

# OFFSHORE LEBANON PROSPECTIVITY & 2<sup>ND</sup> LICENSING ROUND

Appex

**Lebanese Petroleum Administration**

March 5<sup>th</sup>, 2019





# OUTLINE

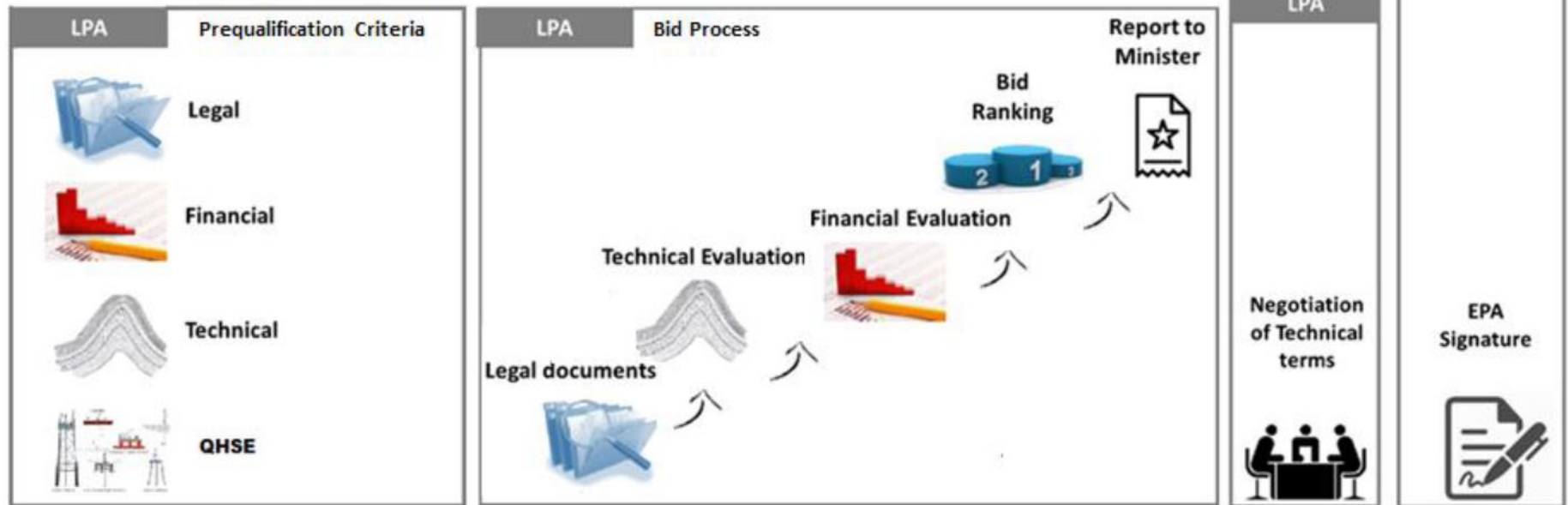
- 🇩🇪 **Licensing Rounds**
- 🇩🇪 **Regional Exploration Activities**
- 🇩🇪 **Lebanon Prospectivity and Future Potential**
- 🇩🇪 **Petroleum System Elements**
- 🇩🇪 **Attractiveness Factors**



# LICENSING ROUND PROCESS

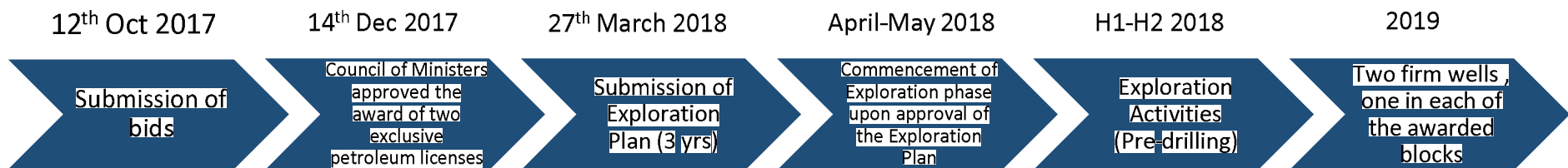
## Prequalification ProBid :

