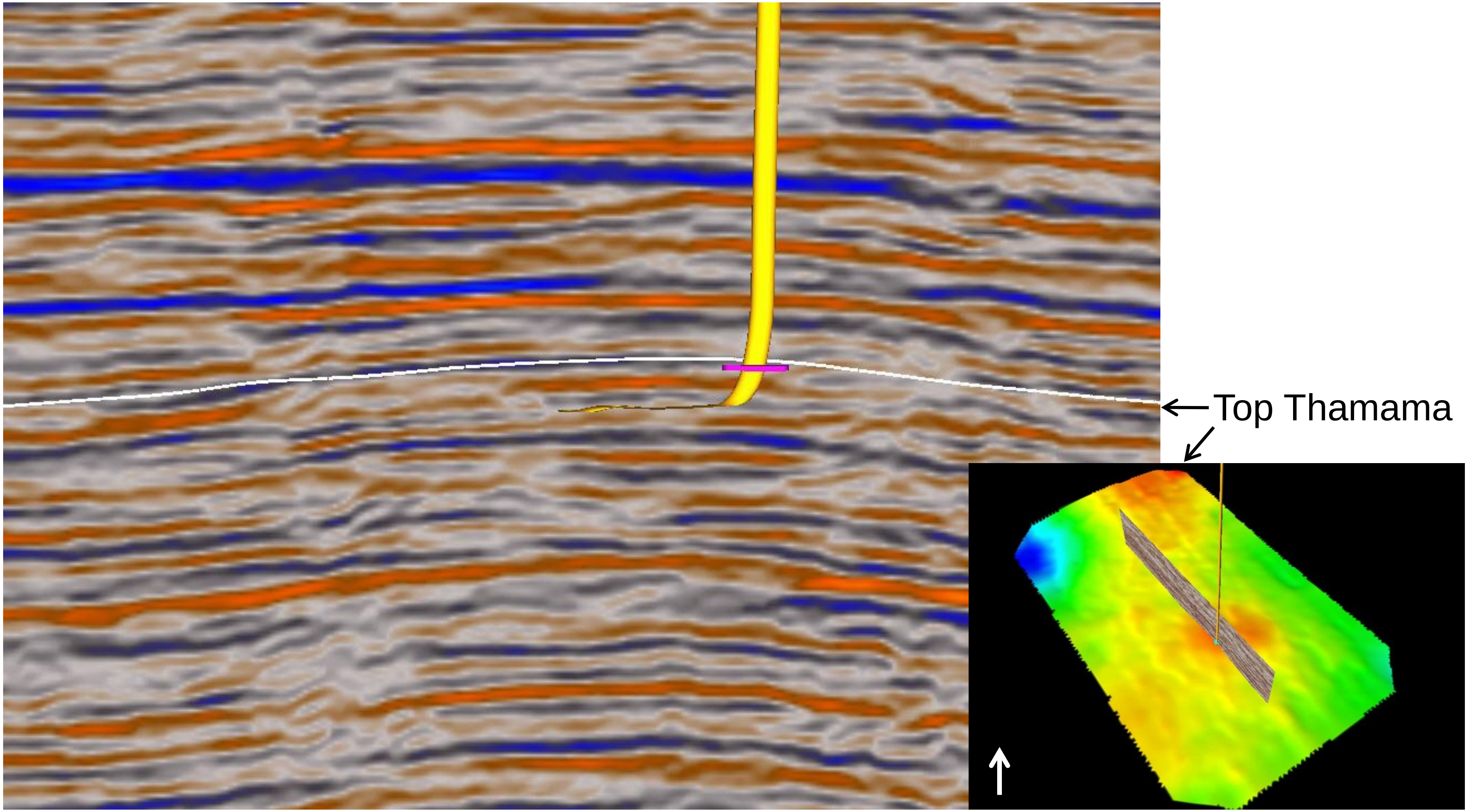
Reduced presence of high dip coherent noise with improved reflector continuity
Fractures have also been preserved



