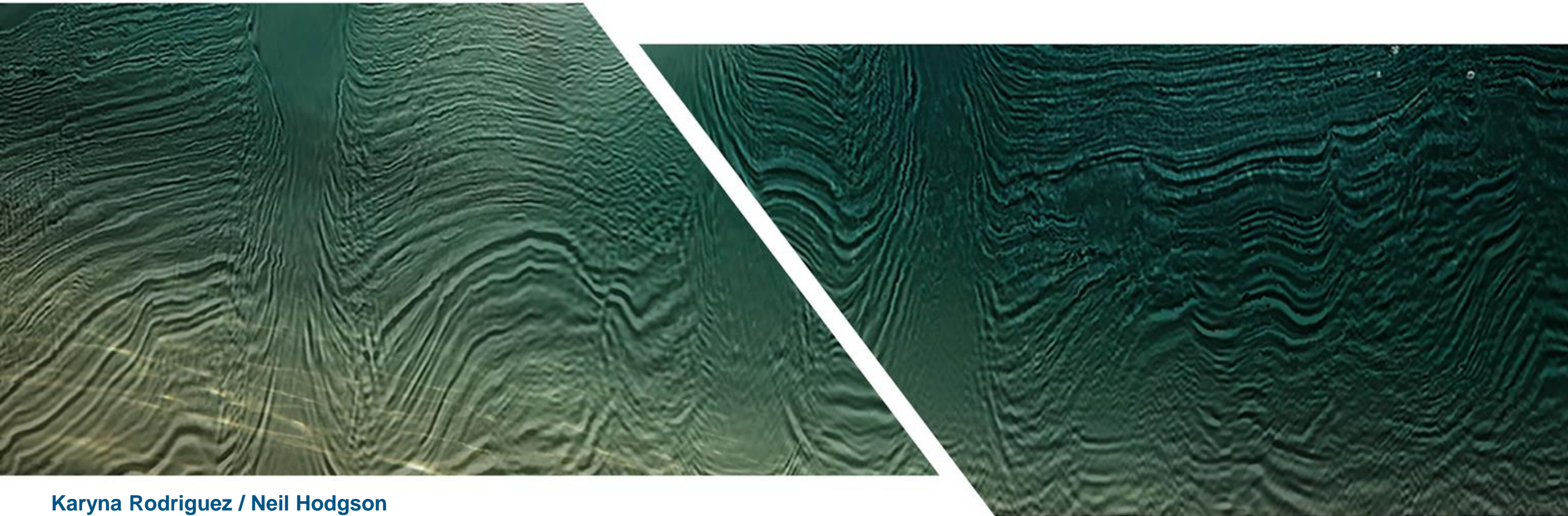




# Grand Tour of Post-Zohr Mediterranean Prospectivity

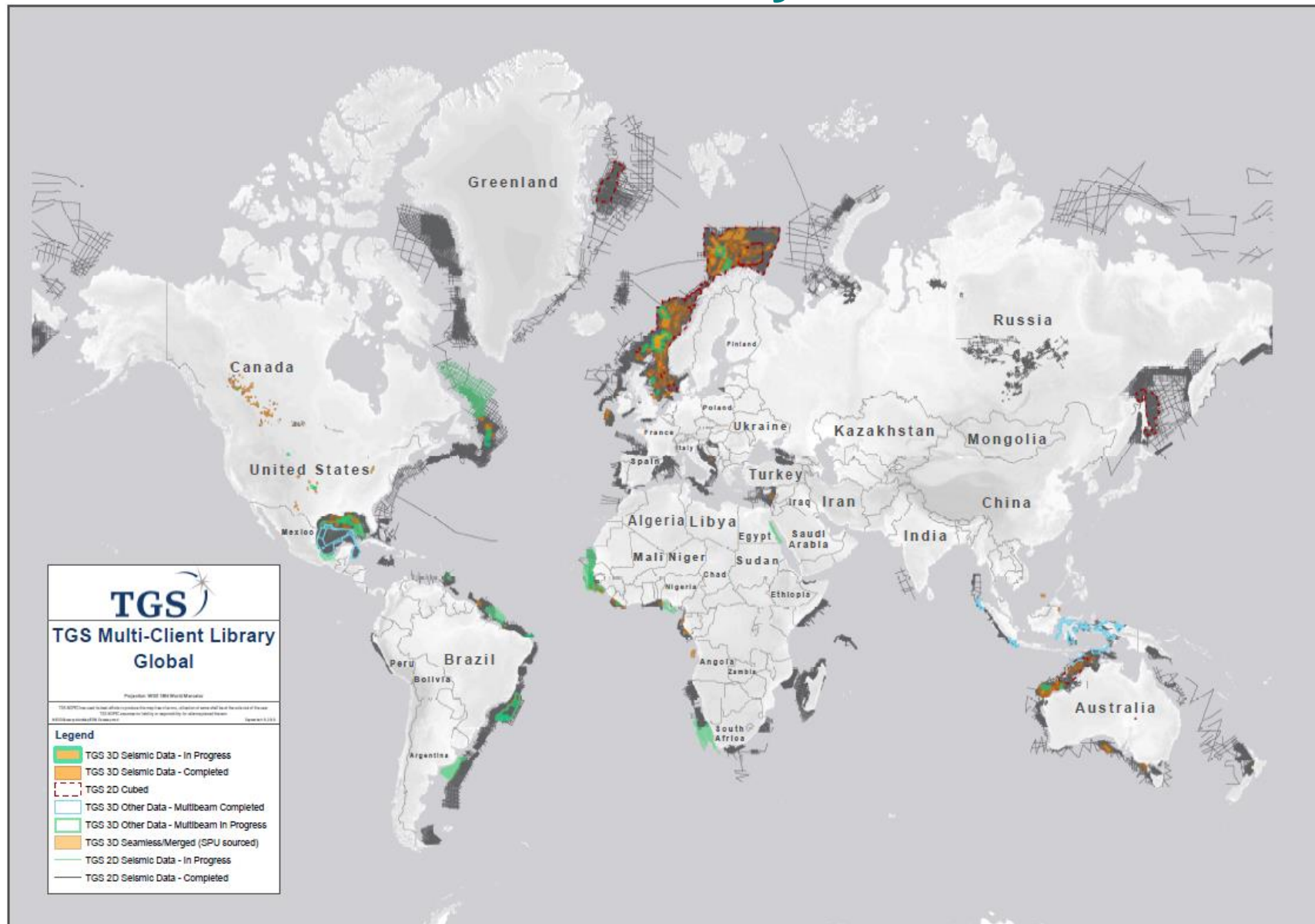


**Karyna Rodriguez / Neil Hodgson**

VP Geosciences

September 2019

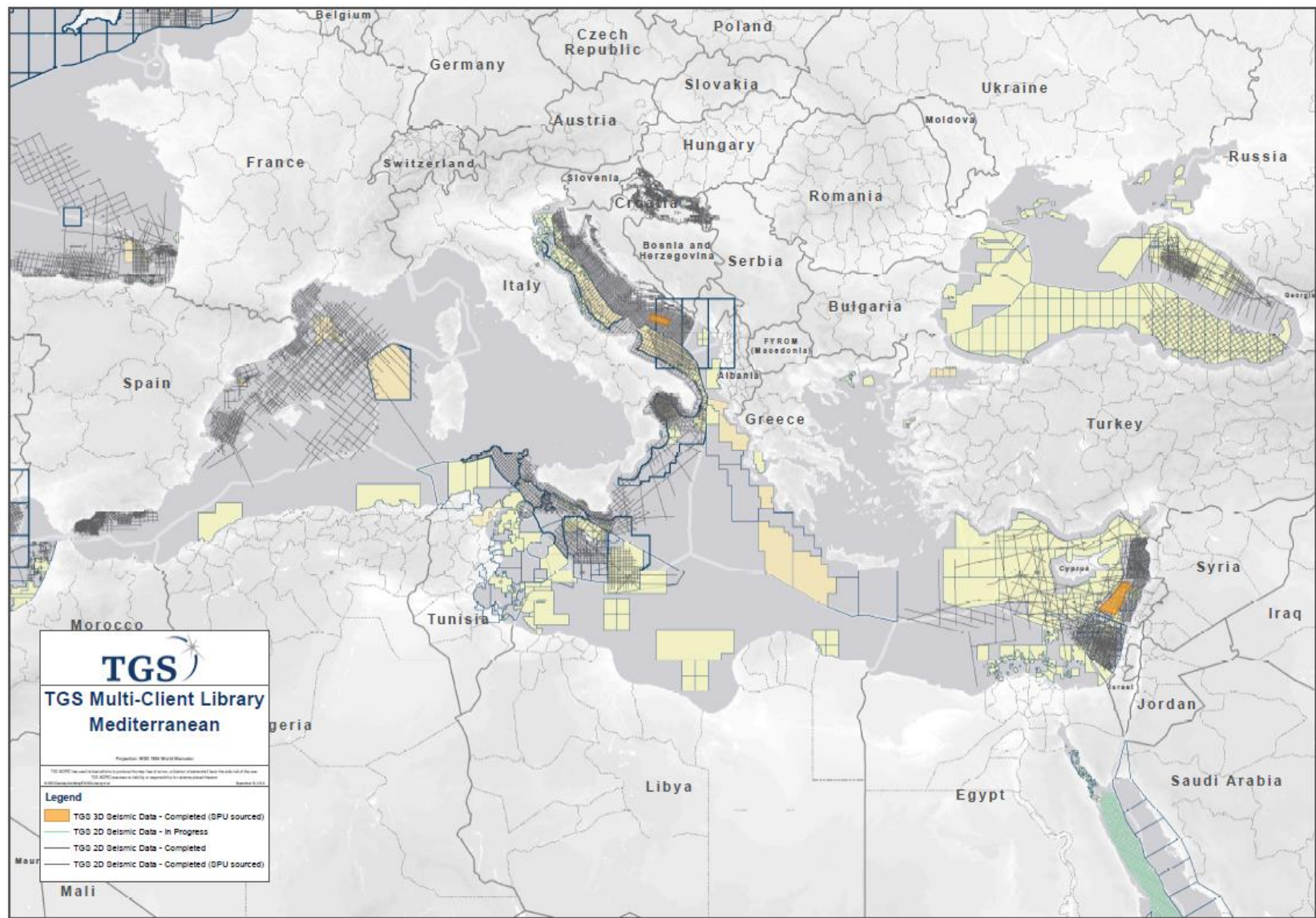
# TGS MC Seismic Data Library



- > 6 MM km of 2D Seismic Data

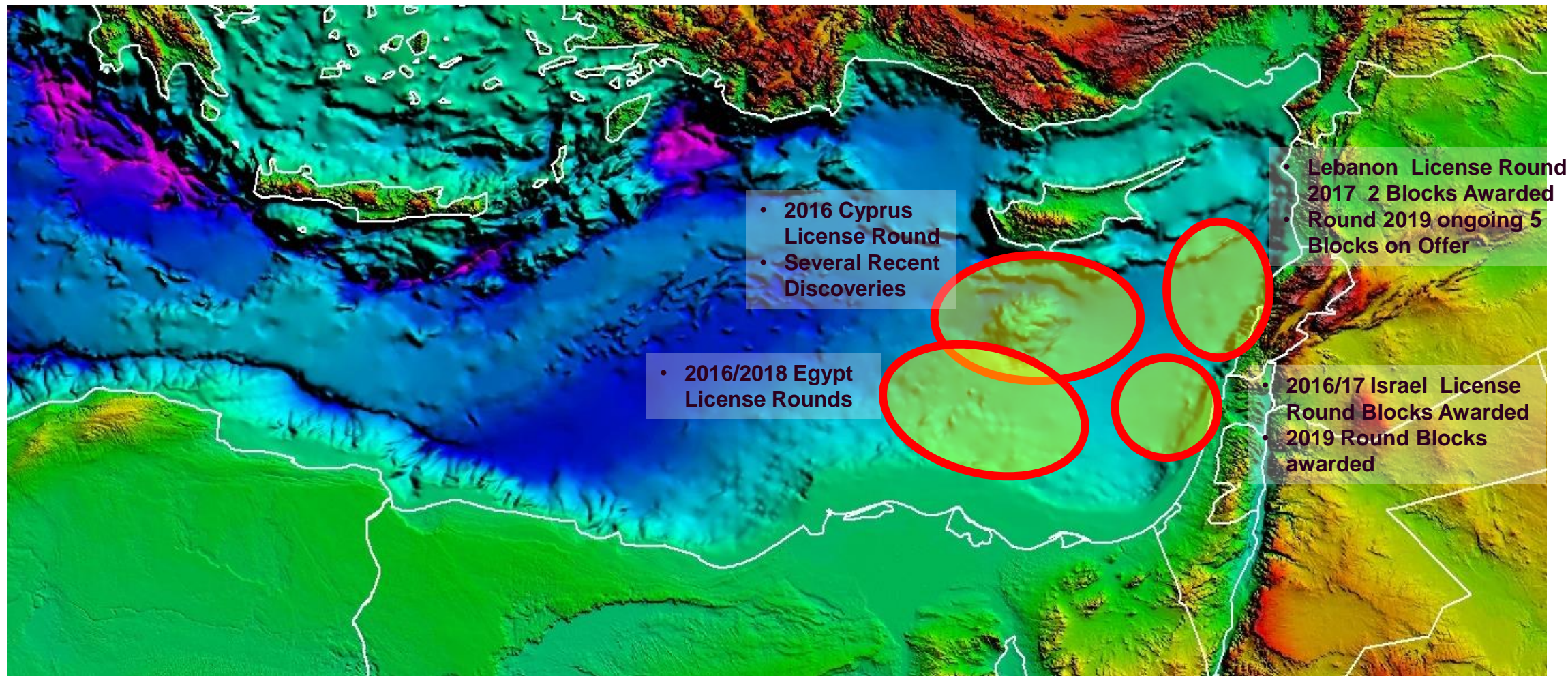


# MC Seismic Data Library in Mediterranean



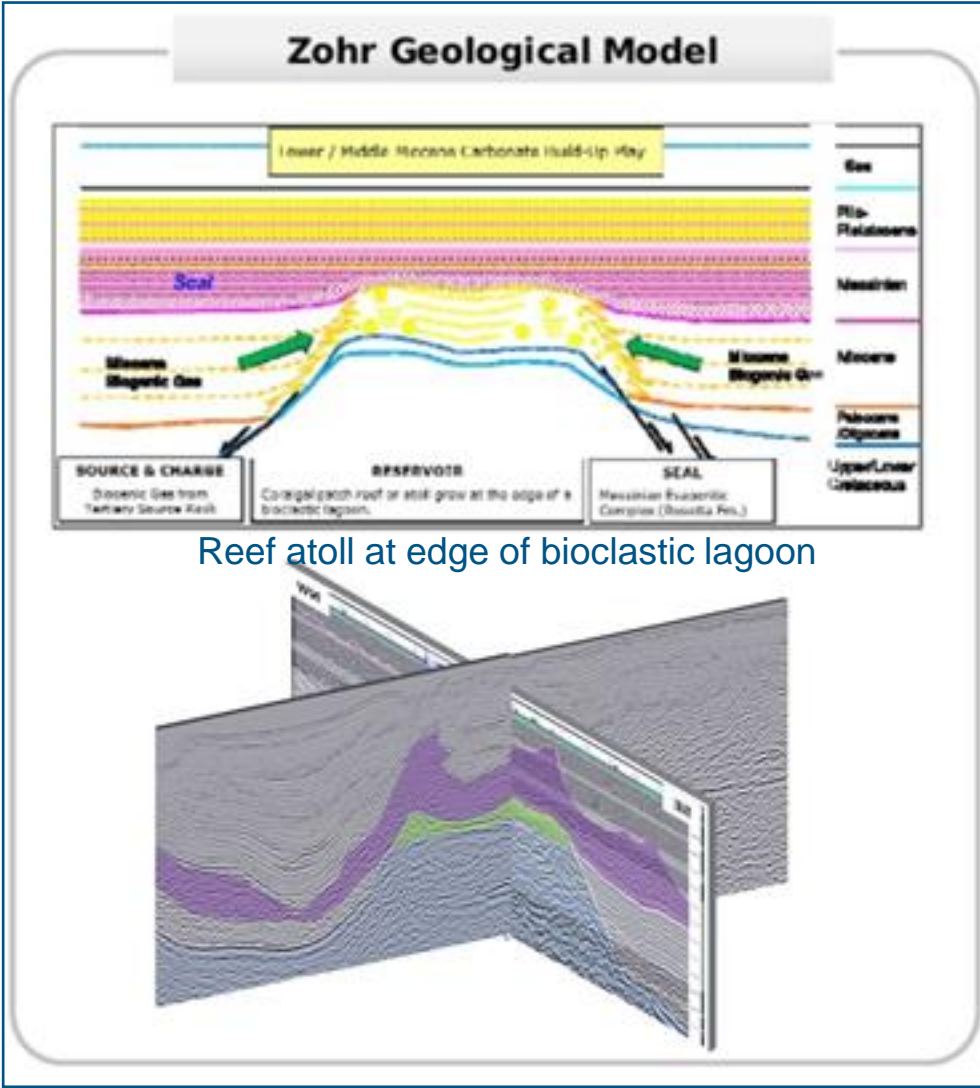
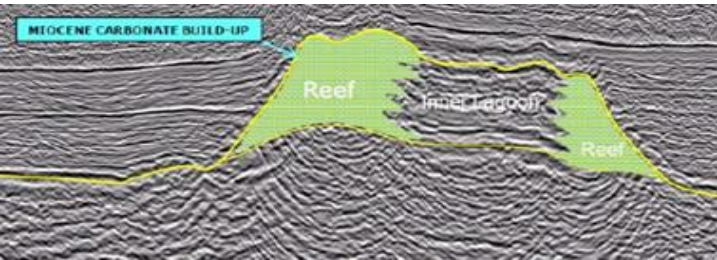