- Operator
- Non Operator
- Consortium (min. 3):
  - Operator (min. 35%)
  - Non Operator (min. 10%)





# 1<sup>ST</sup> LICENSING ROUND CLOSURE /OUTCOME



# 2<sup>ND</sup> LICENSING ROUND TENTATIVE TIMELINE



17<sup>th</sup> May 2018

Quarter 2 2019

Quarter 4 2019

Quarter 1 2020

COM approved the LPA recommendation to undertake preparations for the 2<sup>nd</sup> licensing round

Launch of 2<sup>nd</sup> Licensing Round

Closer of 2<sup>nd</sup> Licensing Round

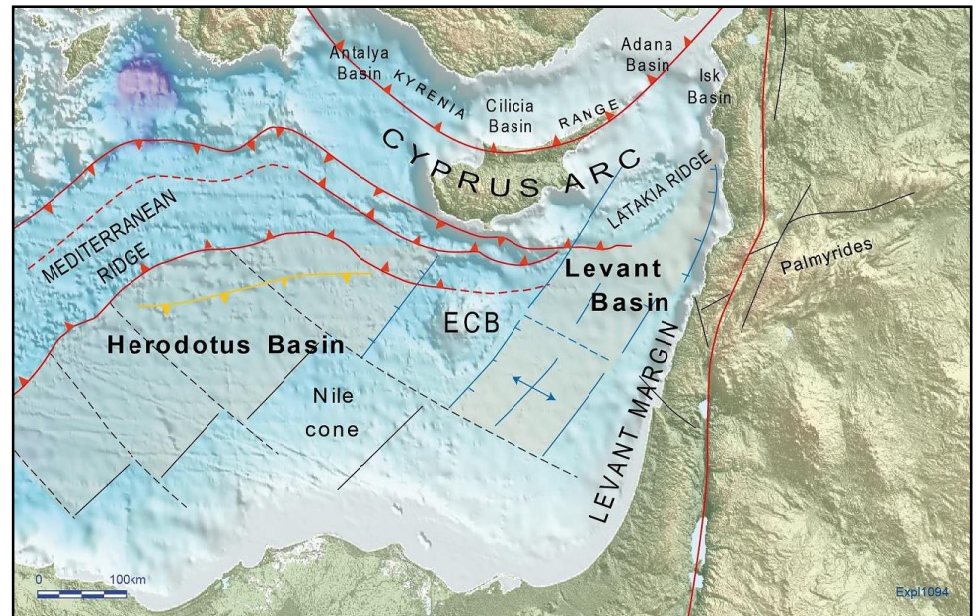
Award



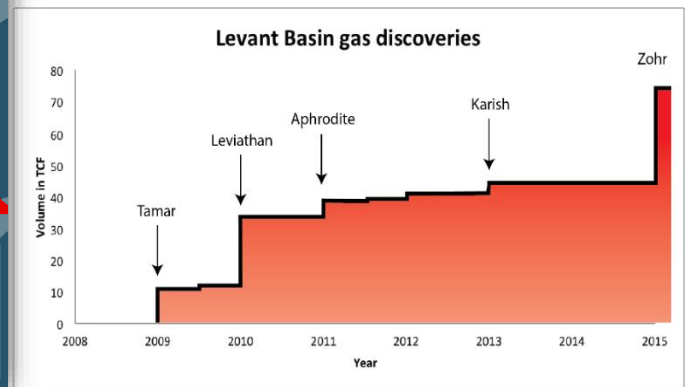
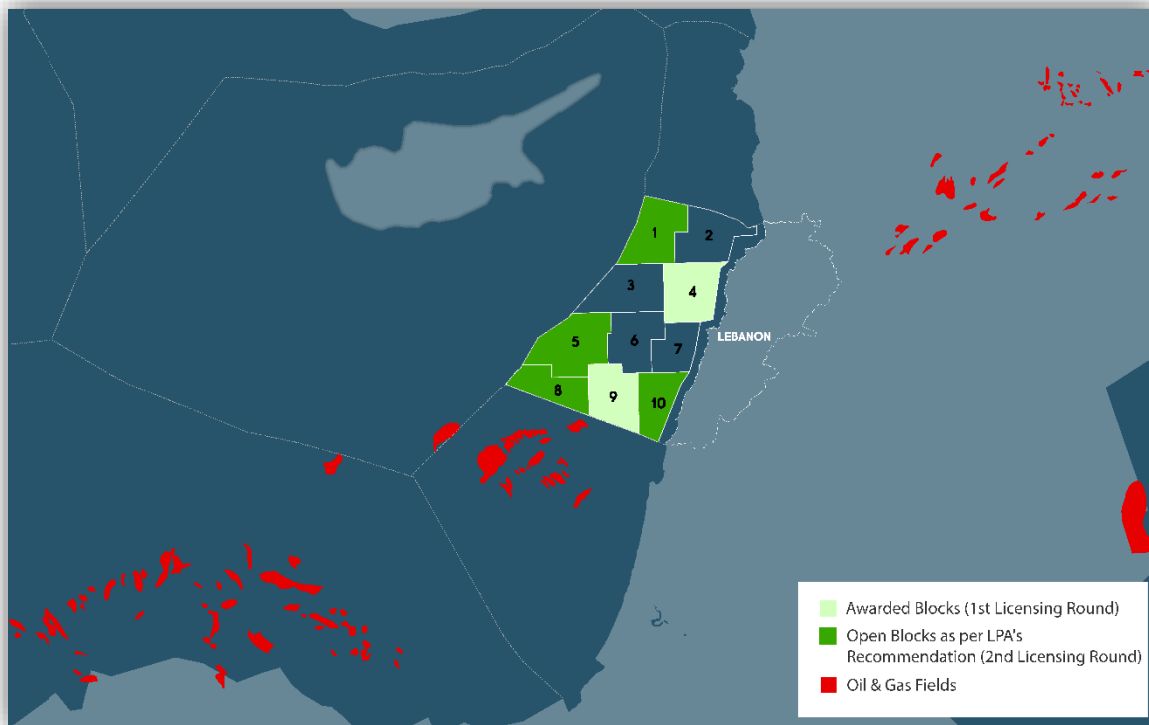


# REGIONAL SETTING

- Lebanon extends along the eastern coast of the Mediterranean Sea and covers a surface area of 10,452 km<sup>2</sup>.
- Lebanon occupies an area corresponding to :
  - South of the Cyprus Arc
  - East of Eratosthenes Continental block
  - The SW margin of the inverted Palmyra Basin
  - NE of the Nile Delta Cone
- This margin is defined by the Dead Sea Transform Fault, a left lateral strike slip fault zone which separates the Arabian plate from the African plate.



# REGIONAL EXPLORATION ACTIVITIES



Source: IHS Market

- Passive Margin for long geologic time
- Numerous discoveries in the region
- Prospects mapped in Lebanon share the same trends
- Zohr was a paradigm shift in the exploration cycle
- Calypso discovery announced by ENI in Block 6 offshore Cyprus and more recent Glaucus by Exxon Mobil in Block 10
- Three Carbonate reservoirs discoveries in 3 years equal in reserves /resources to 18 years of discoveries in turbidites (sand)