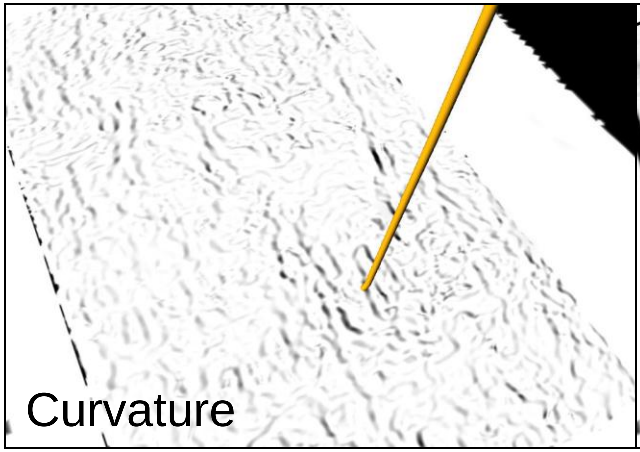
Thamama faulting

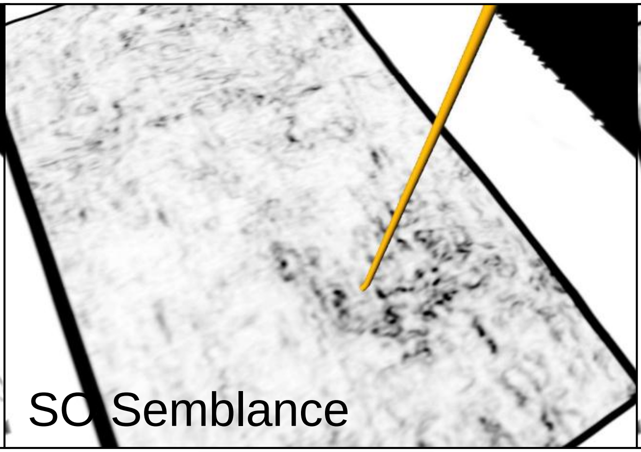


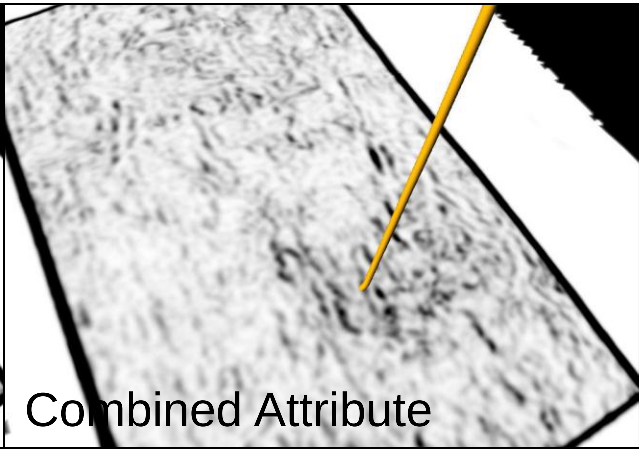
Thamama faulting

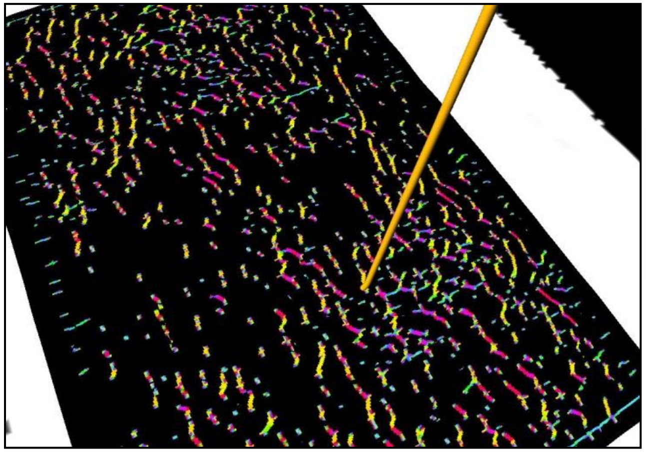


Fault Analysis

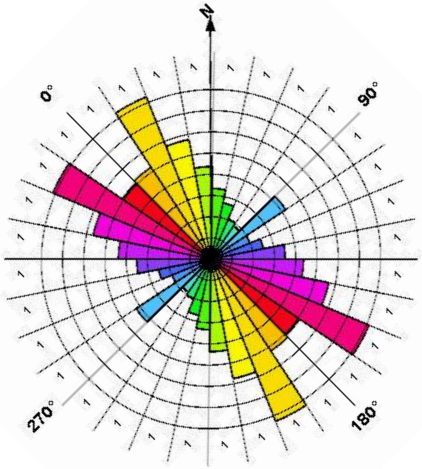


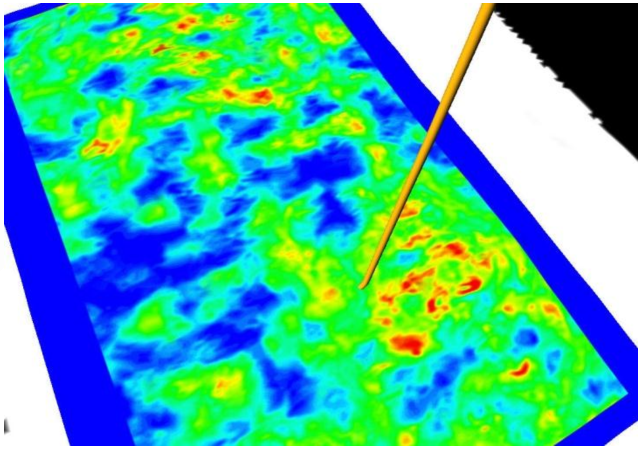






Fault Trends



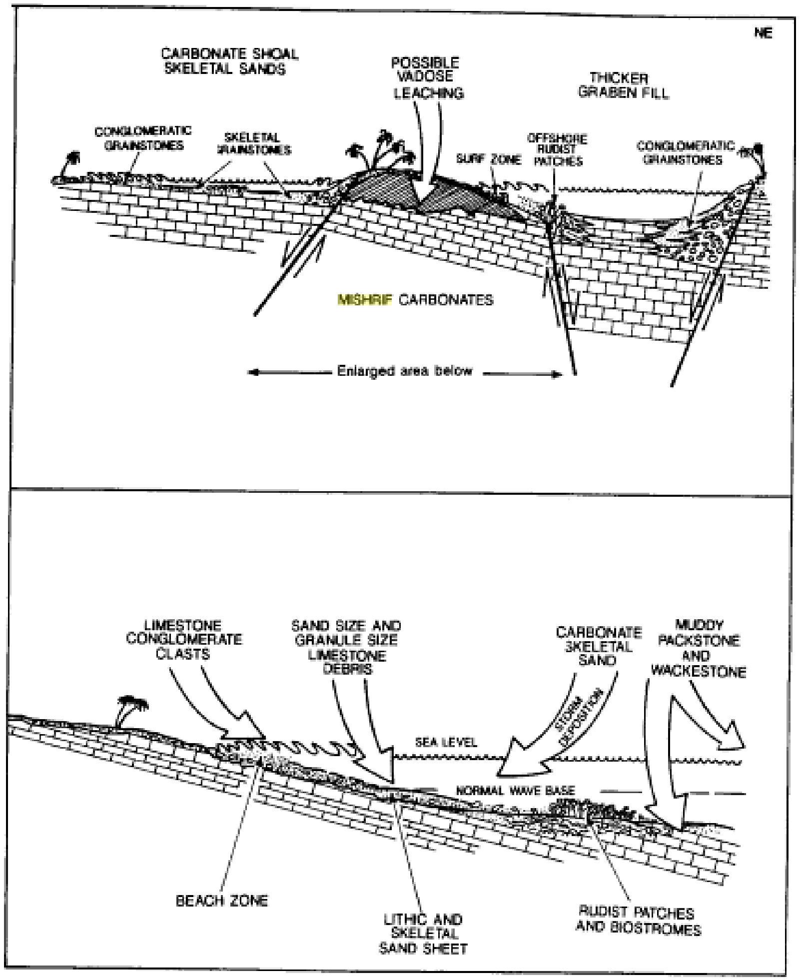


Fault Density

Conclusions

- Curvature picked up the NW-SE regional faults
- SO Semblance picked up NE-SW small scale faults
- Using a combination of the two techniques is the best solution for complete imaging of the faults
- Fault Trends and Density volumes support the bi-directional faulting theory.