# Eastern Mediterranean Boom of Exploration Activity

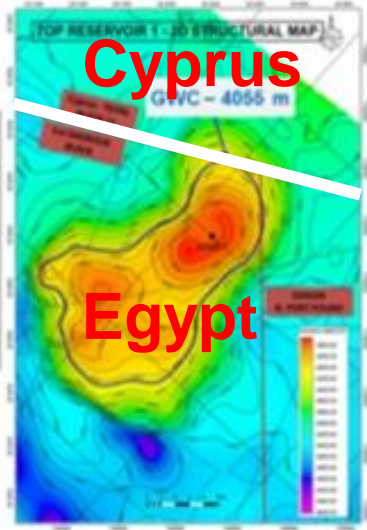
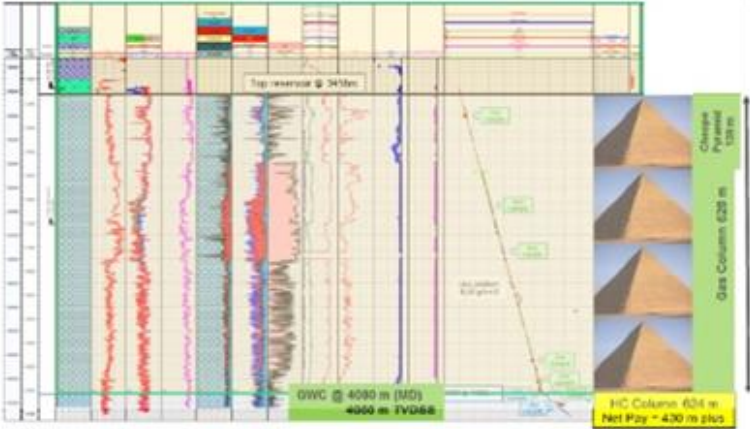




# Zohr Discovery August 2015 / Started-up December 2017



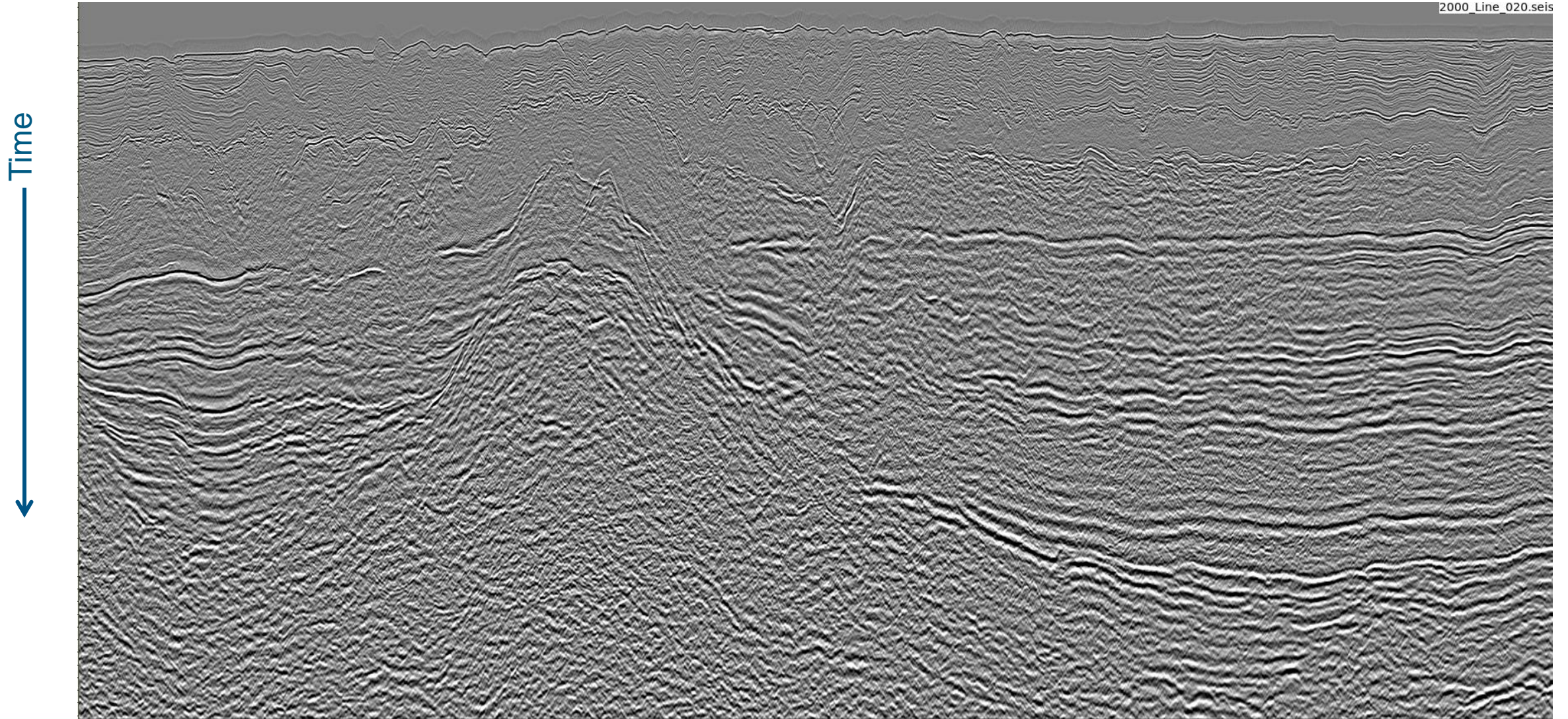
Zohr 1 : 624m column 430m net pay  
Zohr 2X : 455m column 305 m net pay





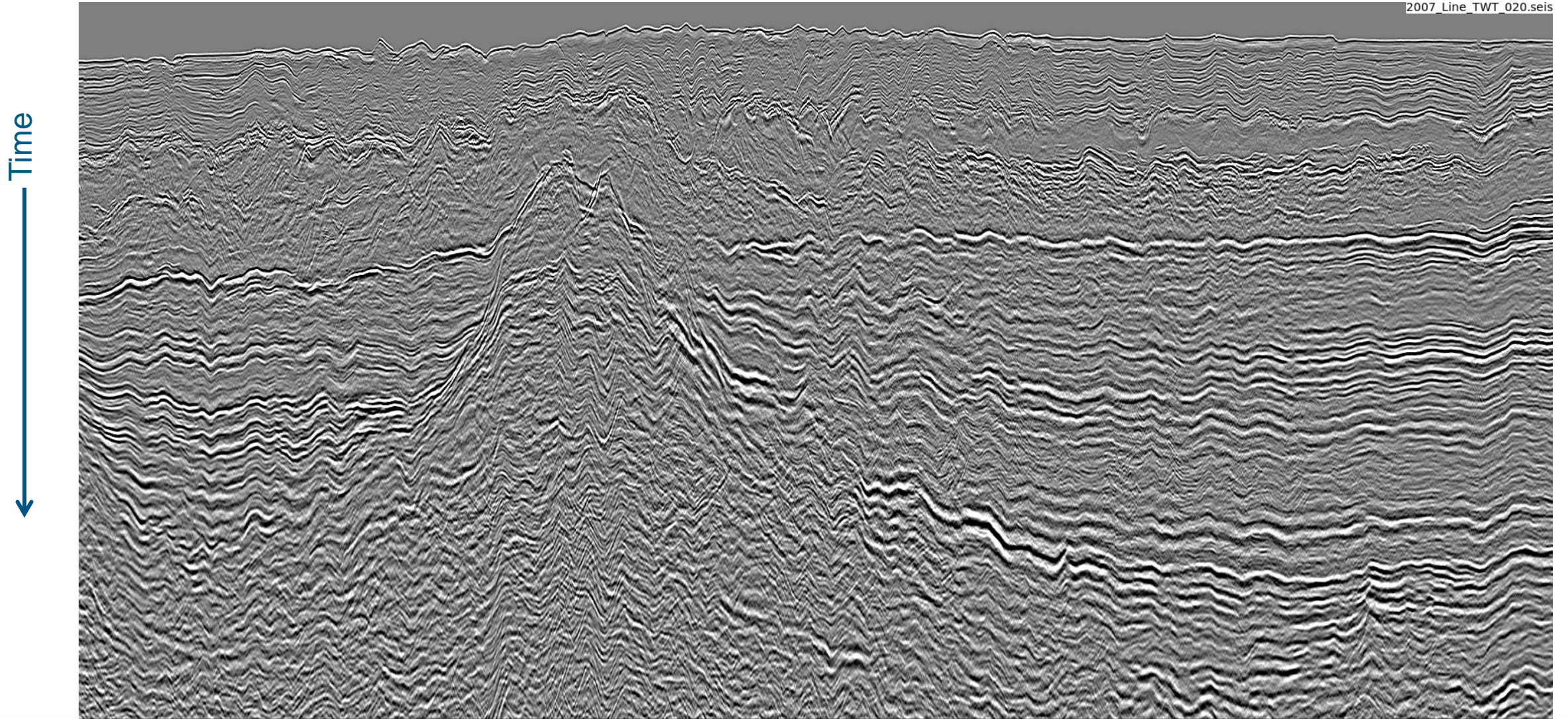
# Eastern Mediterranean Seismic Data Reprocessing