# **LEBANON PROSPECTIVITY AND FUTURE POTENTIAL**



# PREVIOUS EXPLORATION WORK AND HC SHOWS – ACTIVE THERMOGENIC SYSTEM

*Onshore Drilled Wells*



*Ongoing Seepage causing Bitumen Curtains Adjacent to Fault Planes*



*Hasbaya Asphalt: Total Organic Carbon*



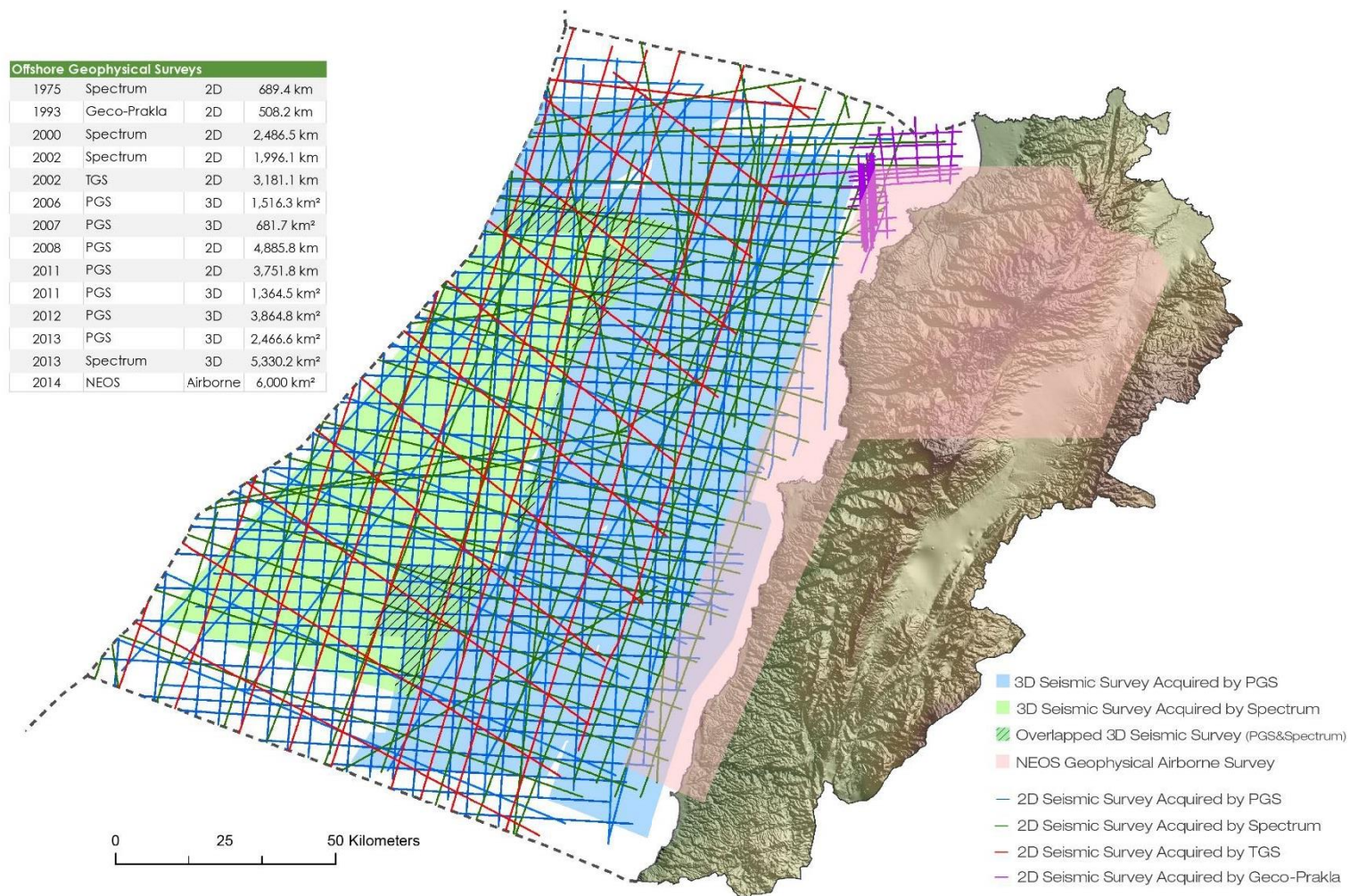
*Metrit Asphalt in dolostones rocks*



*Chekka Hydrocarbon Shows*