Part 2: Stratigraphic analysis

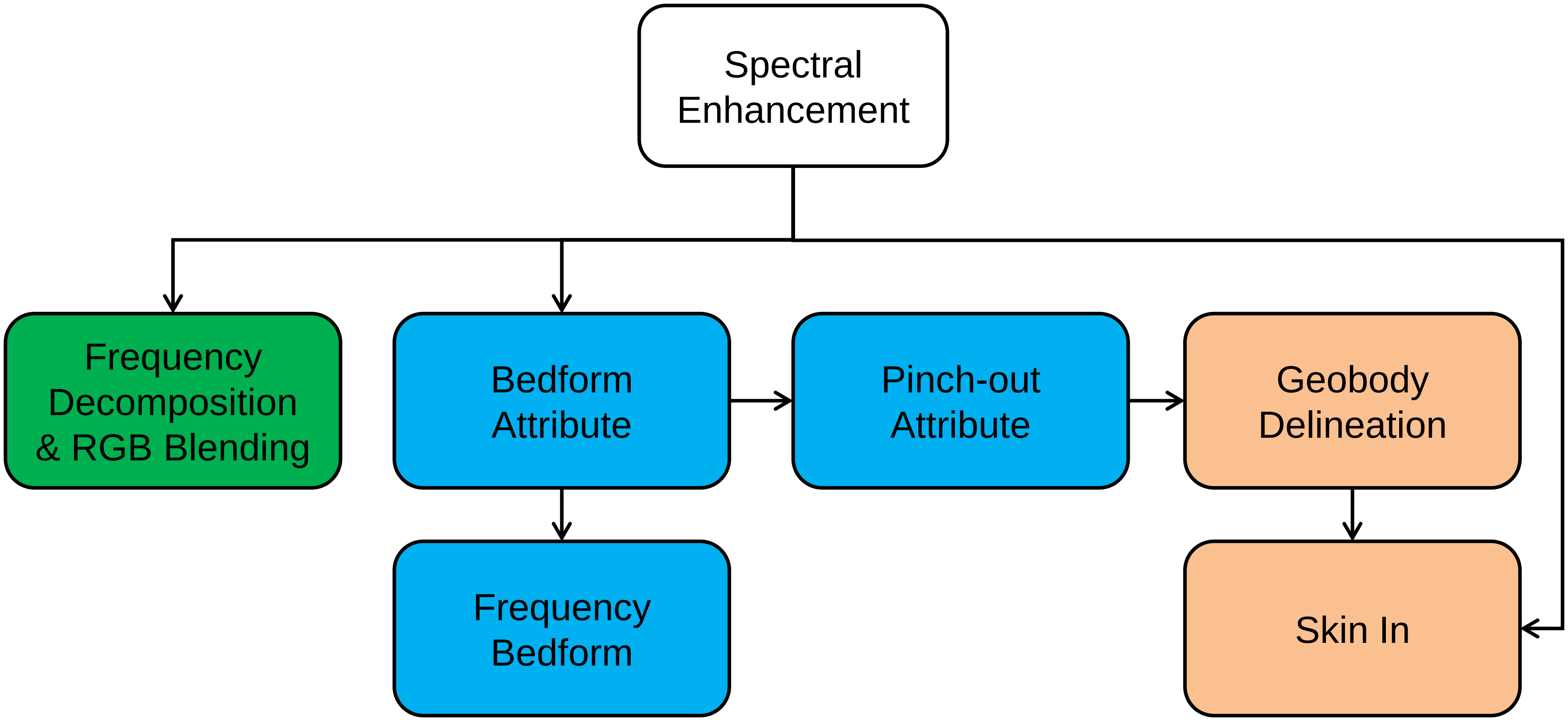


Edgell, 1996

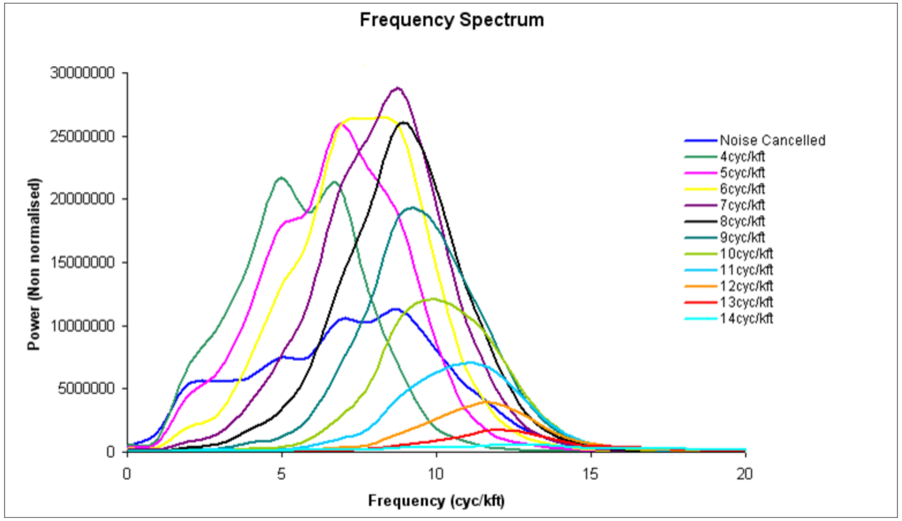
- Rudist reefs form in water depths of ~10m
- As the water recedes the reefs start prograding
- Sub aerial exposure and subsequent leaching causes moldic porosity
- Deposition of the overlying mudstone forms a seal □Good Reservoir
- So the most productive zones are seen as top laps onto the Top Mishrif unconformity.

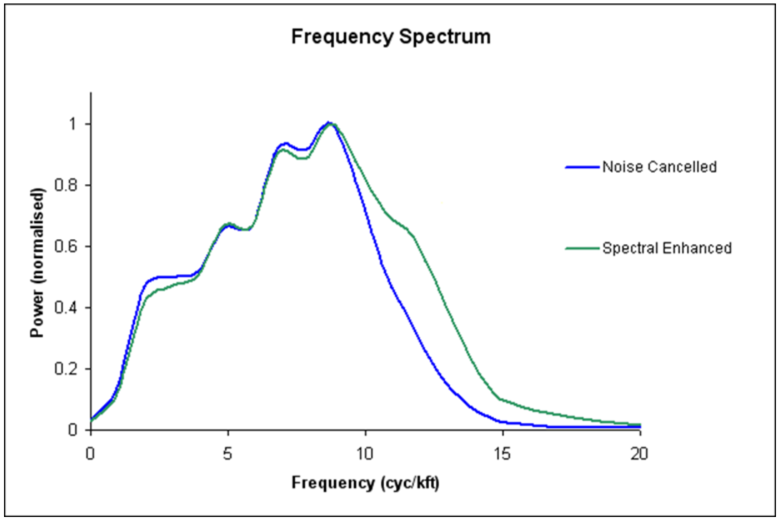
- Find the most productive zones in the Mishrif formation