## Original



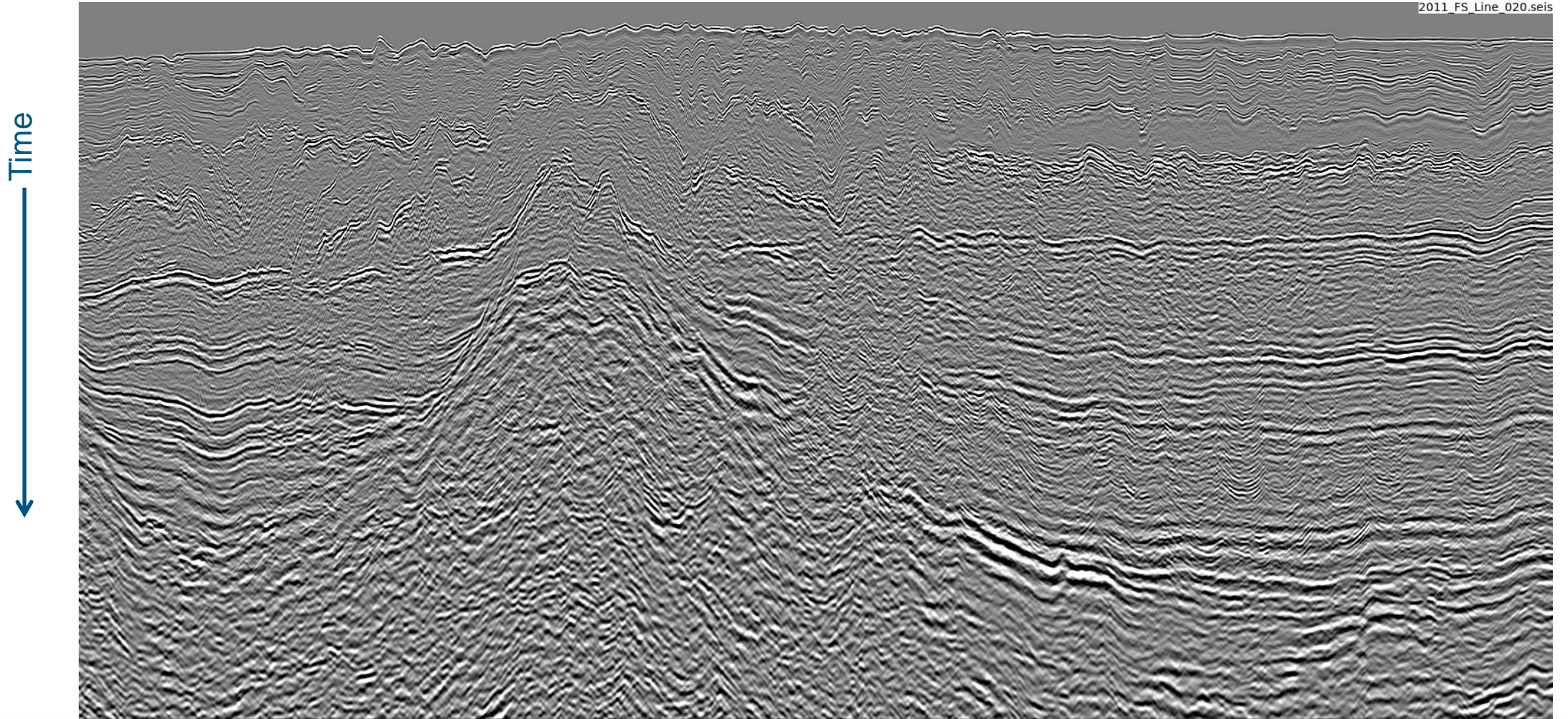


# Eastern Mediterranean Seismic Data Reprocessing 2007 PSDM



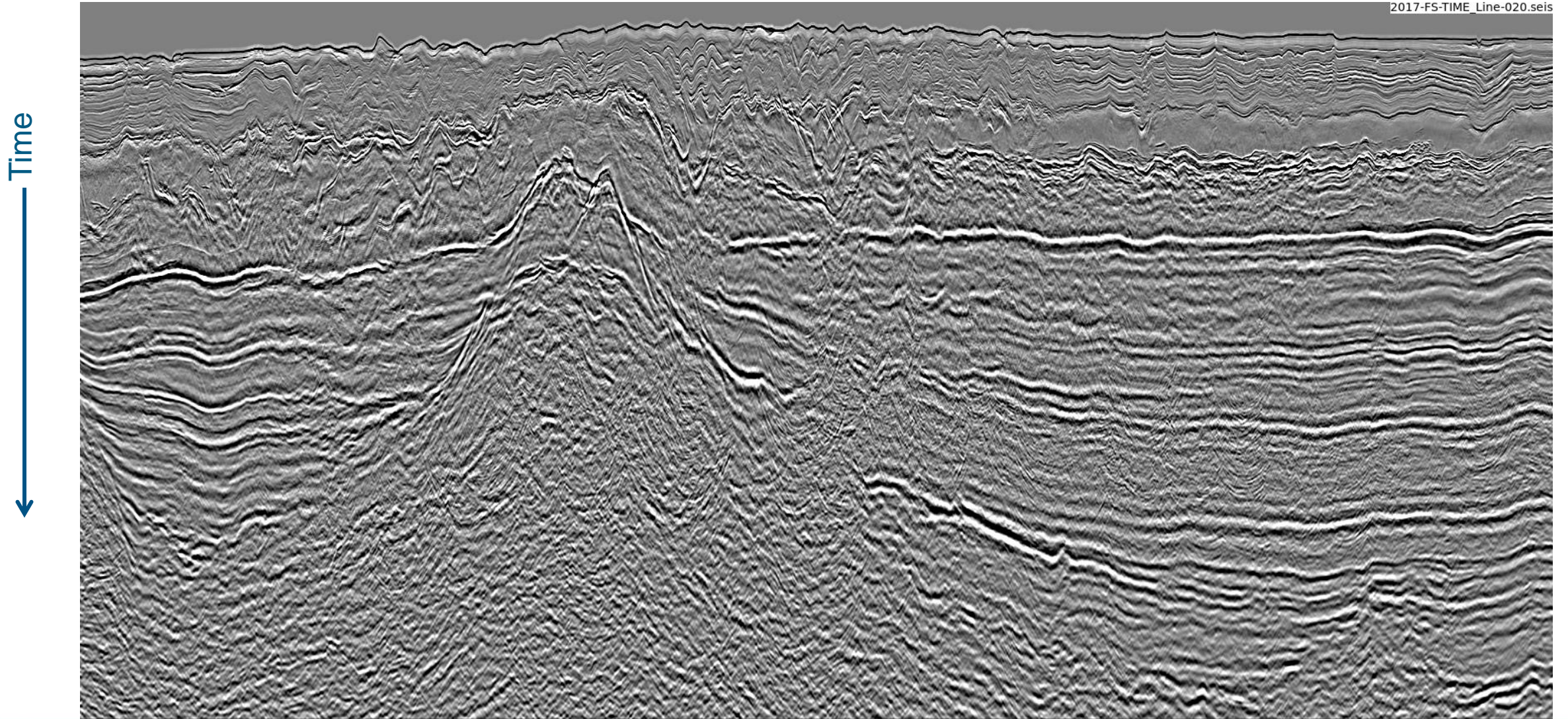


# Eastern Mediterranean Seismic Data Reprocessing 2011 PSTM



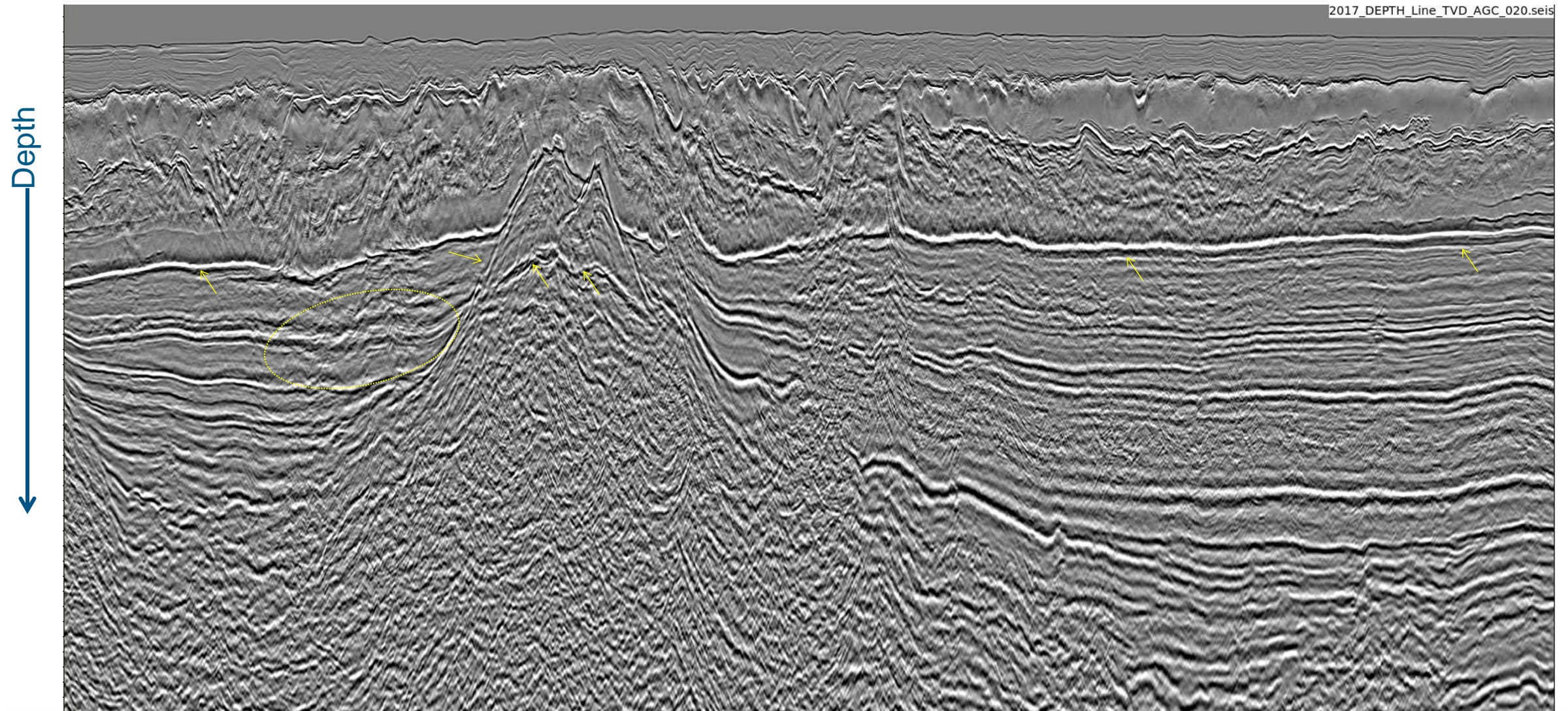


# Eastern Mediterranean Seismic Data Reprocessing 2017 Broadband





# Eastern Mediterranean Seismic Data Reprocessing 2017 PSDM

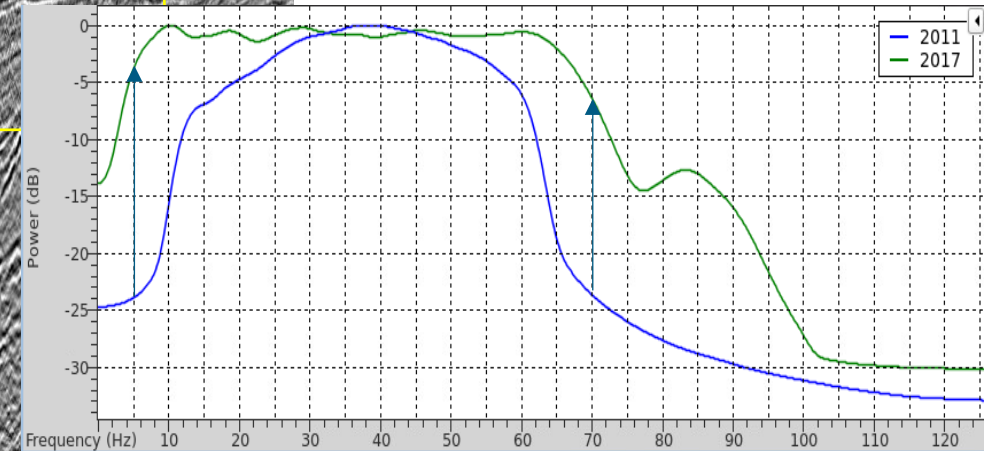
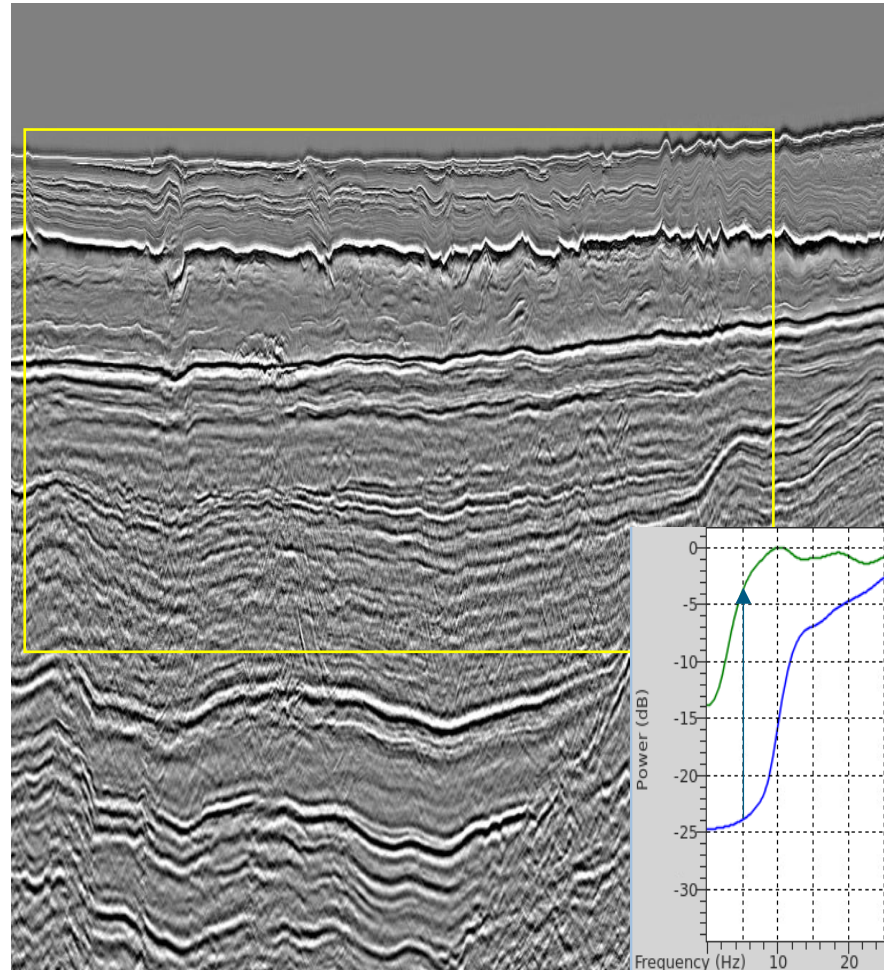
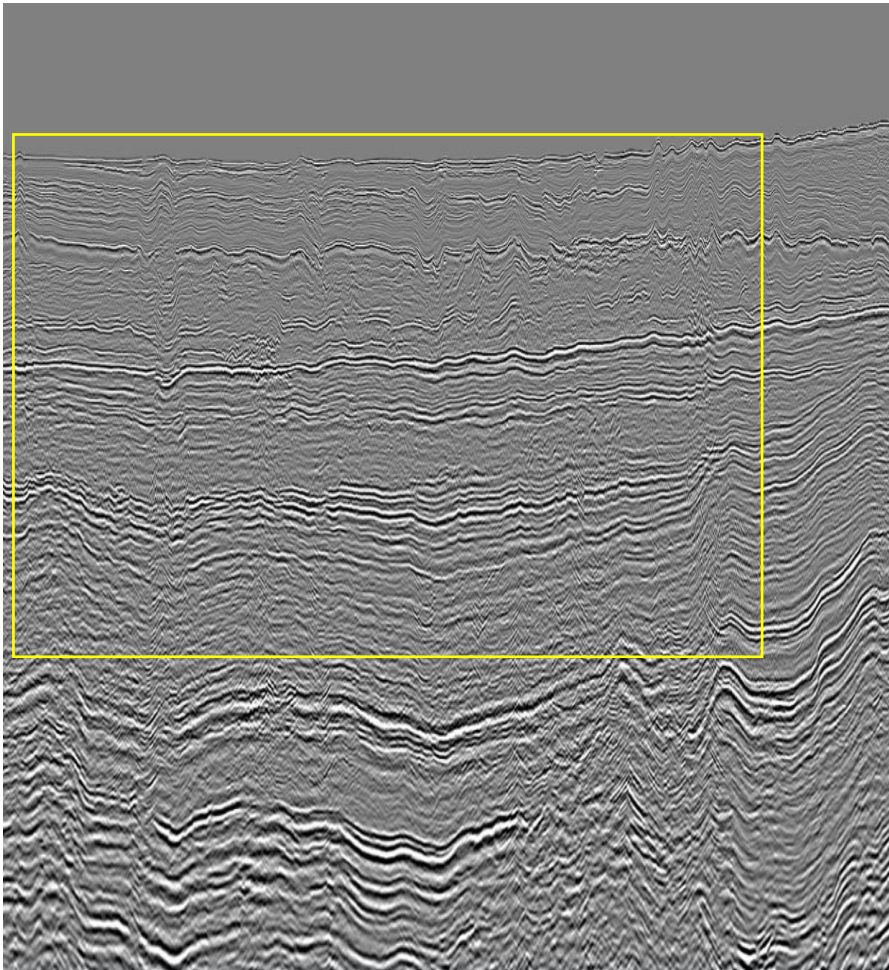




# 2011-2017 bandwidth Comparison

## 2 key results

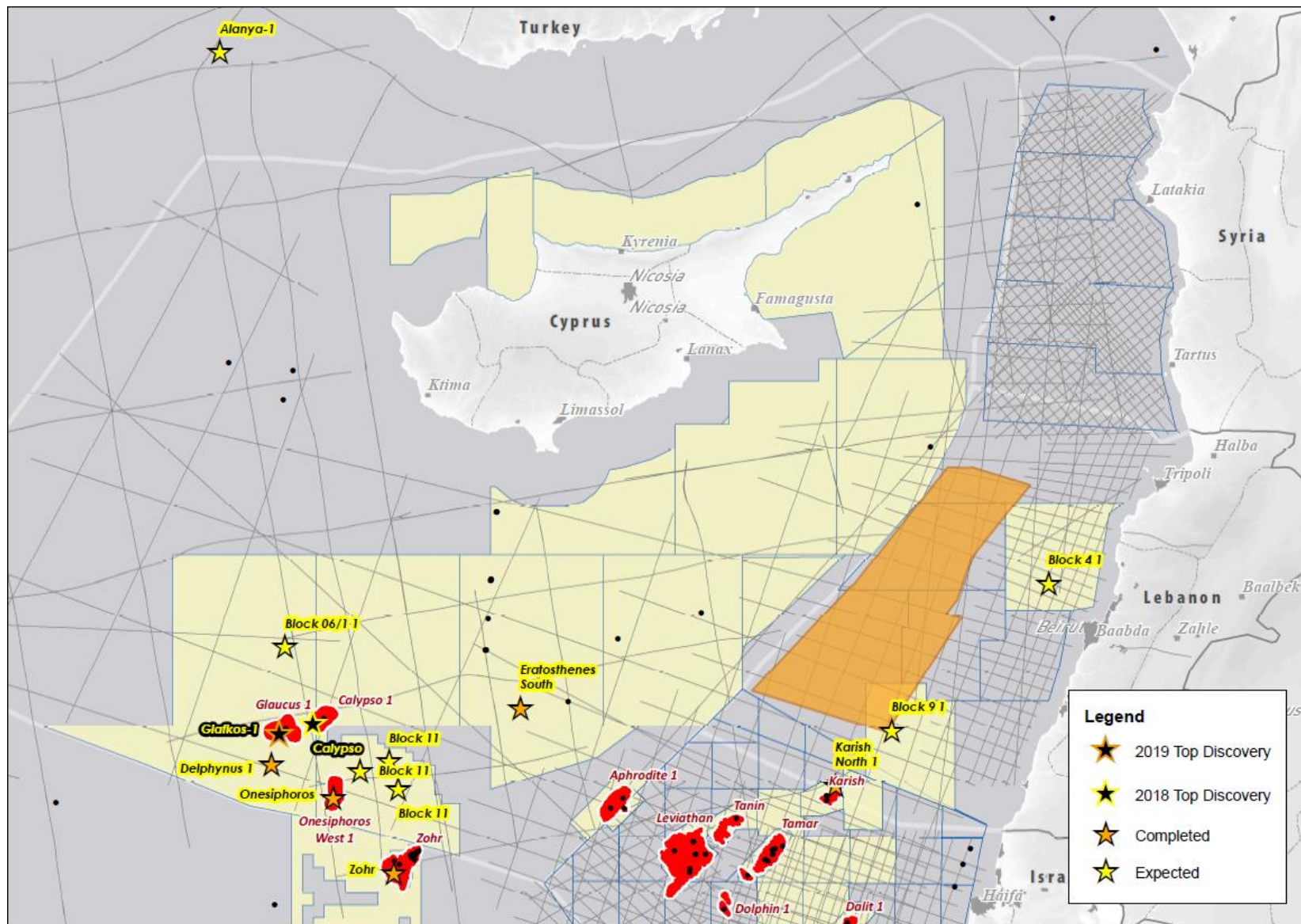
- Identifying Zohr Analogues
- Source Rock Characterization



Deghosting recovers both low and high frequencies



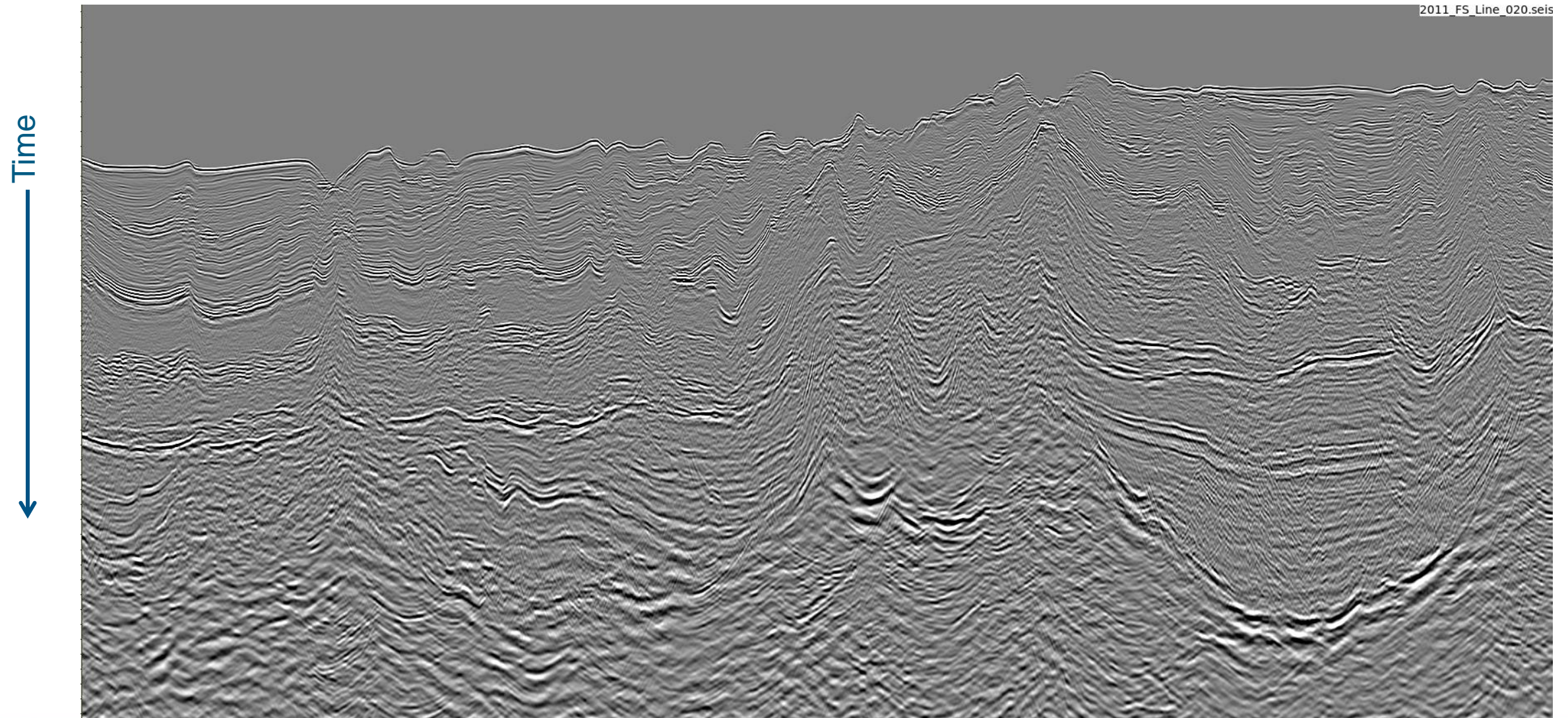
# Identifying and Understanding Zohr Analogues



- Zohr up to 30 TCF
- Onesiphoros and Delphynus smaller sub-commercial discoveries
- Calypso and Glaukos (>6 TCF) amongst largest discoveries 2018/2019