# GEOPHYSICAL DATA COVERAGE OFFSHORE LEBANON

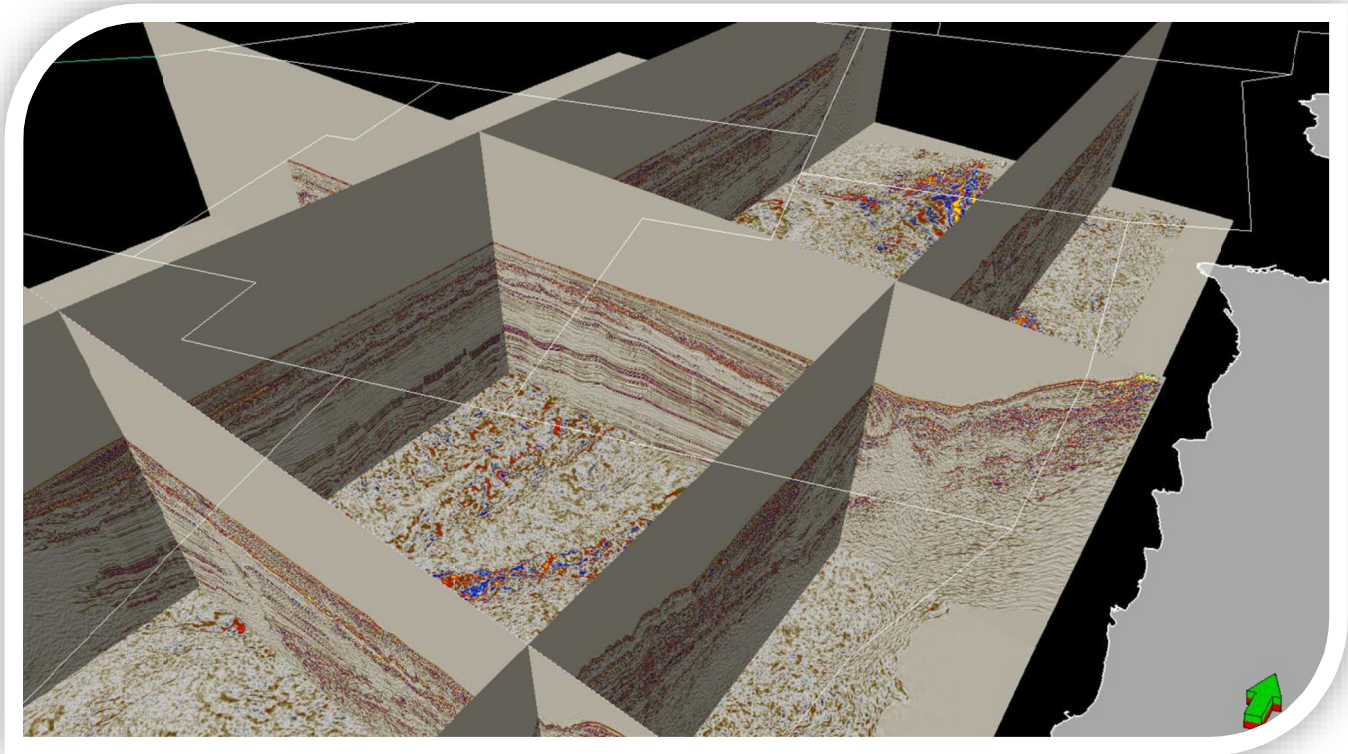


40 Companies have Licensed Lebanese Offshore Data



# AVAILABLE GEOPHYSICAL DATA

- Modern 2D and 3D Seismic data across the EEZ.
- Complete Data viewing at:
  - LPA Offices
  - Spectrum
  - PGS



Data viewing request can be made via email: [datacenter@lpa.gov.lb](mailto:datacenter@lpa.gov.lb)