Part 2: Stratigraphic analysis



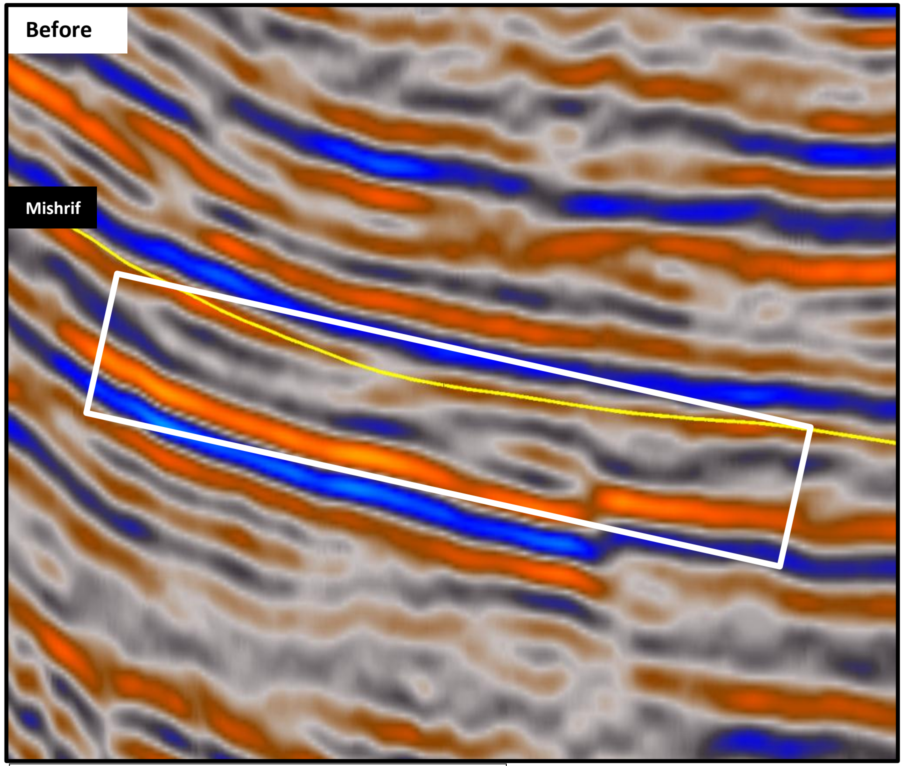
Spectral Enhancement

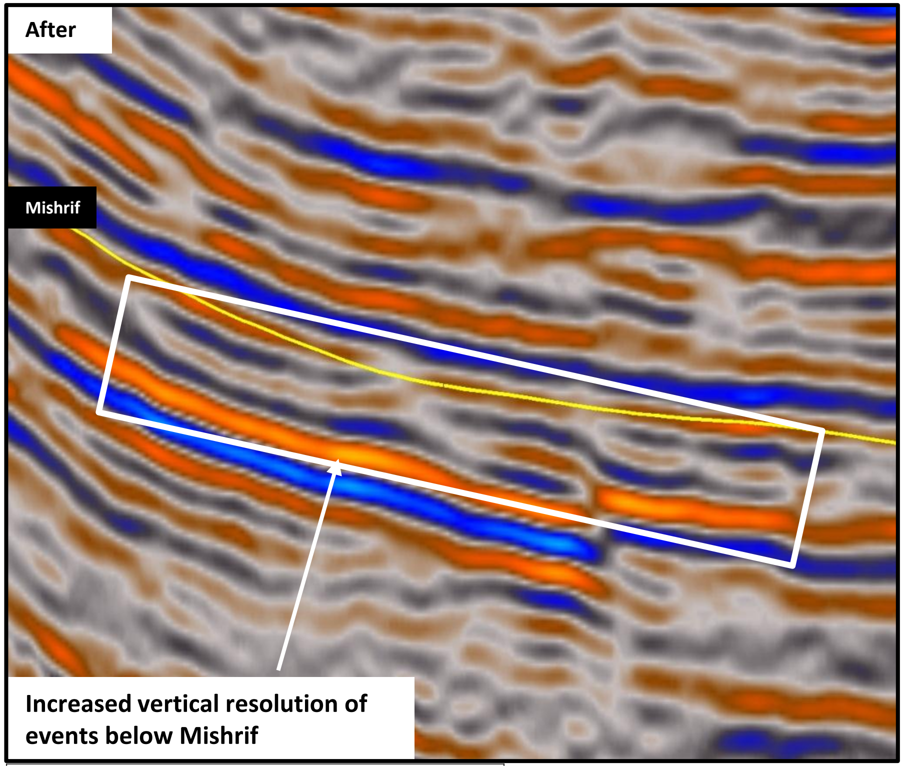


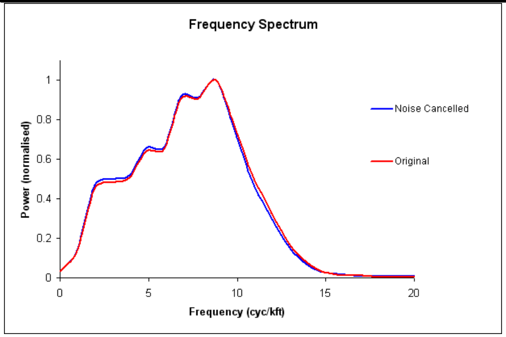


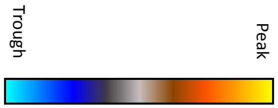
- Split the spectral into discrete frequency bands
- Noise Cancel each band
- Apply a weighting factor
- Recombine