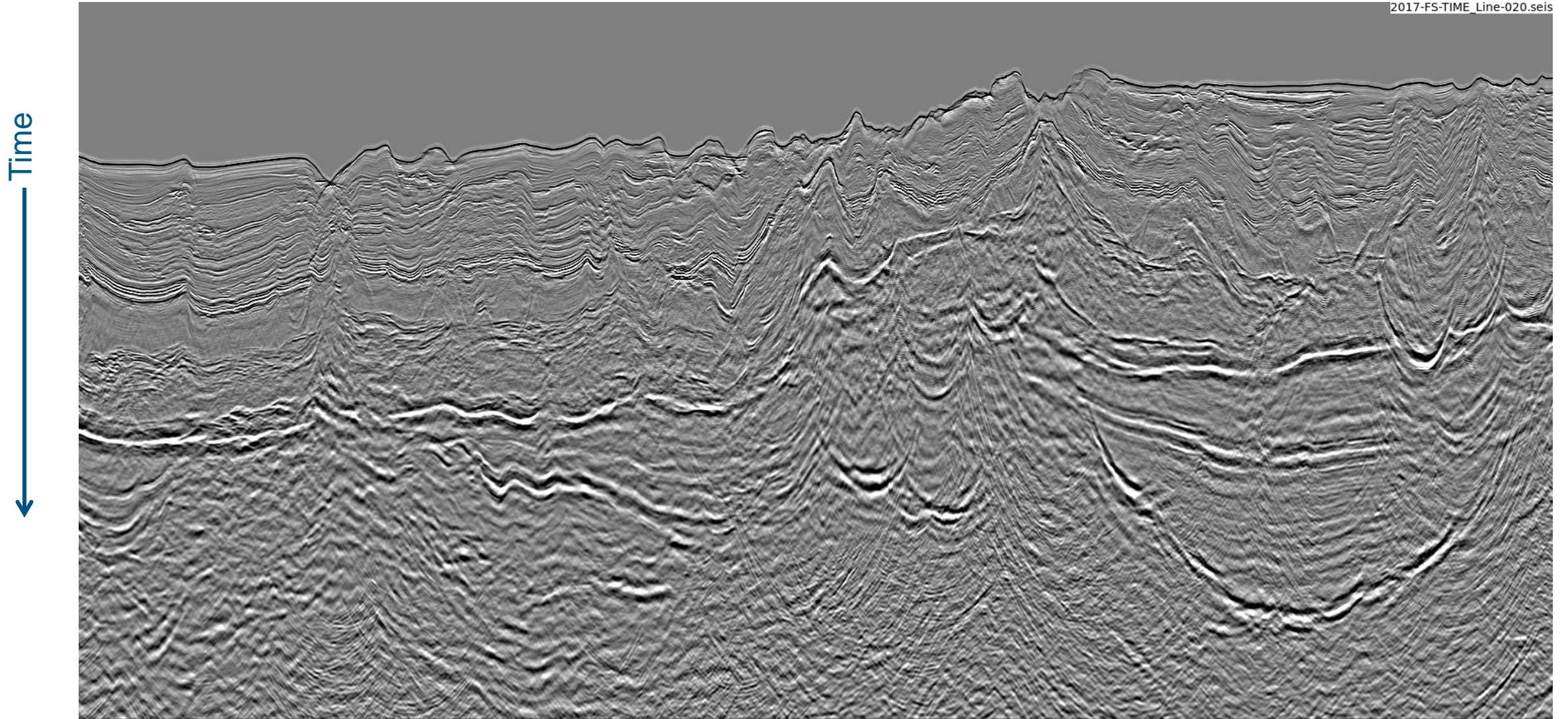


# Delphynus 2011 Image



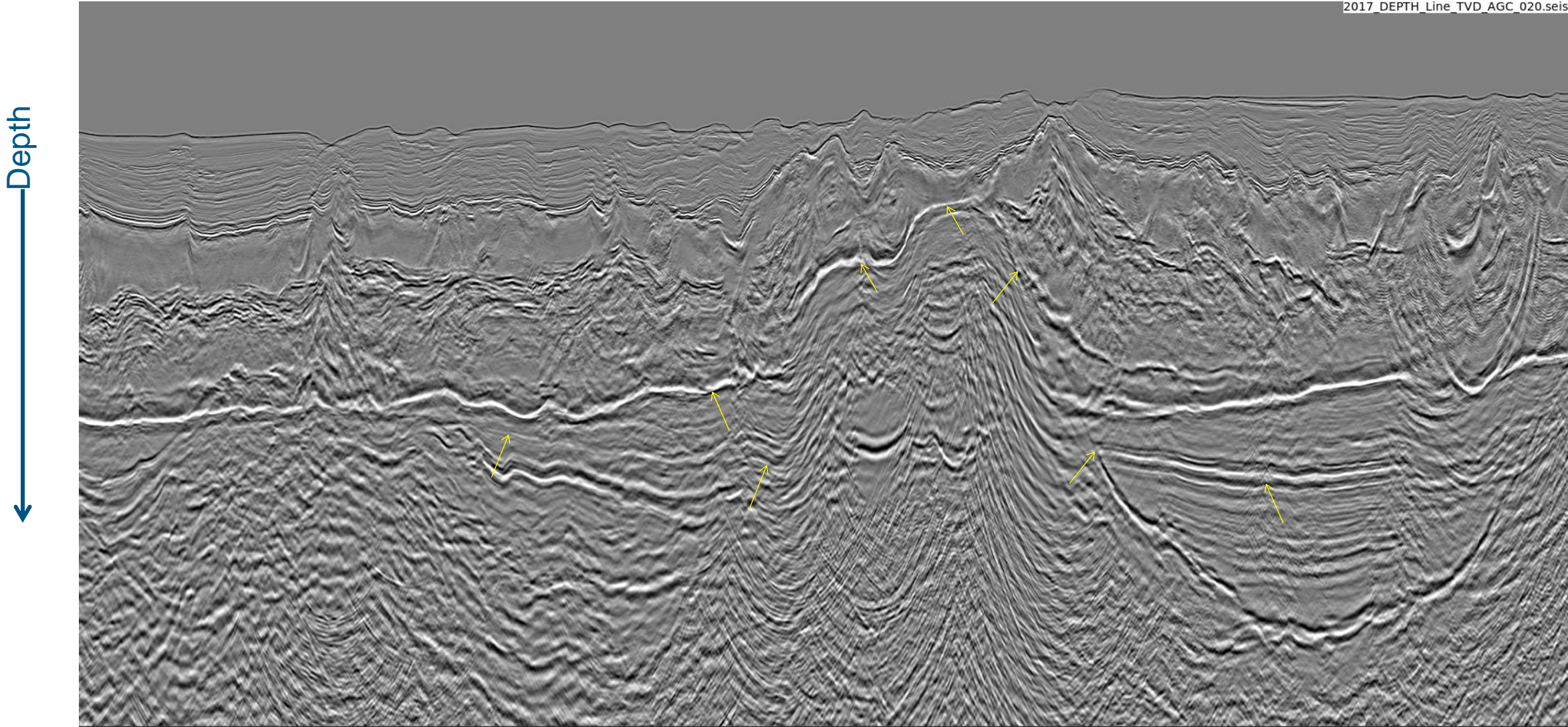


# Delphynus 2017 PSTM Broadband



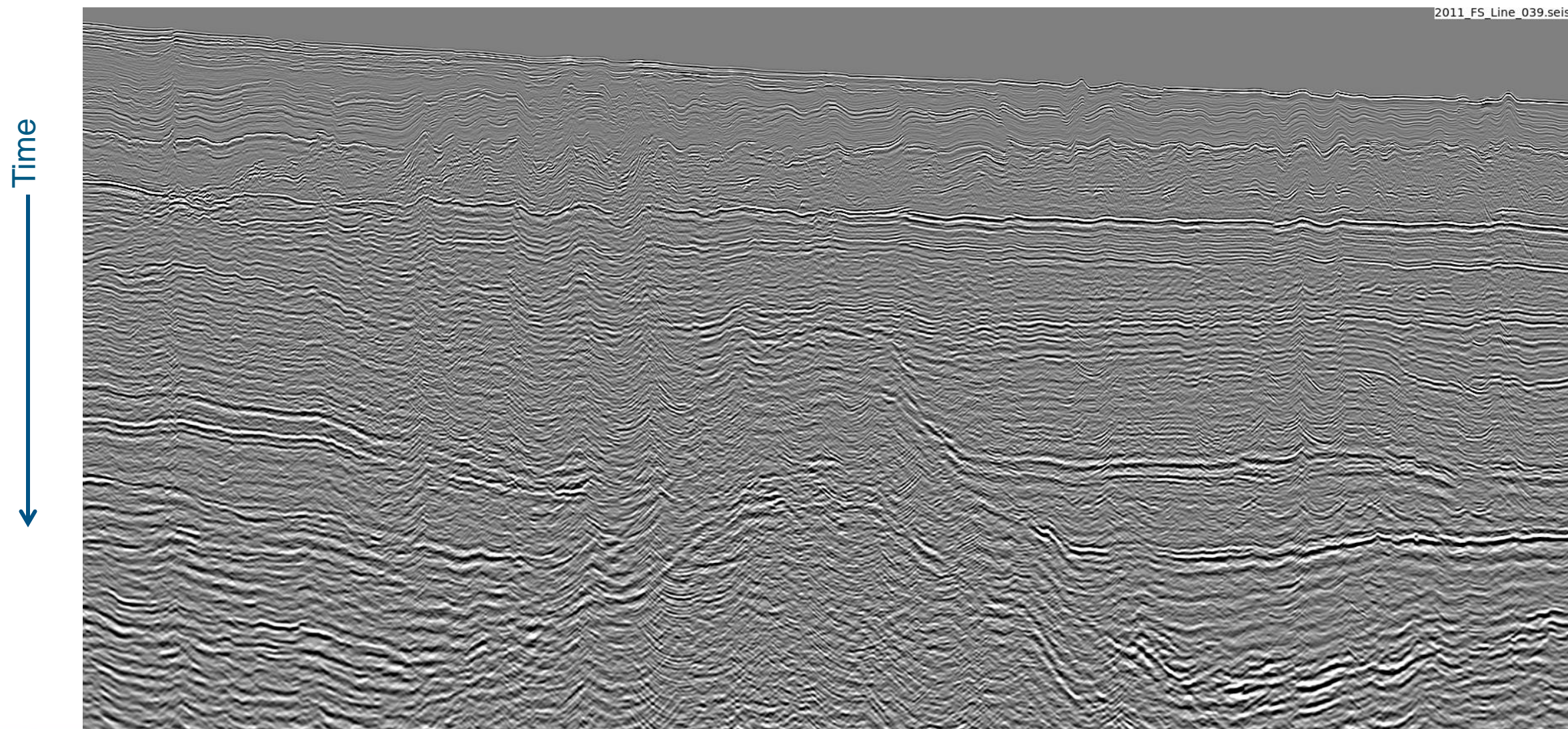


# Delphynus 2017 PSDM Improved Image



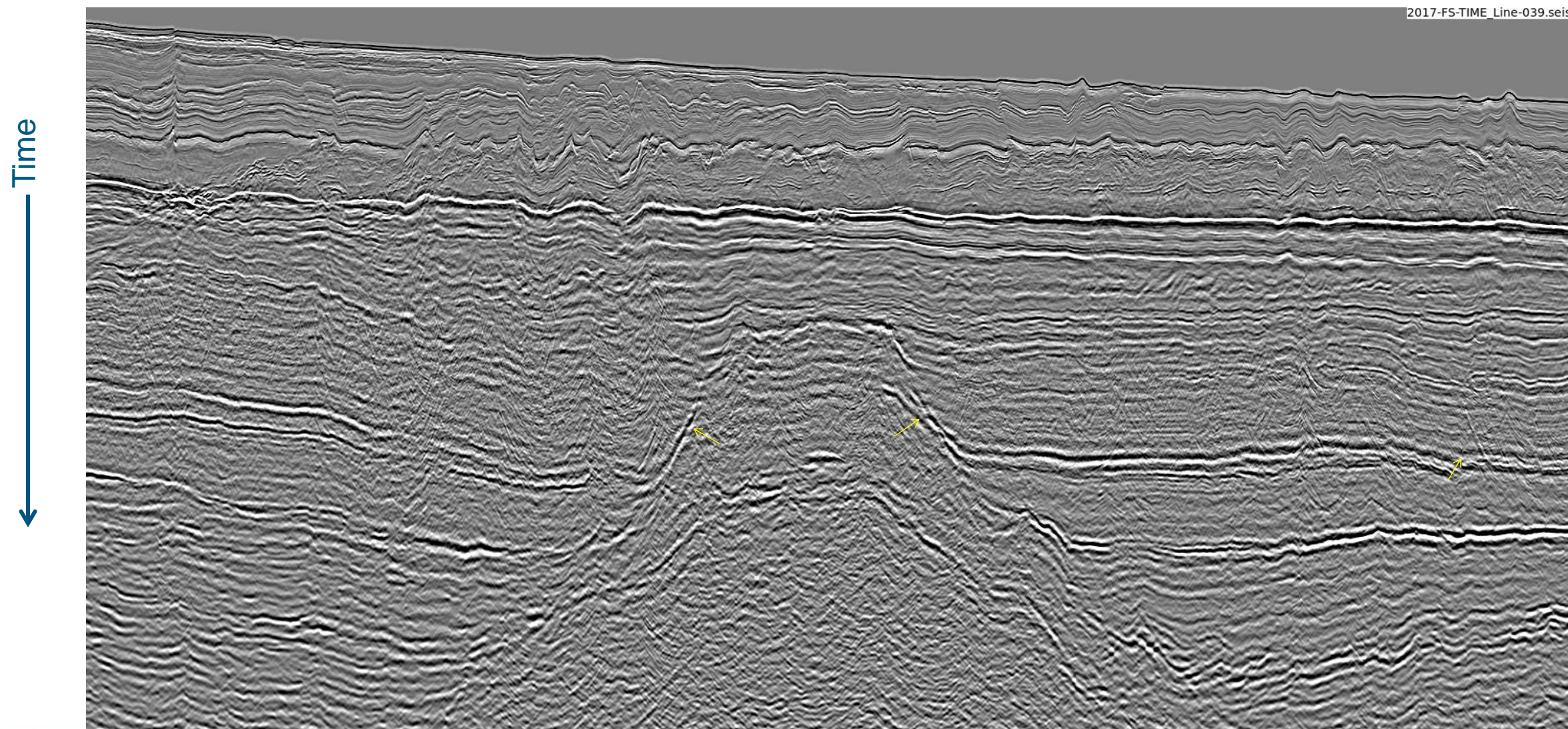


# Identifying Undrilled Zohr Analogues 2011 PSTM



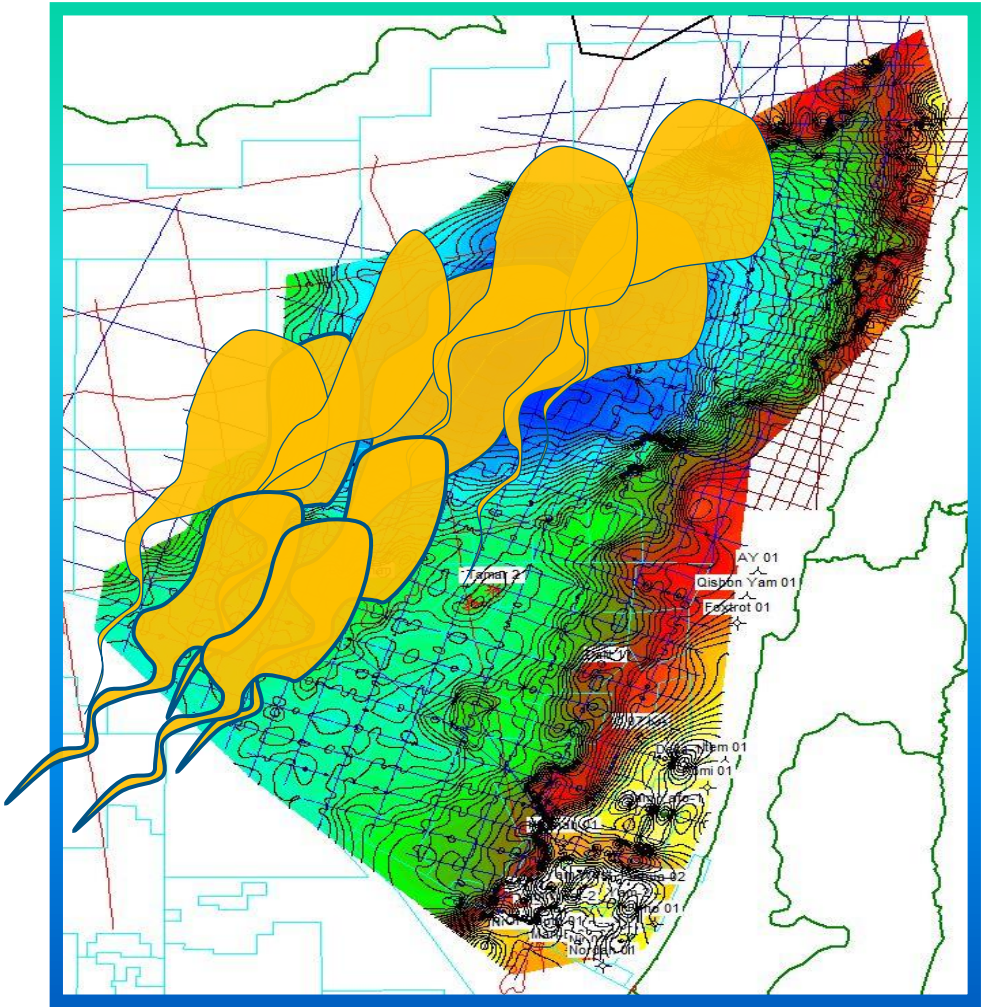
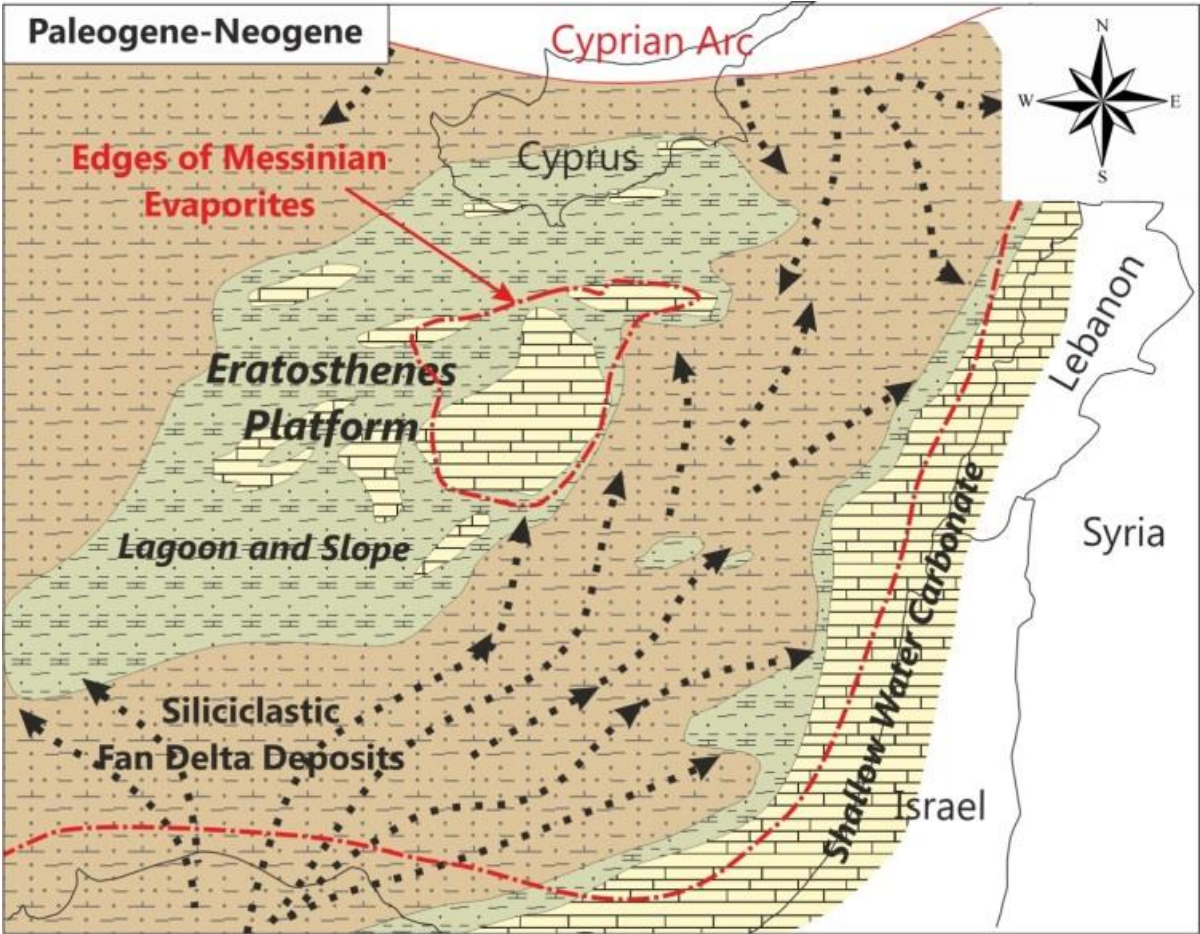


# Identifying Undrilled Zohr Analogues 2017 PSTM





# Erastotherenes Platform Control on Sand Deposition





# South Levant Discoveries > Biogenic Gas

## Tanin

2011 Gas Discovery,  
130ft net pay  
Lower Miocene 'Tamar' sands.  
Reserves: Mean 1.1 TCF

## Aphrodite

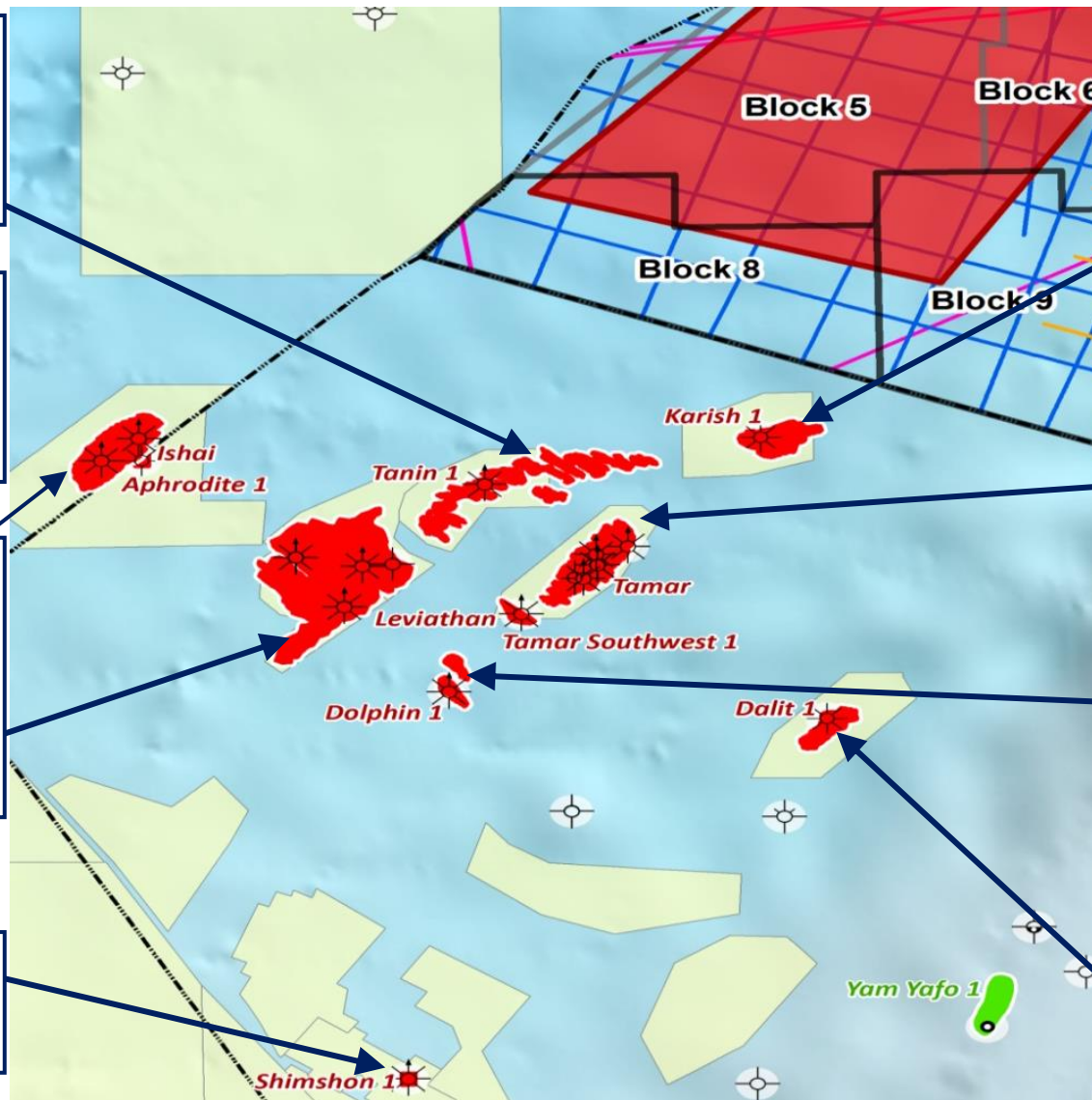
2011 Gas Discovery  
310ft net pay  
Miocene sands  
Reserves: Mean 7 TCF

## Leviathan

2010 Gas Discovery  
220ft net pay  
Lower Miocene sands  
Reserves: Mean 17 TCF.  
**\*Reported deeper thermogenic  
gas zone at 21,000ft**

## Shimsom

2012 Gas Discovery  
Reserves: Mean 1 TCF.



**Q: Where is the thermogenic light oil in Karish coming from?**

## Karish

2013 Gas Discovery  
180ft net Lower Miocene sands  
Reserves mean 2-3 TCF  
**\* Producing thermogenic light oil**

## Tamar

2009 Gas Discovery **2012 onstream.**  
460ft net Mid- Lower Miocene sands  
Reserves Mean 9 TCF

## Dolphin

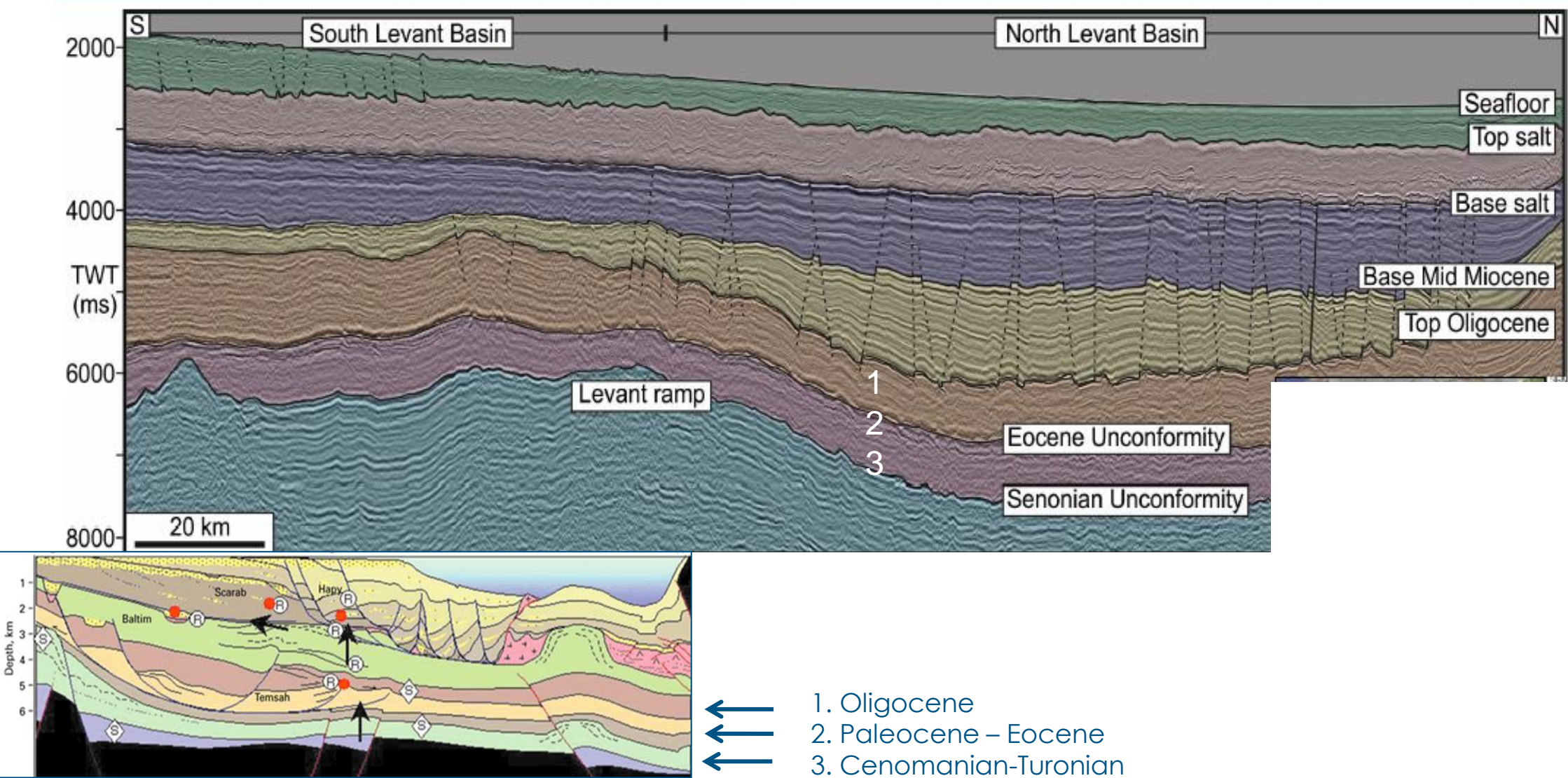
2011 Gas discovery  
'Tamar' sands  
Reserves: Mean ca 0.5 TCF

## Dalit

2009 Gas Discovery  
Lower Miocene Sands  
Reserves: Mean 0.5 TCF

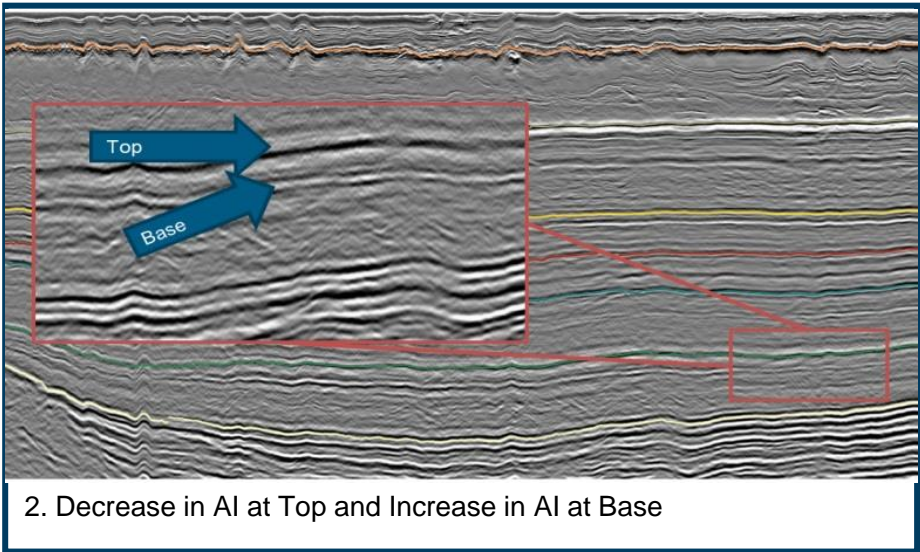
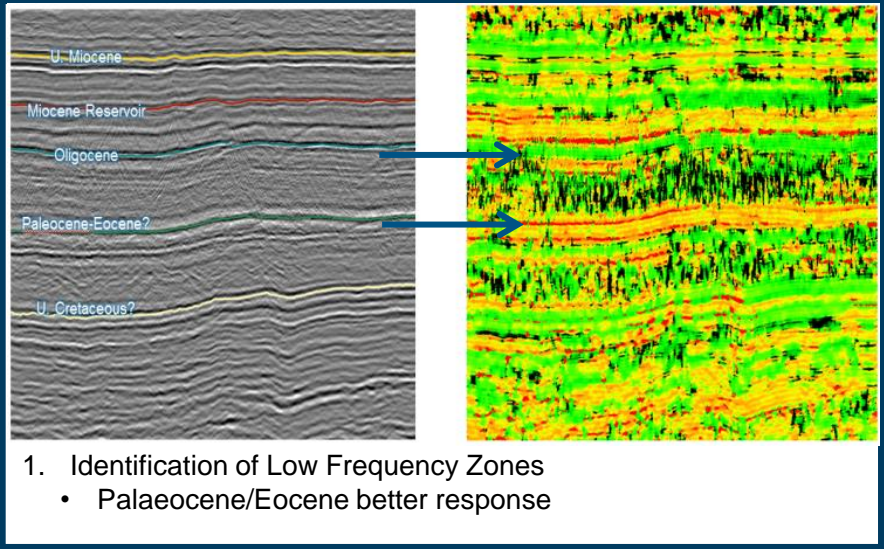
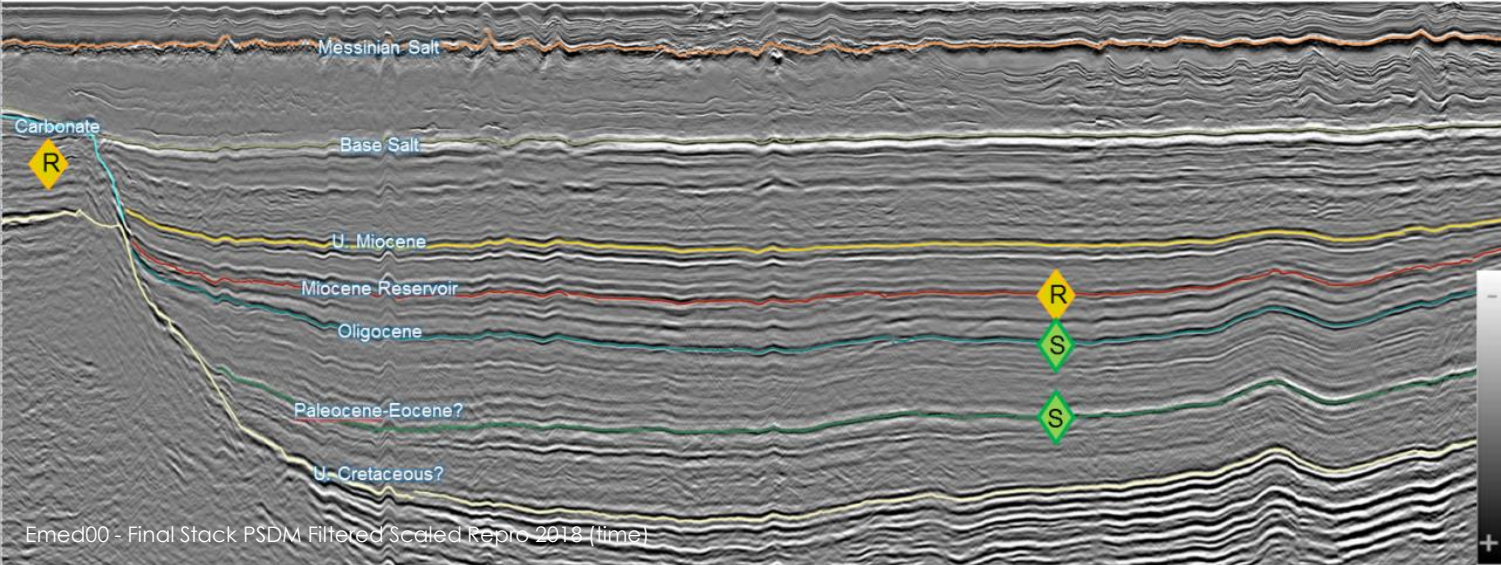