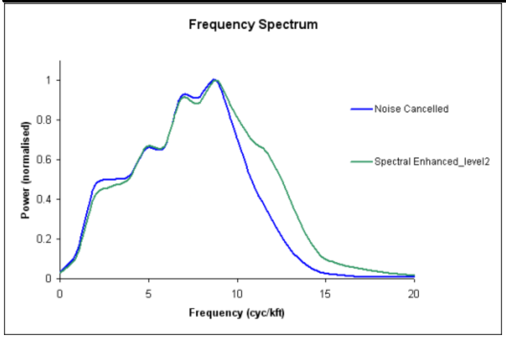
Spectral Enhancement



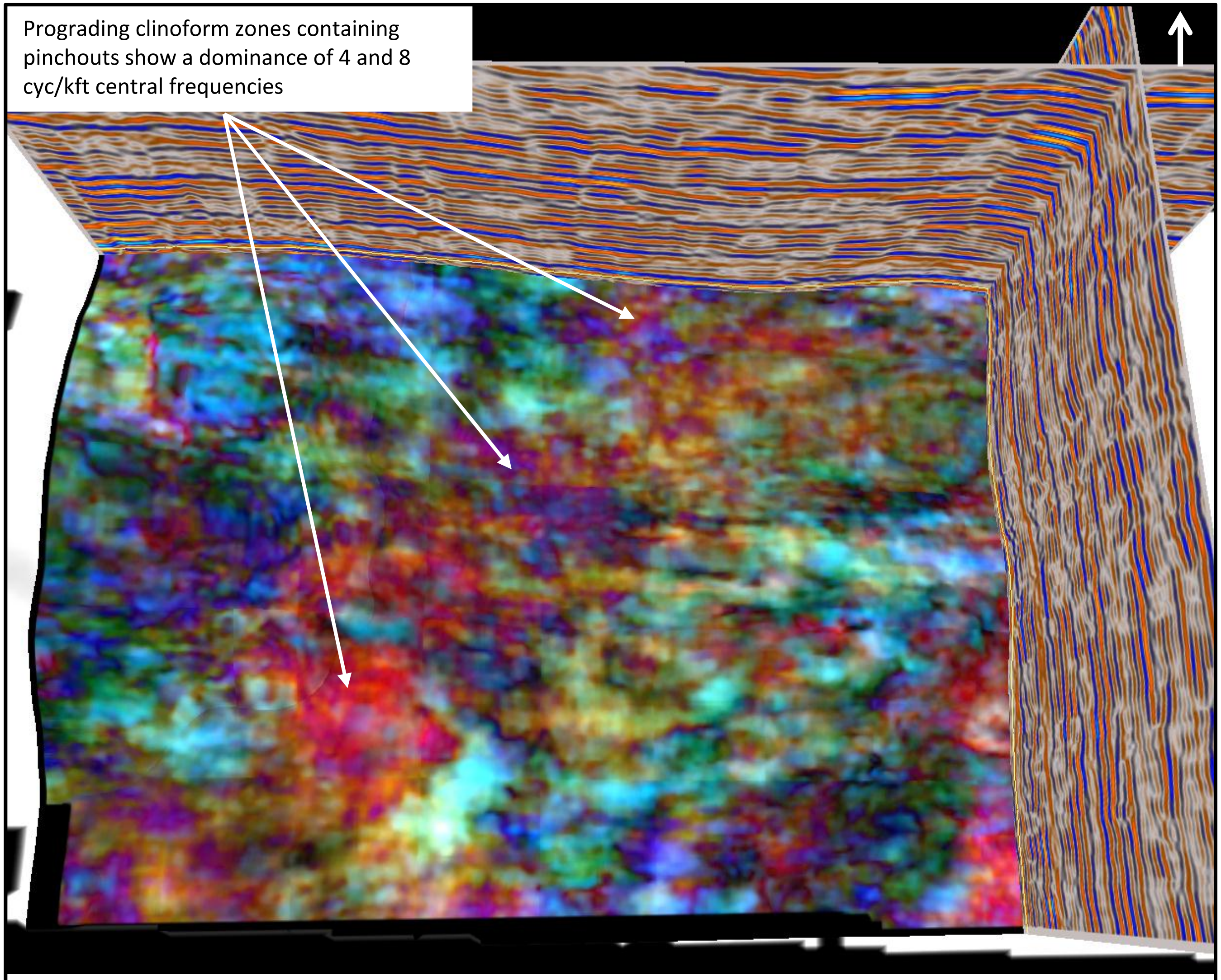






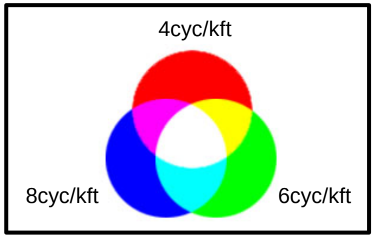


Frequency Decomposition

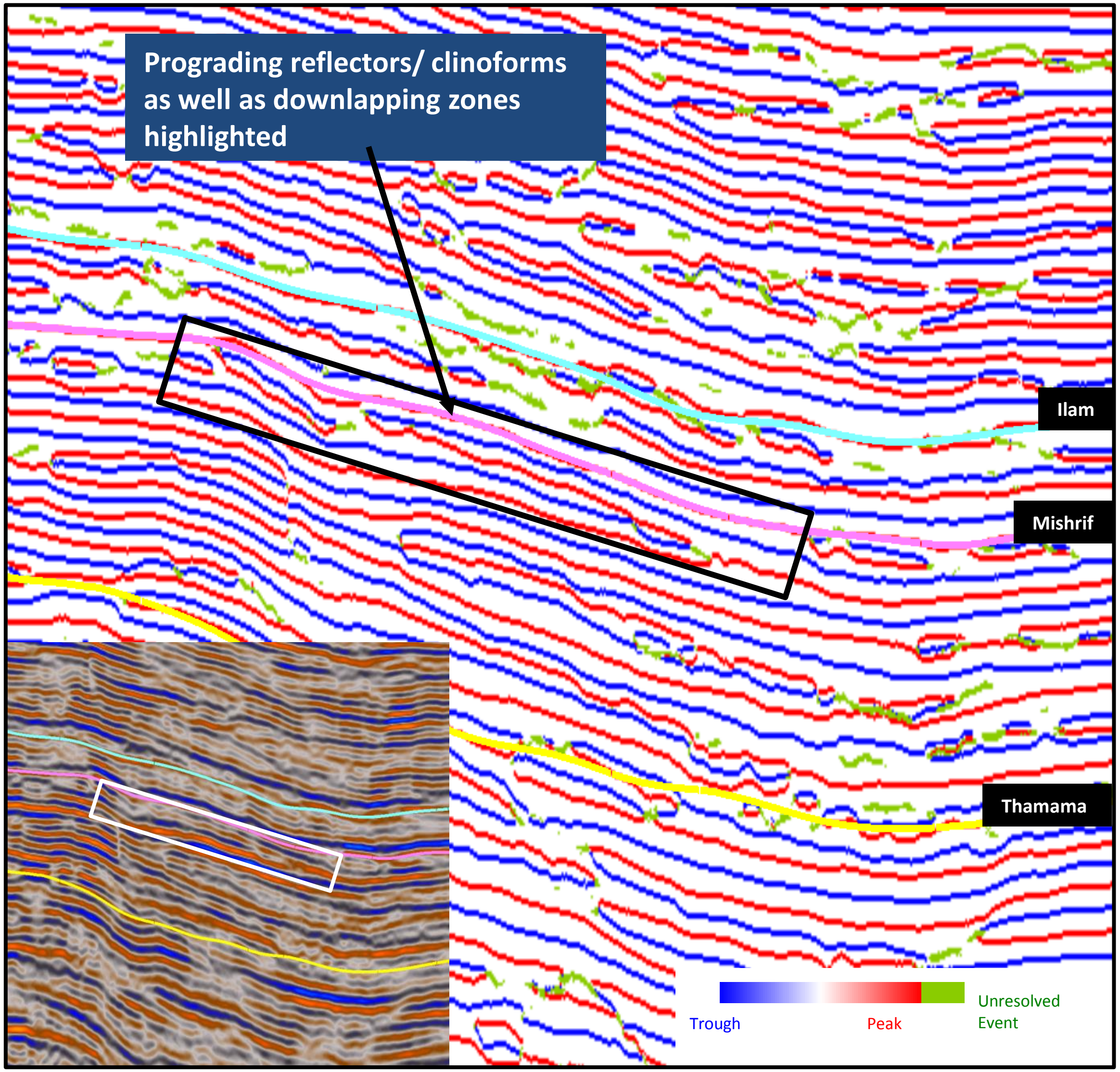


Horizon slice 100ft below Top Mishrif.

Prograding clinoforms associated with the rudist reefs visible as red / purple zones in the RGB blend.