# South Levant to North Levant Basin Correlation

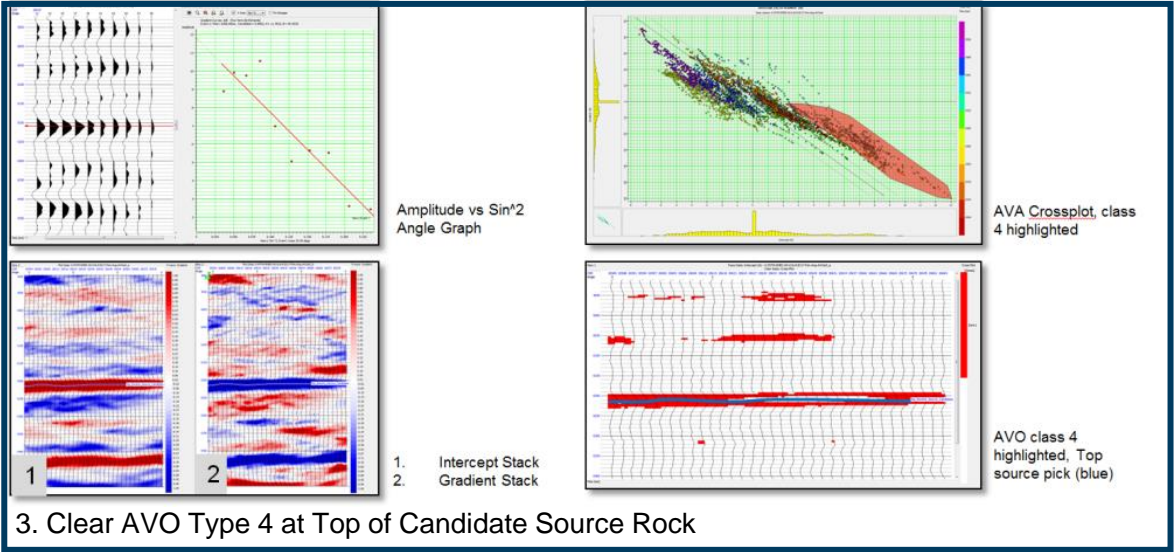




# Offshore Lebanon Source Rock Characterization

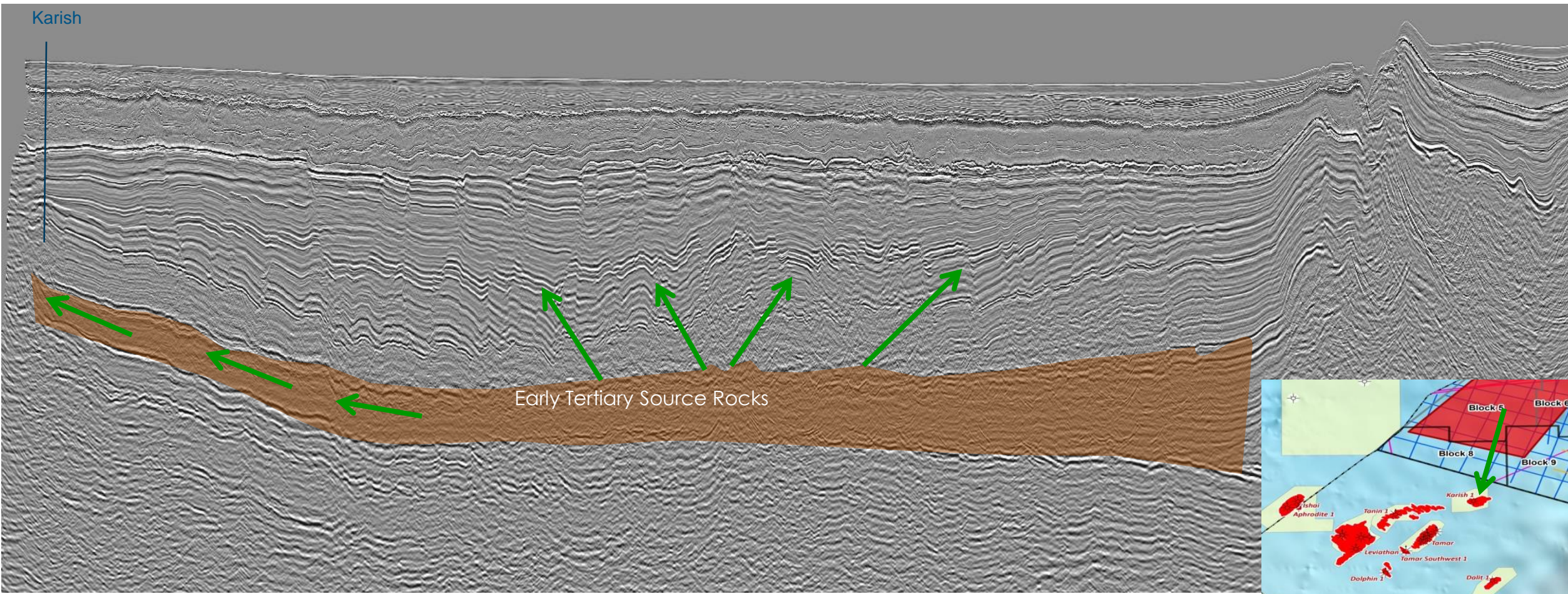


Additional criteria tests carried out on Paleocene/Eocene candidate source rock:  
**Criteria for good quality source rock met**





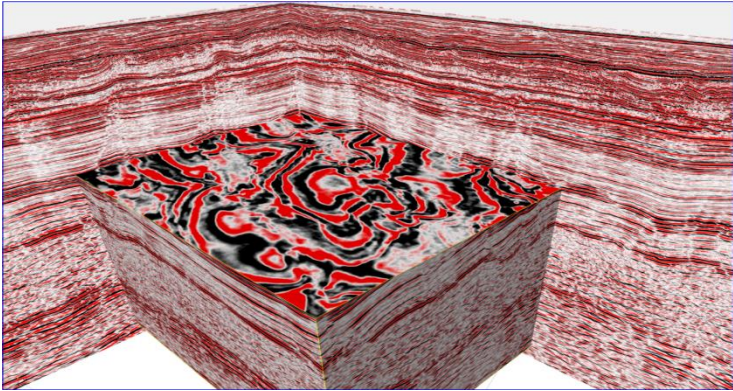
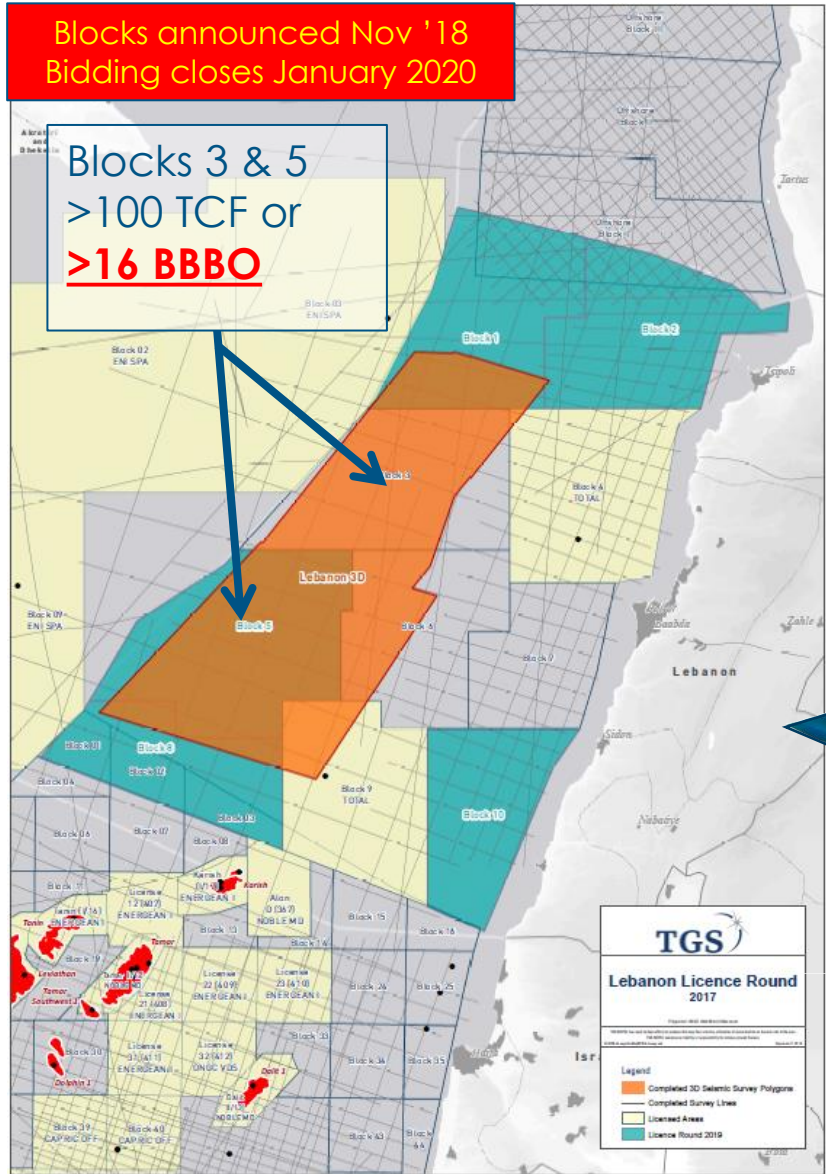
# Karish Oil from North Levant Source Rock Kitchen



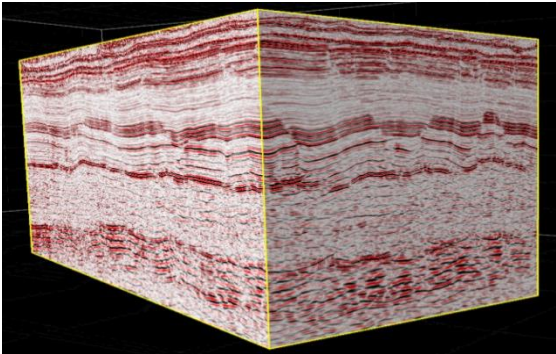
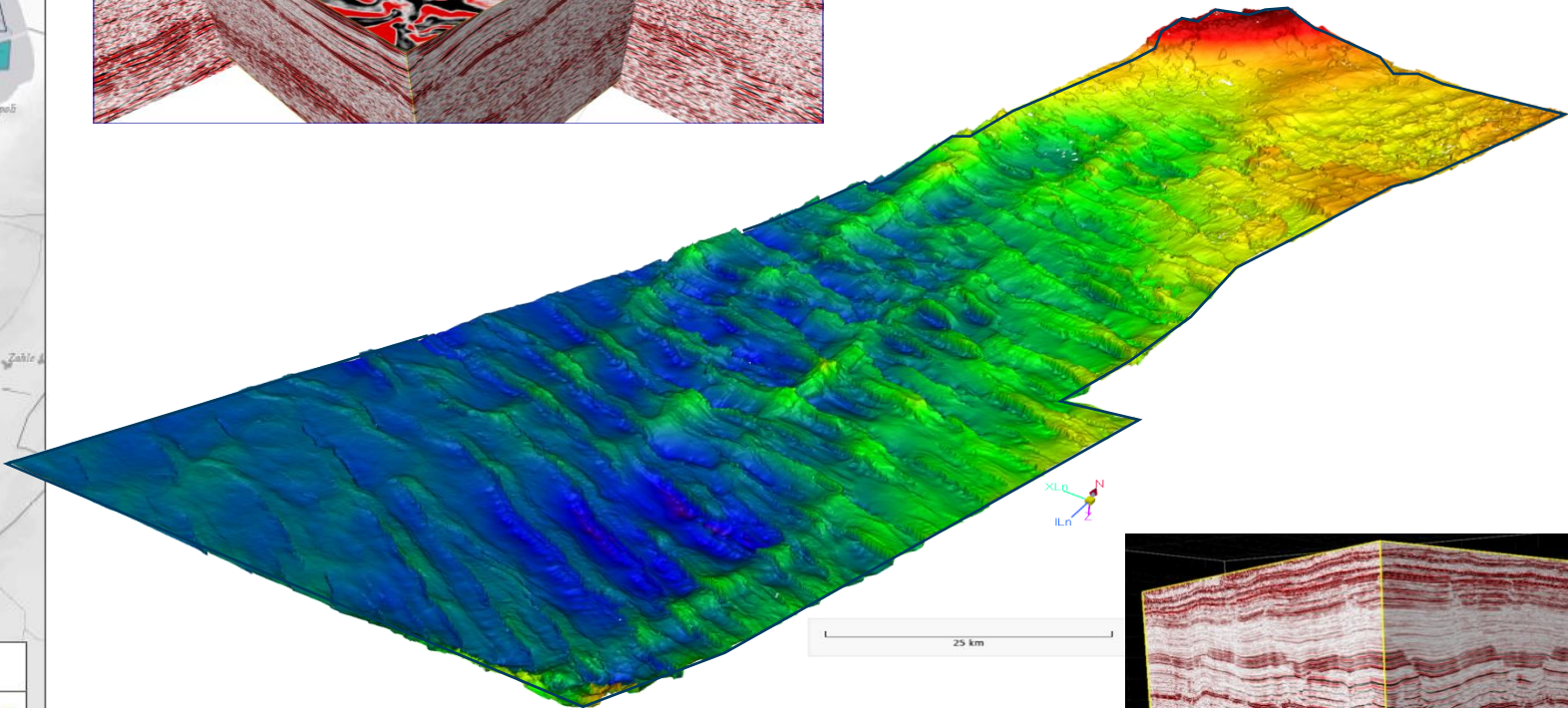
- Long distance oil migration from Oligocene source kitchen in North Levant Basin explains light oil in Karish
- Karish is the South Levant Field nearest the North Levant oil kitchen



# Lebanon Licence Round



Objective in Tamar thickens up to 1 km thick reservoir prone sequences in the North Levant Basin, with god quality sandstones coming from the Nile



Individual structures are as big as Tamar to south. Yet they are less faulted. These structures are arranged along fold axes – once de-risked, multiple repeat success potential

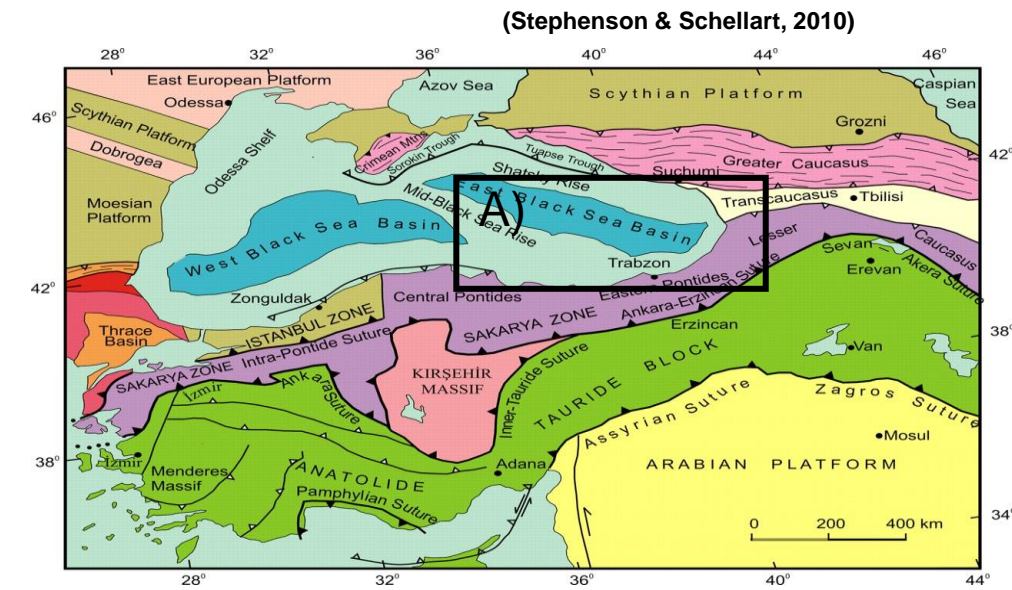
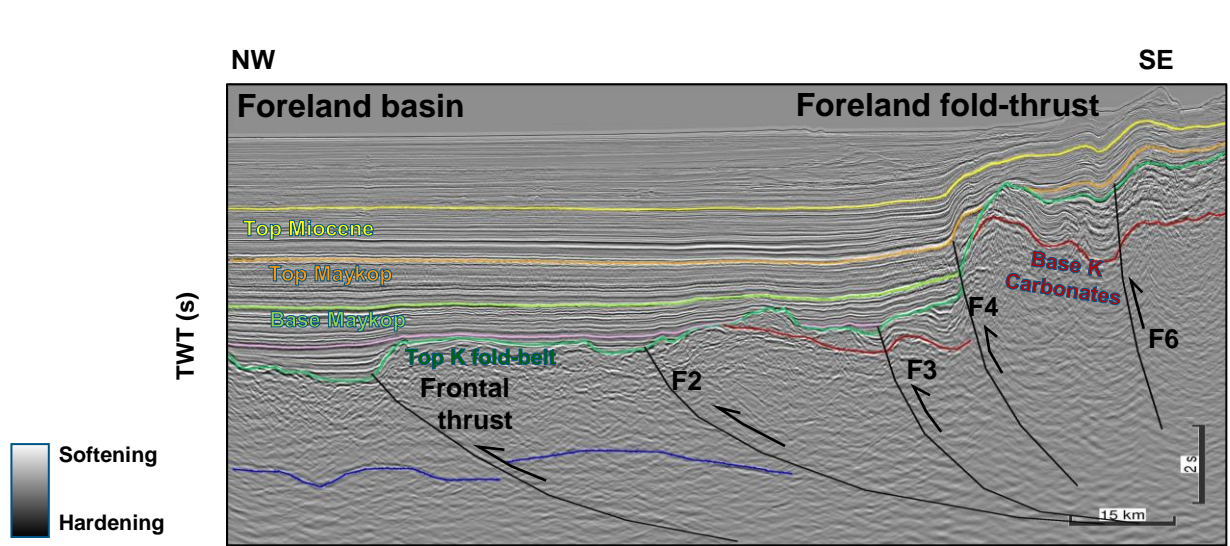