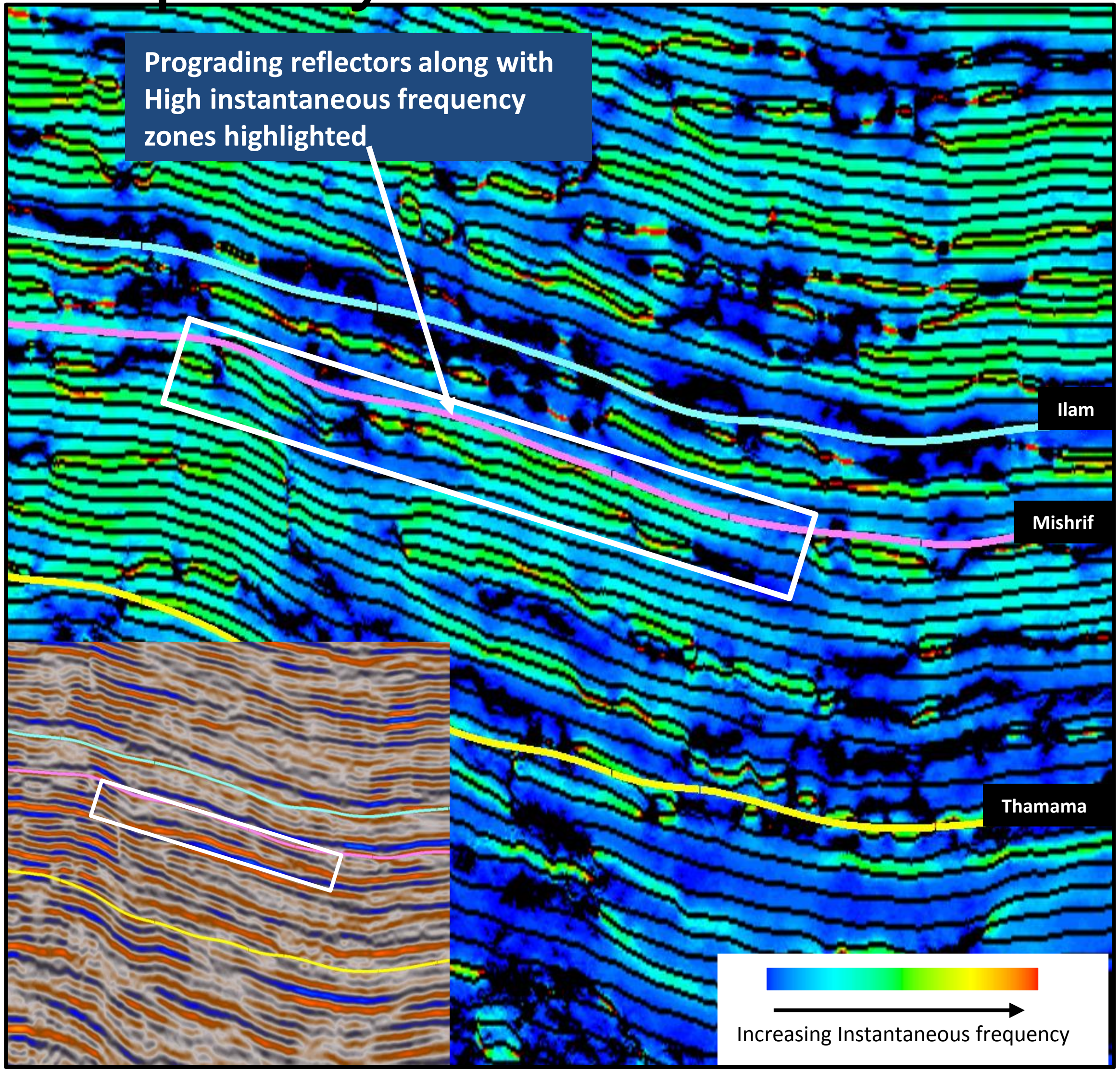


Bedform attribute



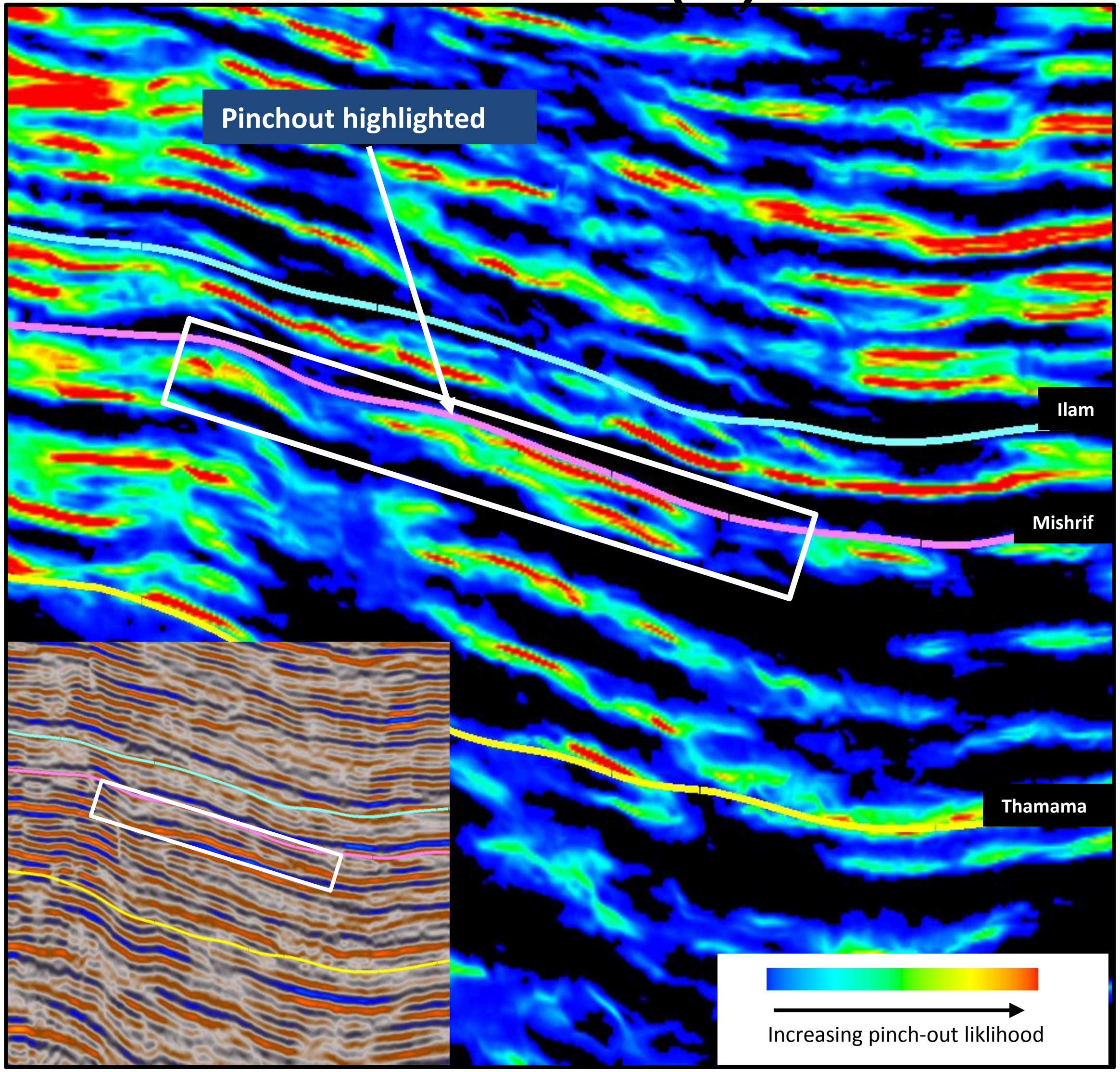
Bedform attribute helps define the individual clinoforms.

Frequency bedform attribute



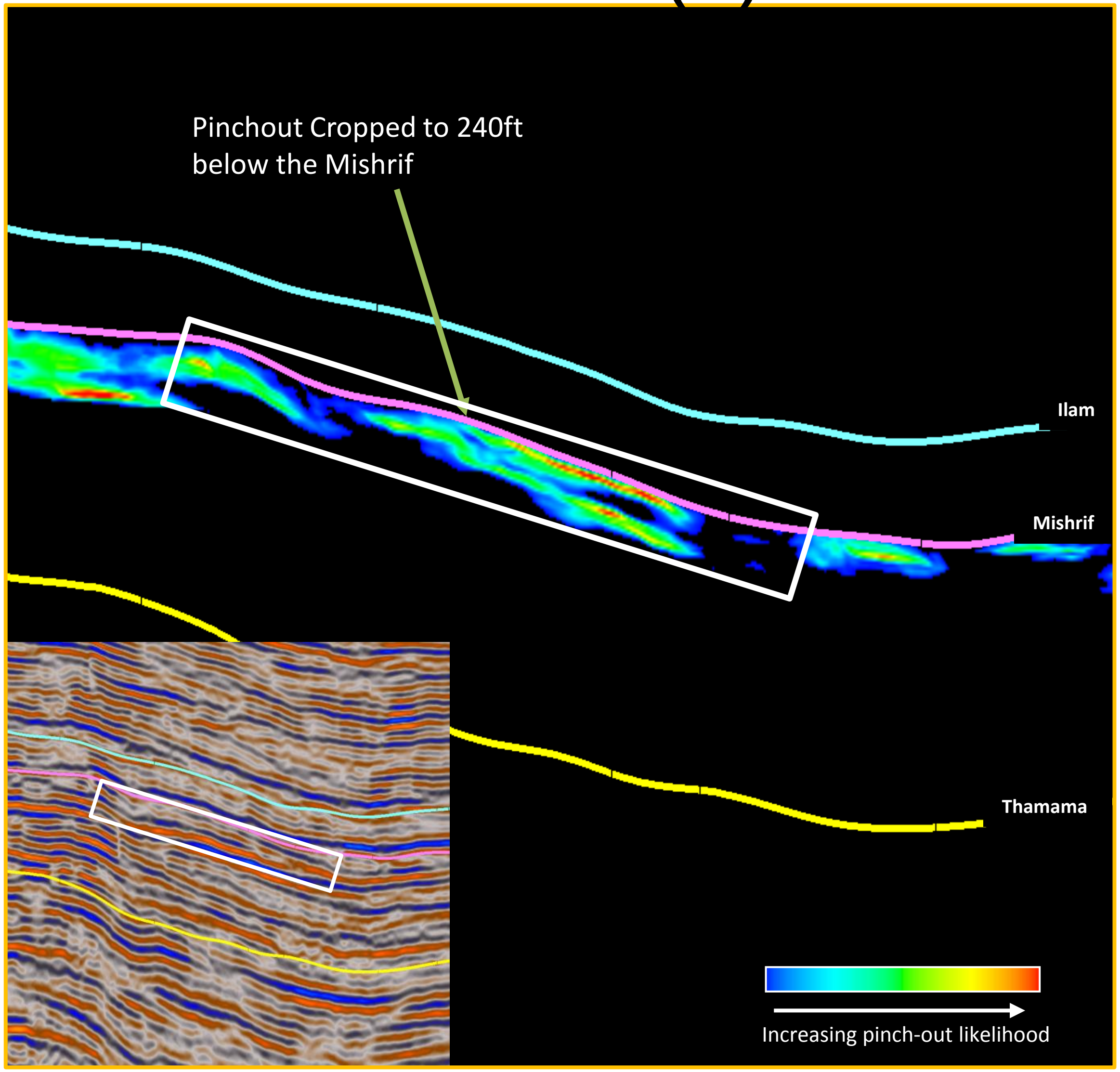
Colour coding the layers between the bedforms with the Instantaneous Frequency helps identify the pinch-outs.