**Staying East but not so Mediterranean....**



# Turkish Eastern Black Sea Fold-Thrust & Foreland Basin

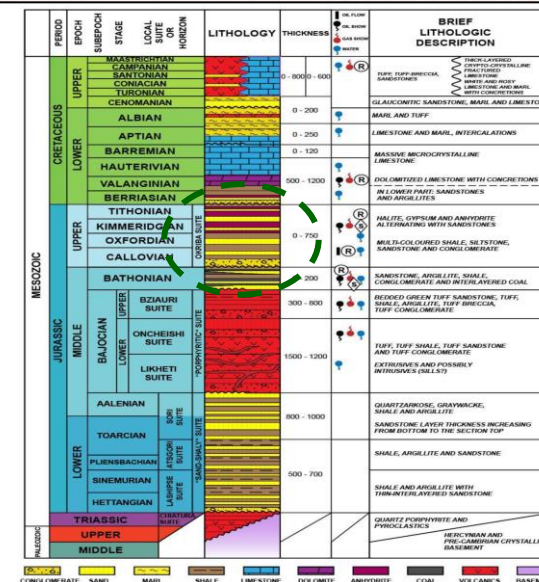
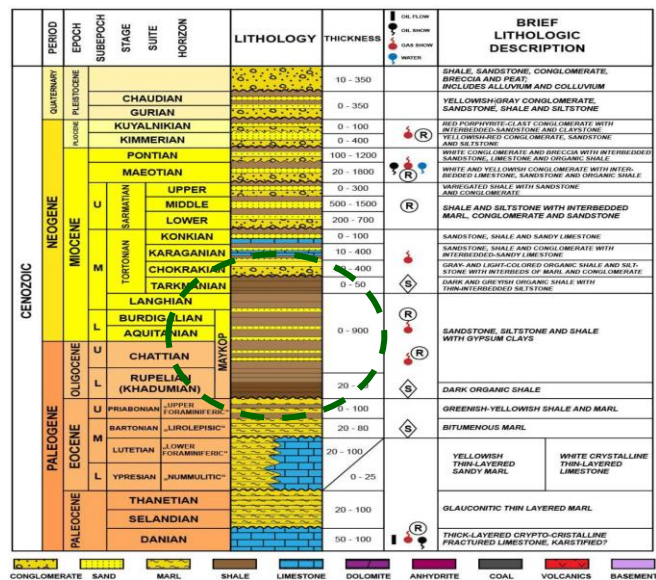
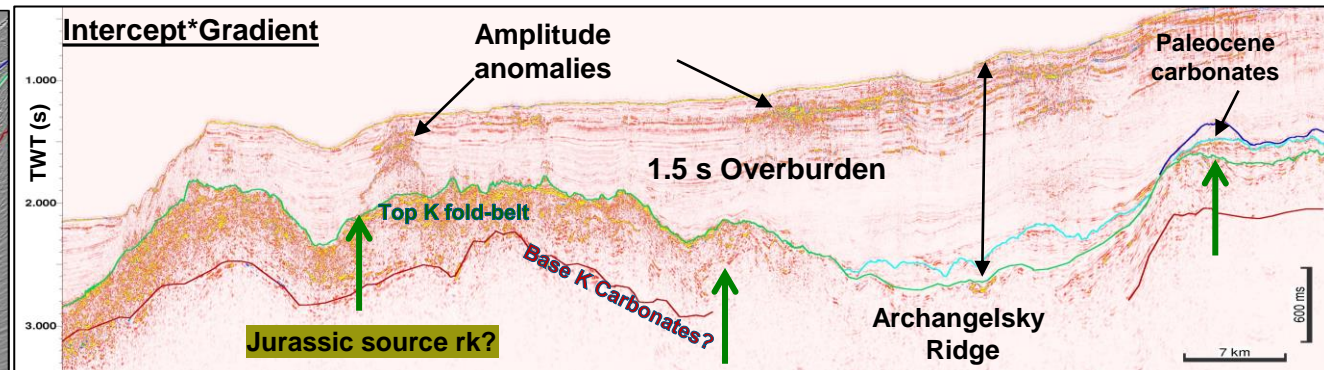
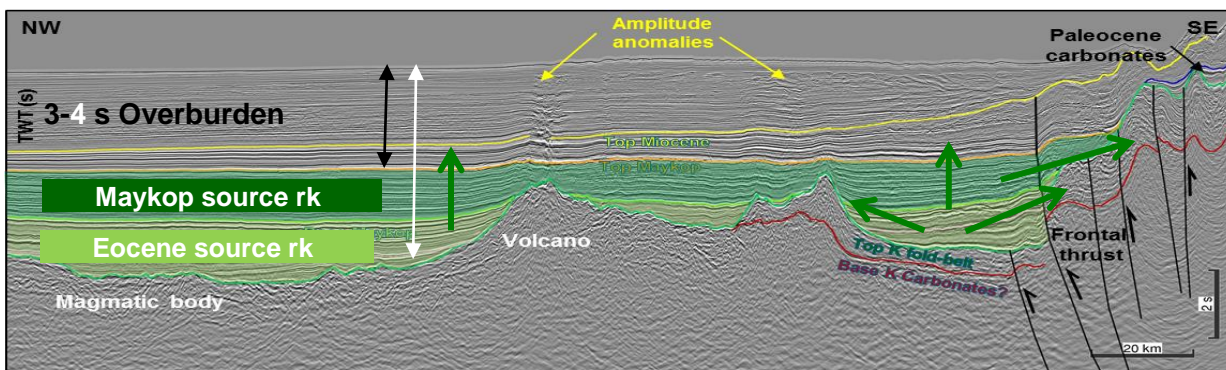


- NE-SW fold-thrust belt developed in the offshore Turkish Eastern Black Sea
- Representing a continuation of the Lesser Caucasus/ Achara-Trialet fold belt onshore Georgia



## Potential Source Rocks

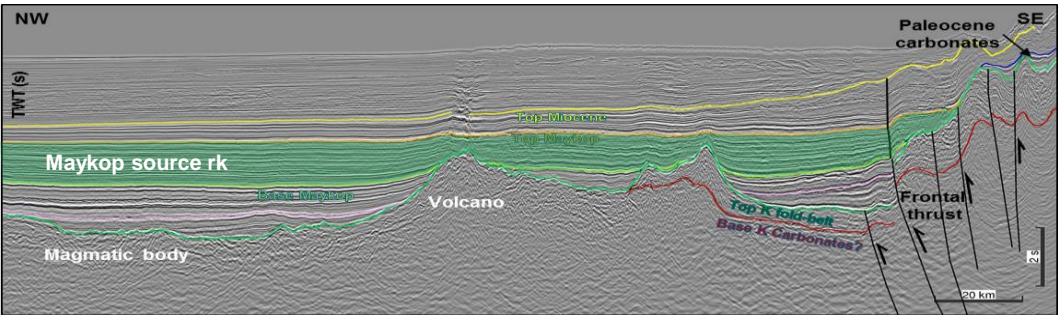
- Miocene-Oligocene Maykop marine shales – TOC ~4% e.g. Chaladidi oil field
- Eocene marine shales - Kuma sequence source of Supsa oil field
- Jurassic marine shales - source of Okumi oil field onshore Georgia?



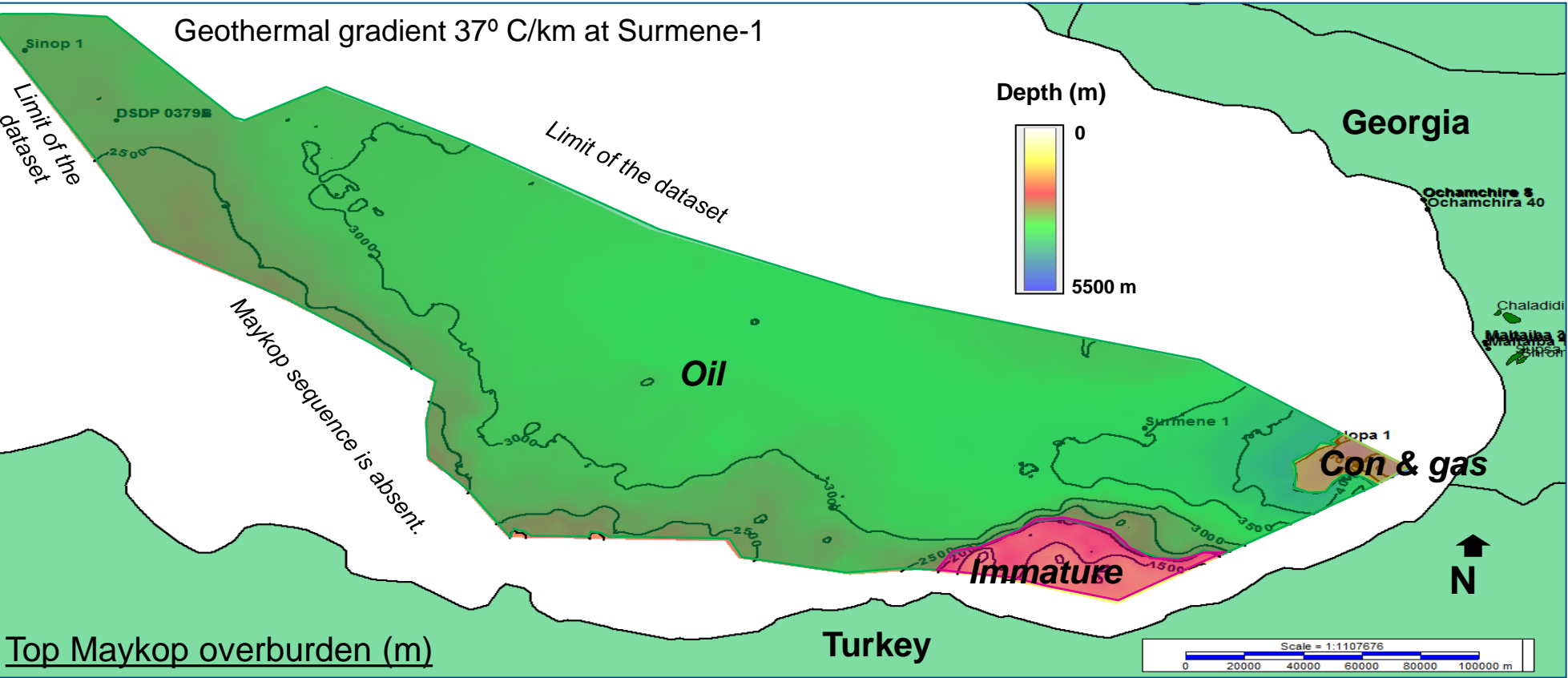
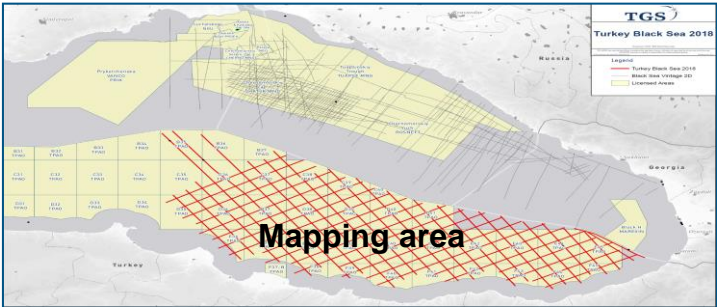
(Tari et al., 2018)



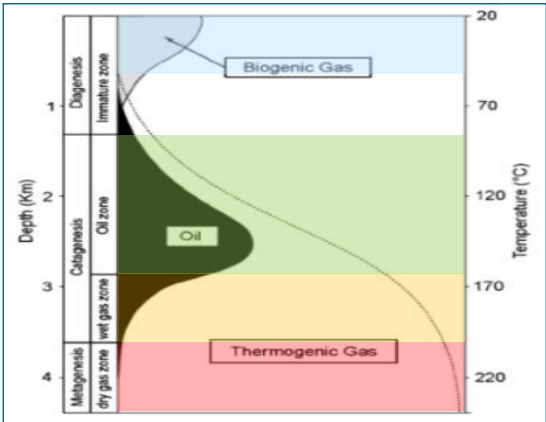
# Maykop Regional Occurrence and Maturity