Pinchout attribute (1)



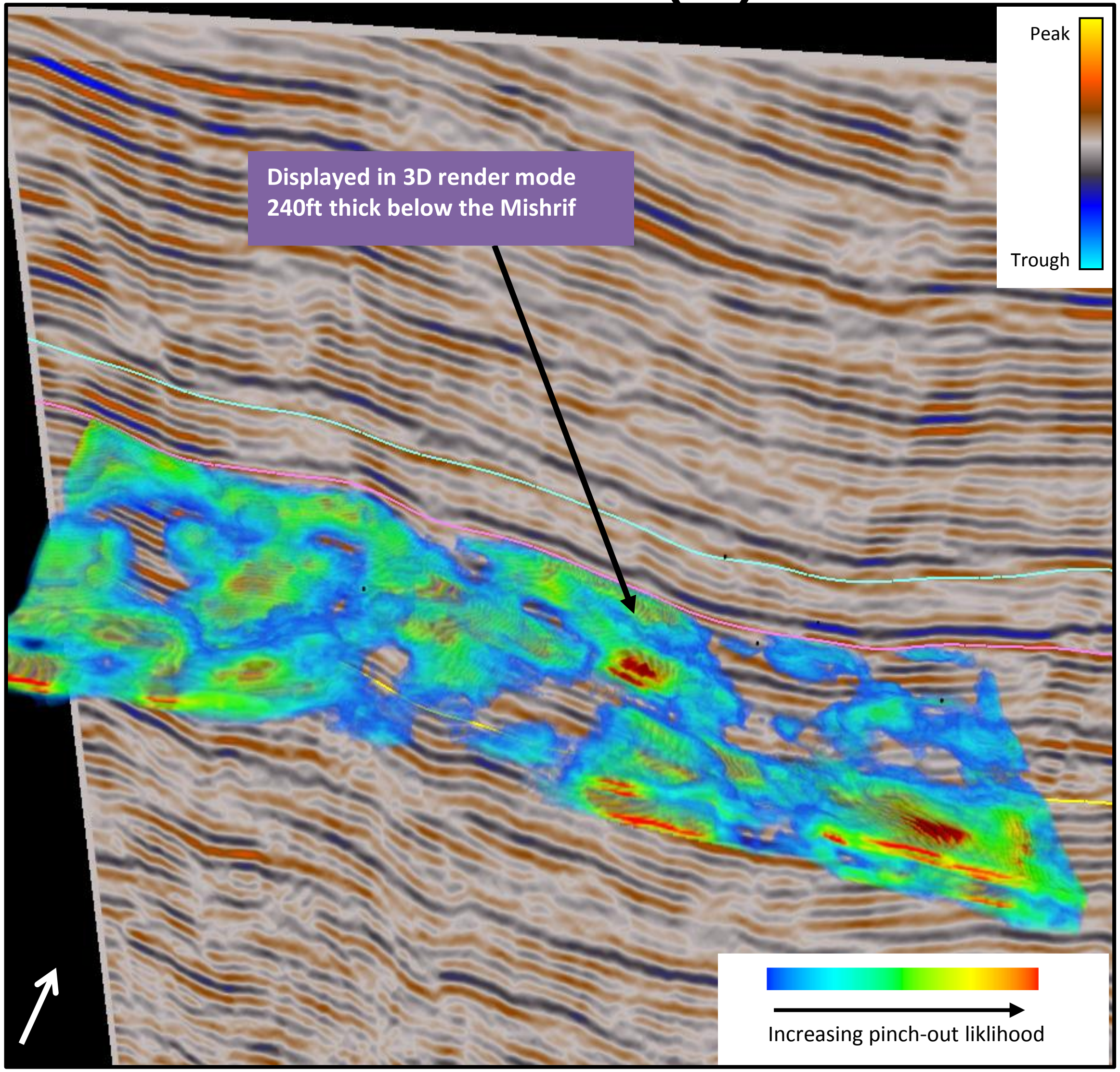
Pinch-out attribute highlights pinch-outs and high frequency zones.

Pinchout attribute (2)



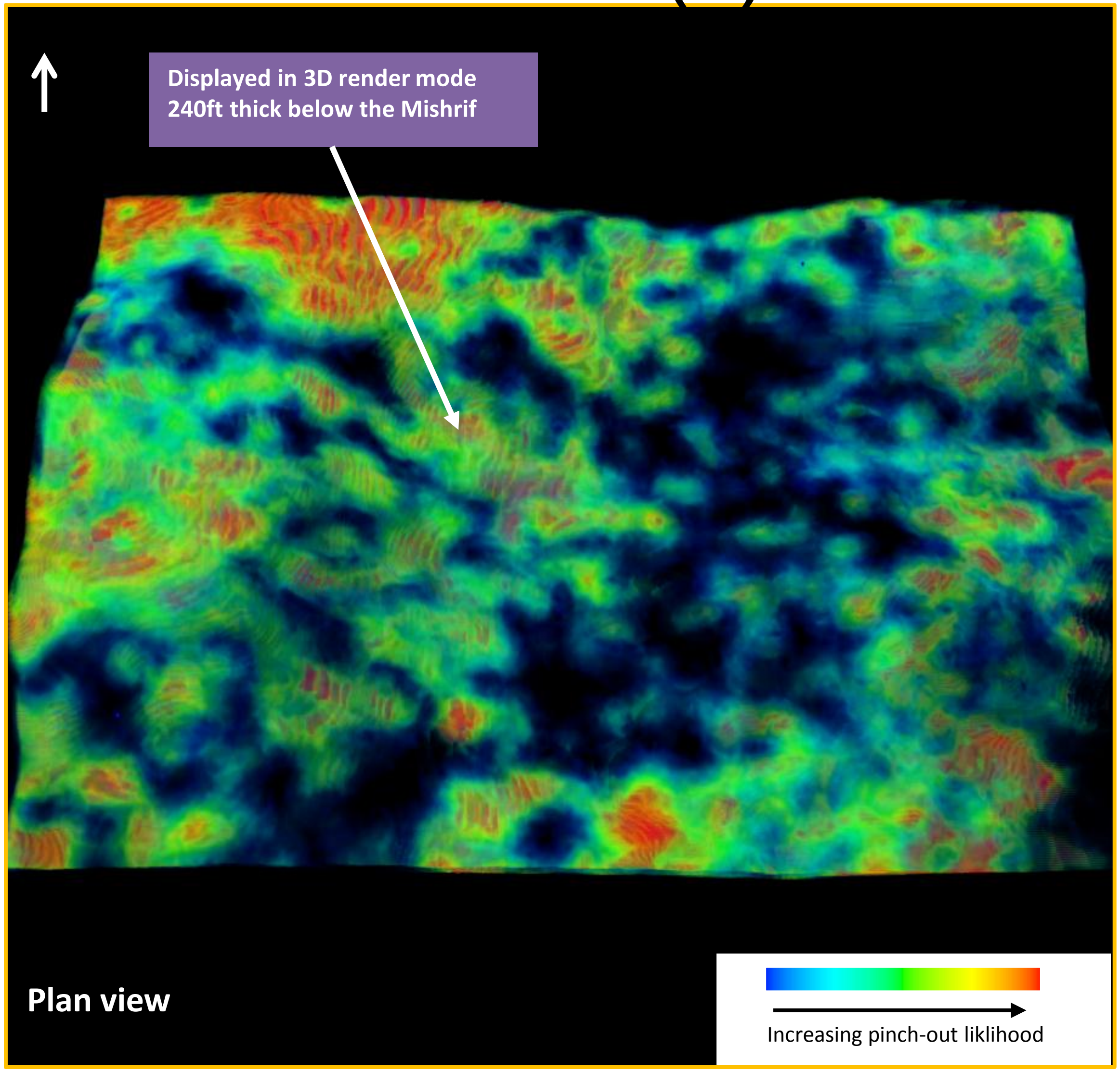
Pinch-out attribute cropped between the Top Mishrif and 240ft below the Top Mishrif.

Pinchout attribute (3)



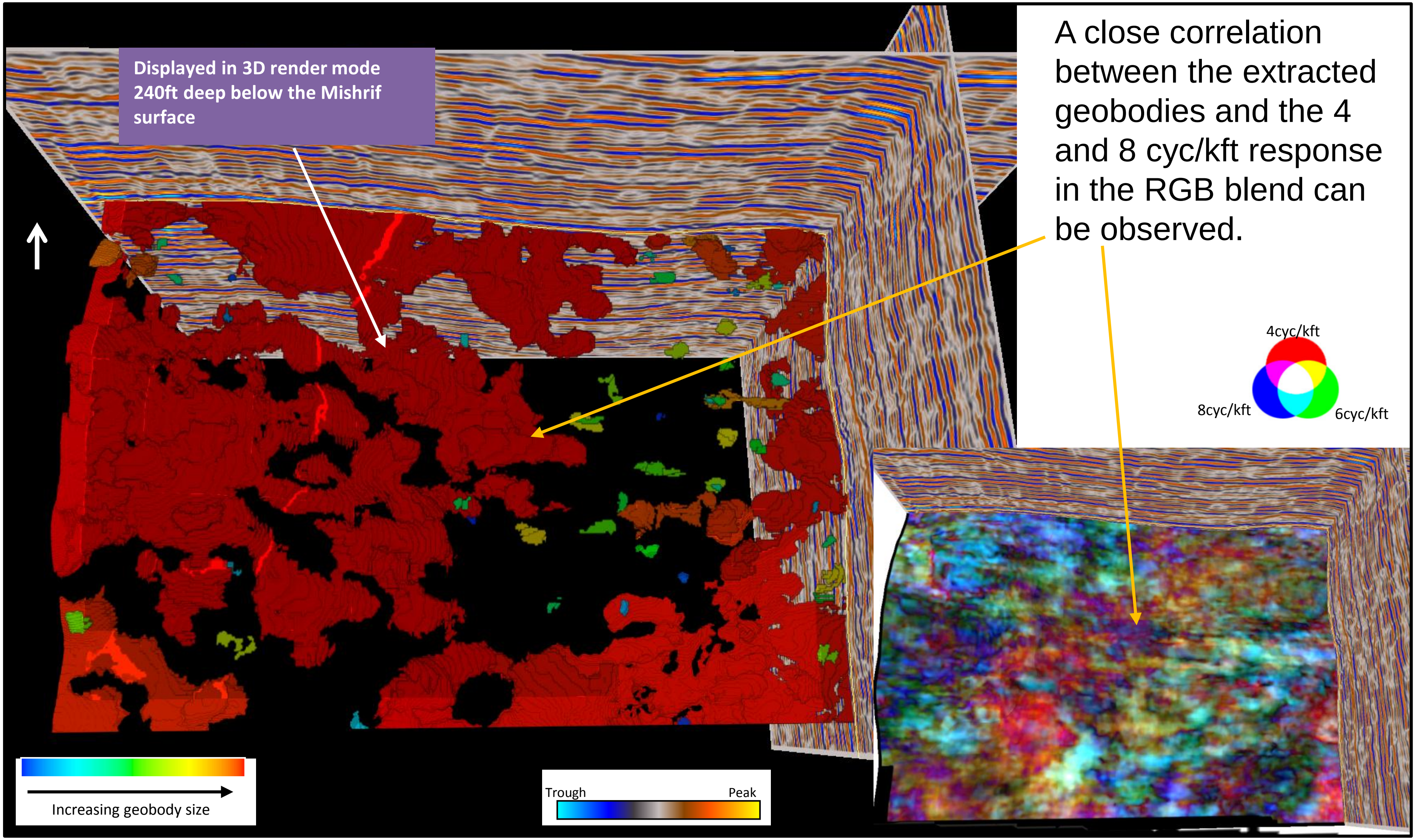
Opacity render of the pinch-out attribute.

Pinchout attribute (4)



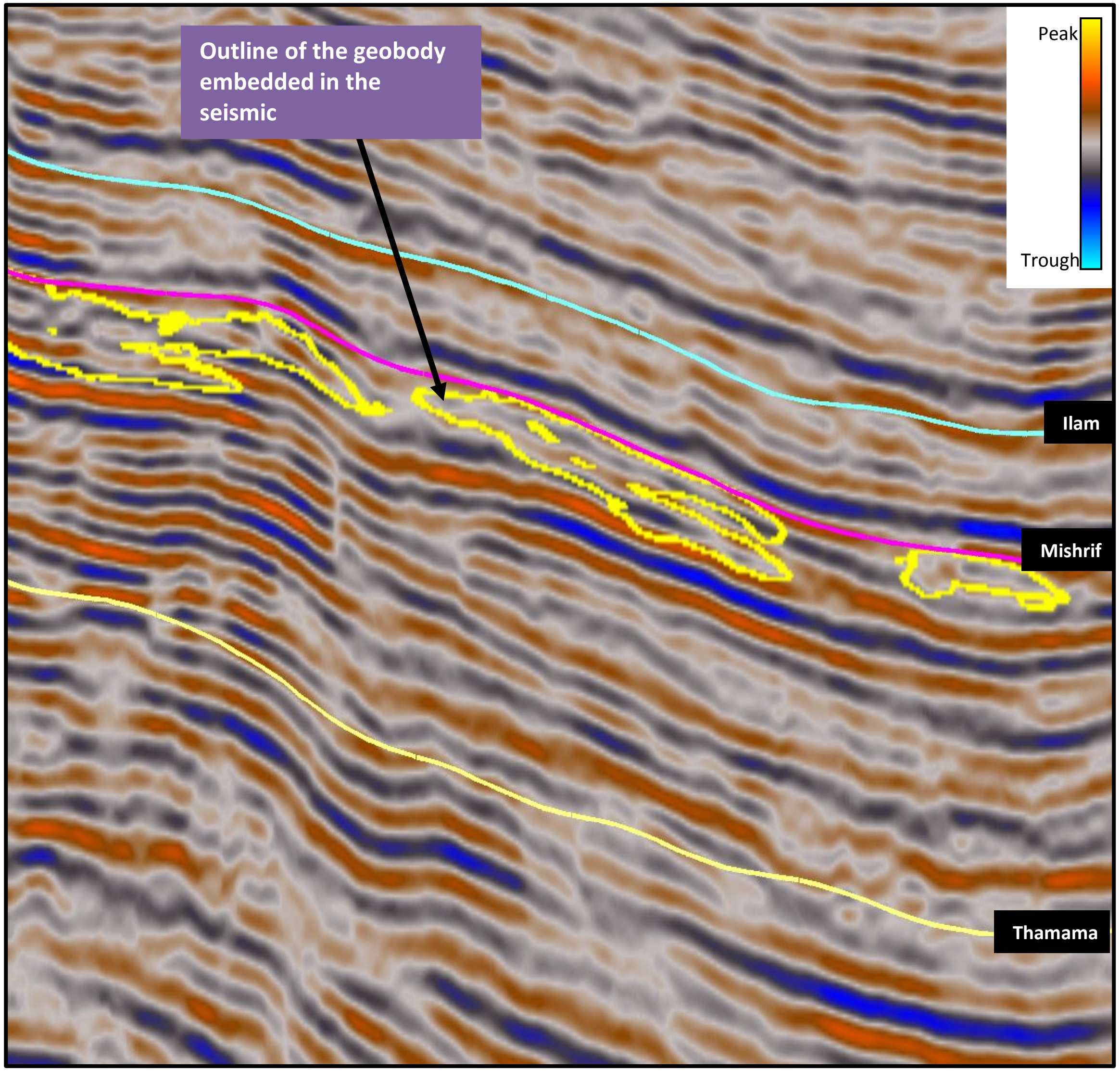
Opacity render of the pinch-out attribute.

Geobody delineation



A close correlation between the extracted geobodies and the 4 and 8 cyc/kft response in the RGB blend can be observed.

SkinIn volume



The Skin In volume showing the outer edge of the geobody embedded into the spectrally enhanced data.

Conclusions

- The objective was to identify the geometry and position of the rudist reefs.
- Data conditioning techniques improved the image of the reefs and pinch-out locations.
- Frequency Decomposition and RGB blending identified the pinch-outs and gave an indication of their size and extent.
- Geobody extraction accurately detailed their size and extent.