- Extensive presence
- Mostly in the oil window



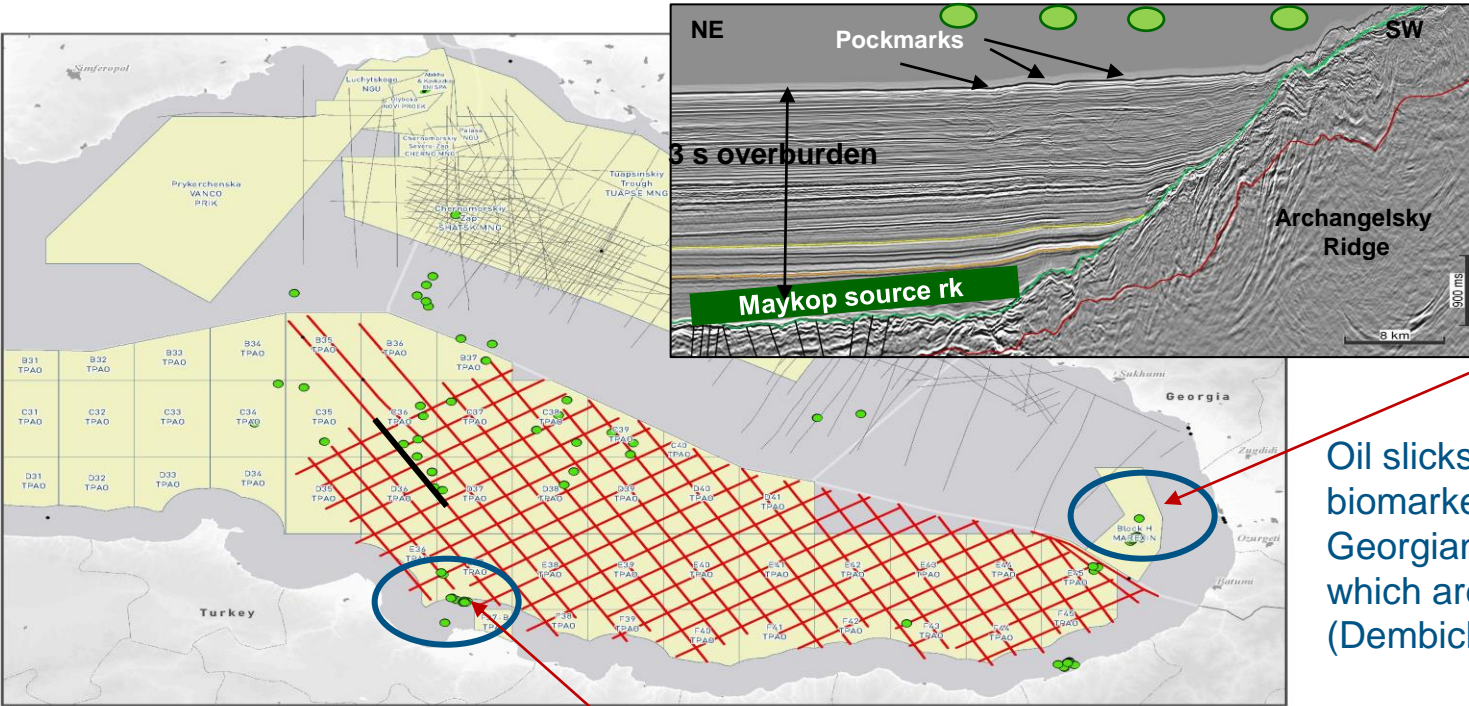
## Maturity Model



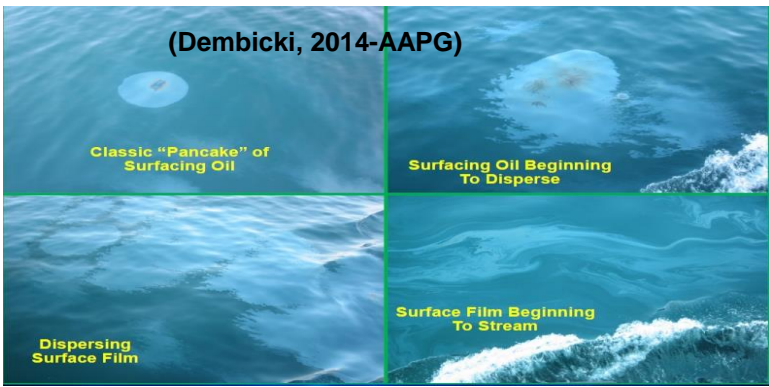
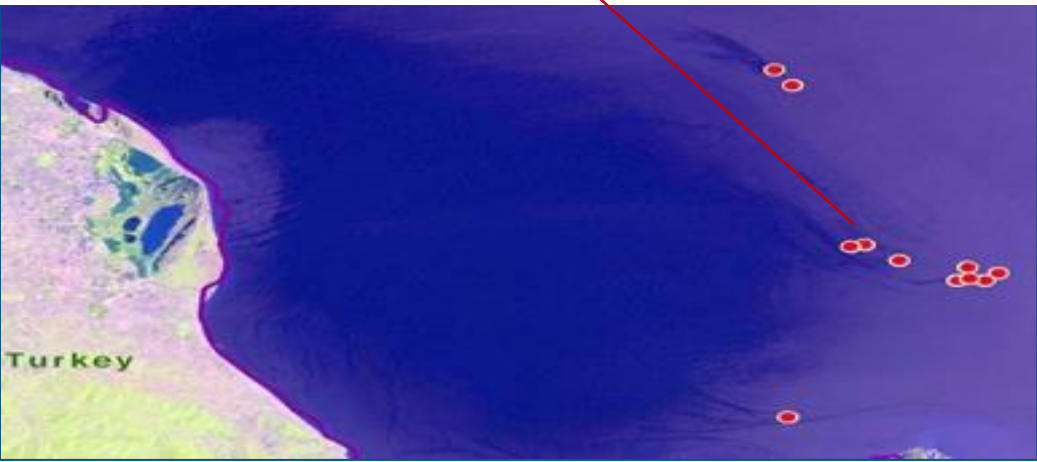
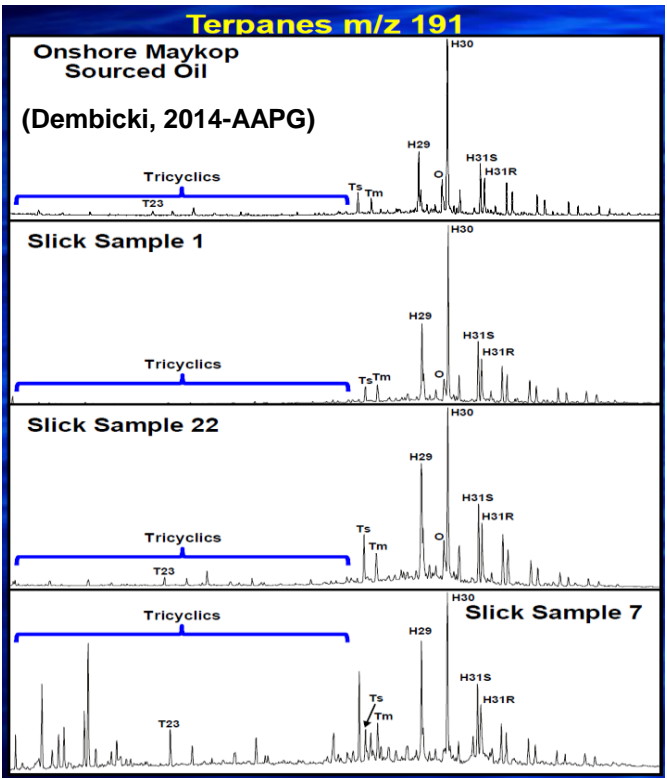
(Tissot & Welte, 1984)



# DHIs: Sea Surface Oil Slicks

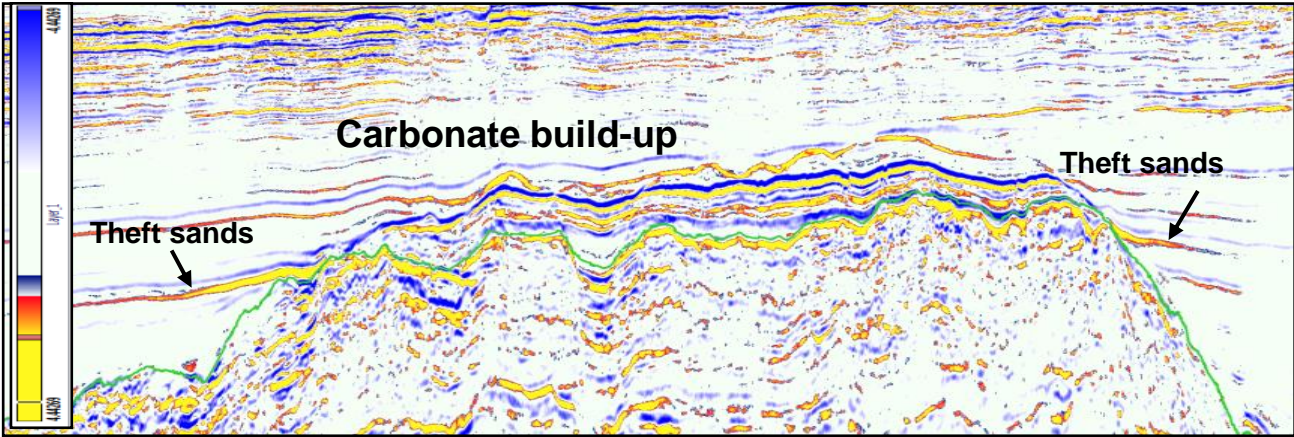
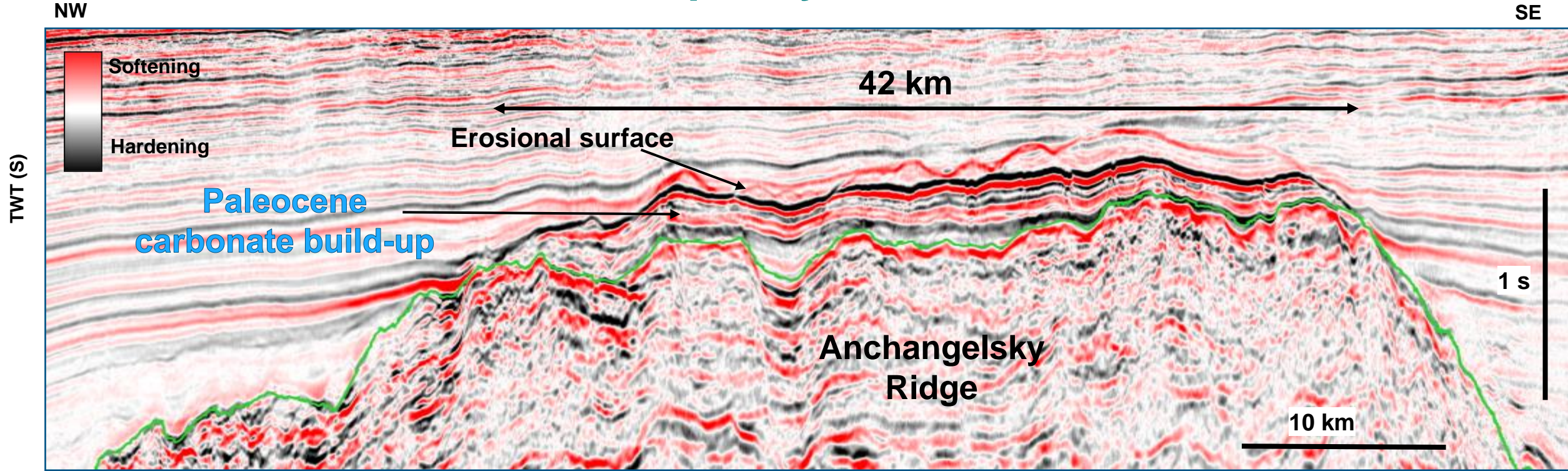


Oil slicks have similar biomarker to the onshore Georgian Maykop source oils which are naturally occurring (Dembicki, 2014-AAPG).





# Paleocene Carbonate Build-up Play

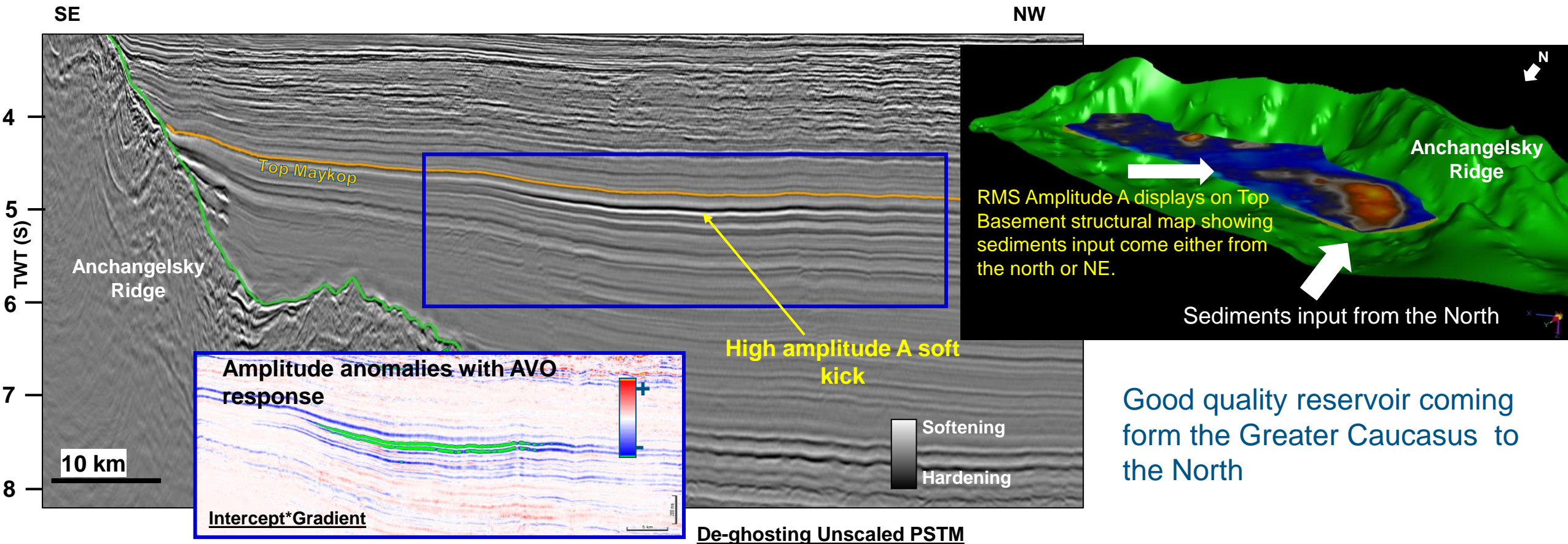


Reverse polarity amplitude attribute



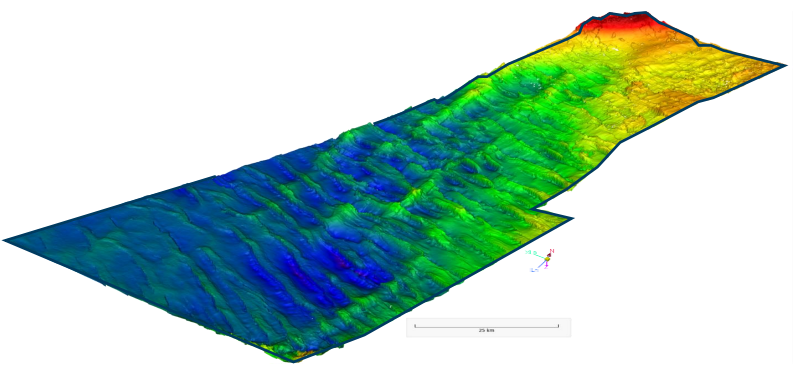
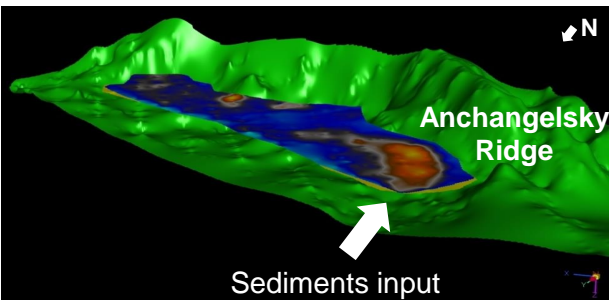
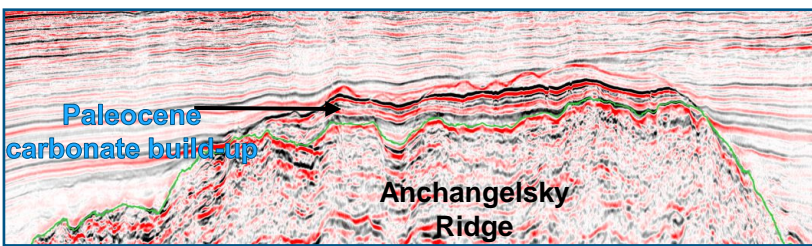
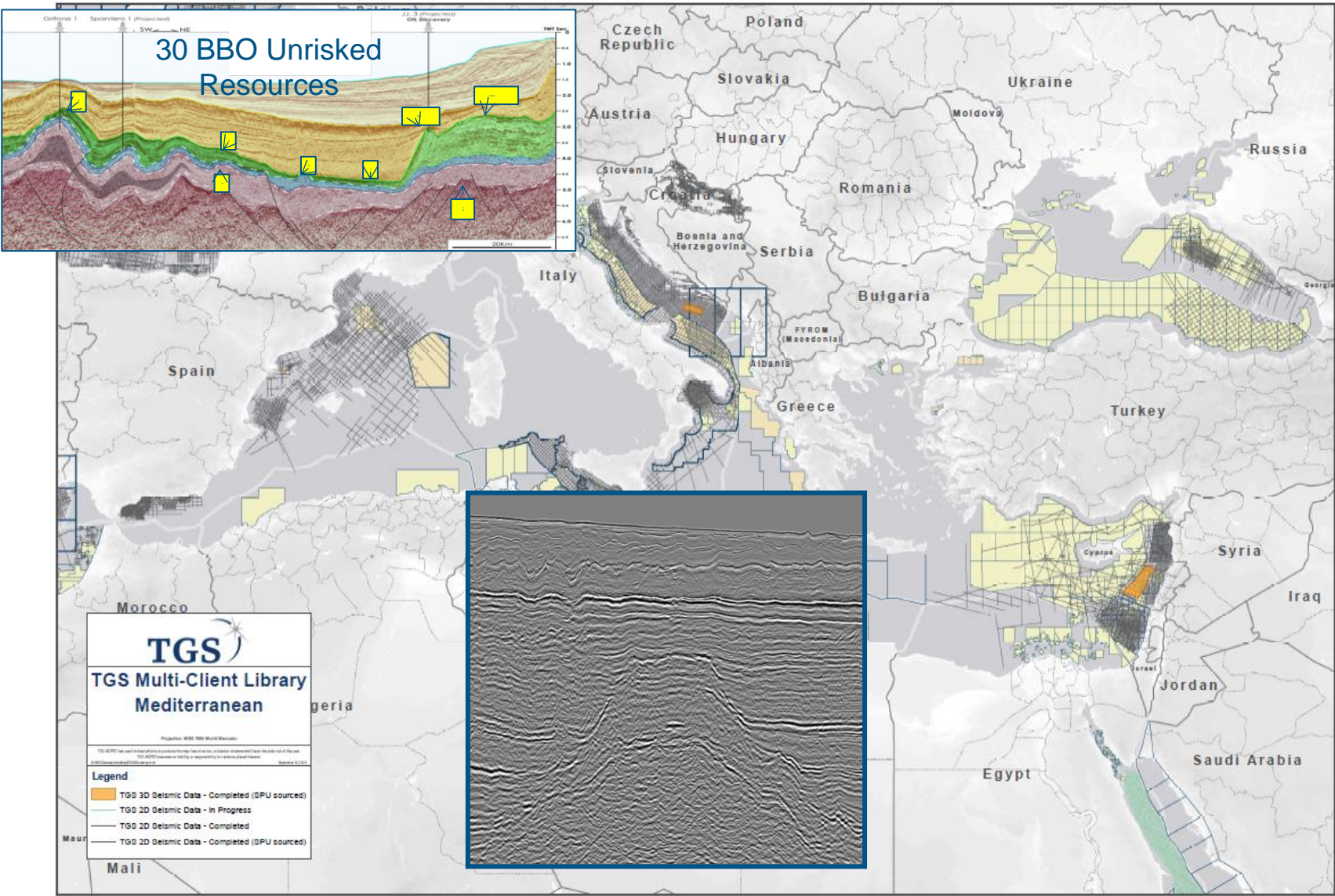
# Miocene Basin Floor Fan within Maykop Play with AVO/AVA Support

- Garaberezhouriv gas discovery in Oligocene sandstone reservoir within the Maykop sequence, 17% porosity and 2-250mD permeability (Tari et al., 2018)





# MC Seismic Data Library in Mediterranean





Thank you



www.TGS.com