# VIRTUAL DATA ROOM

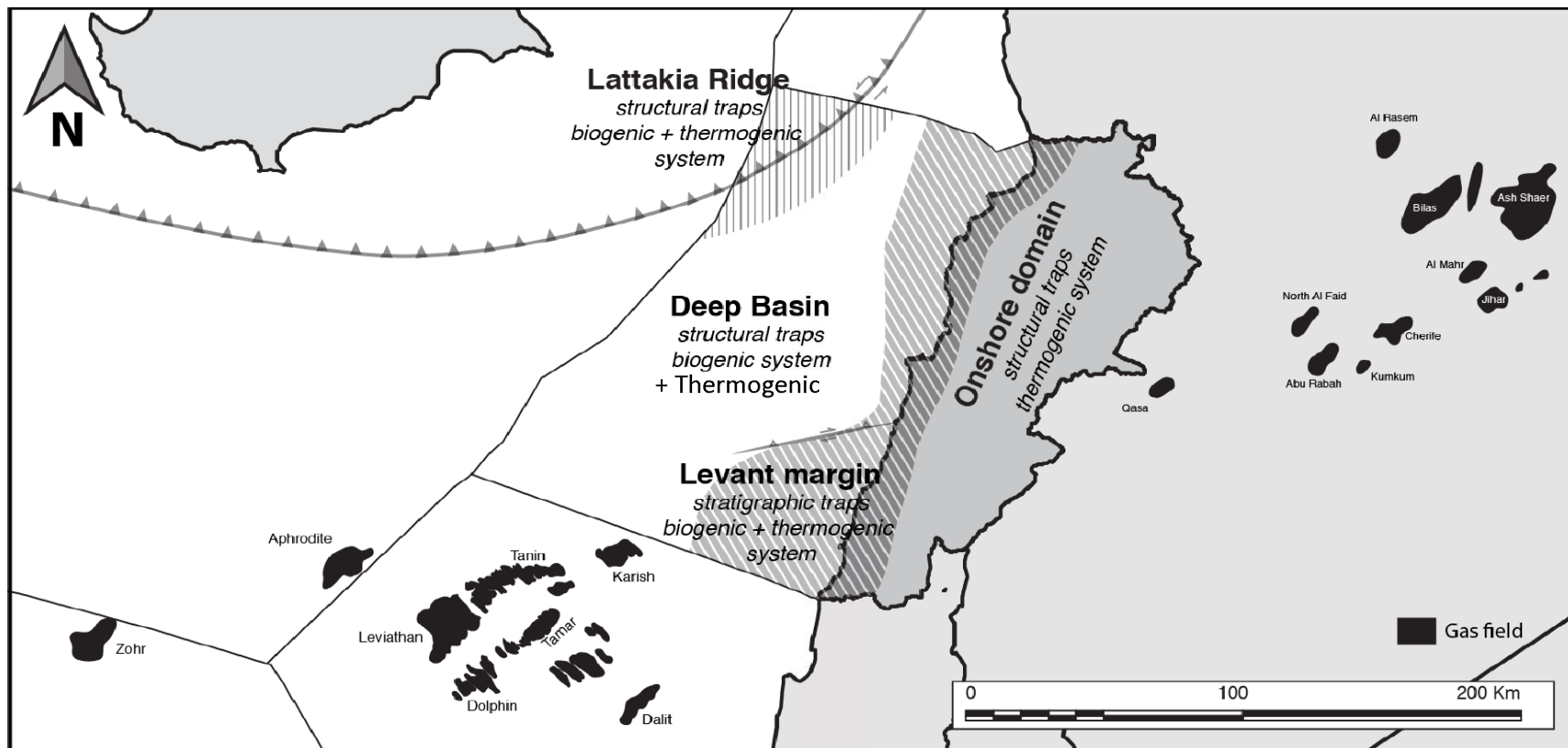


- Accessible through a Web Browser
- 24 / 7 Access
- 3,200 km of 2D Seismic Data Available
- Actual SEG – Y Viewing
- Integrated Seismic Interpretation Tool
- Technical Documents & Presentations Available
- Framework GIS Geopackage Available



# THE PETROLEUM SYSTEMS OF LEBANON

- 4 petroleum systems identified
- Consist mainly of gas in the deep Basin (based on basin modelling)
- Liquid oil expected onshore, along the margin and possibly in the deep basin

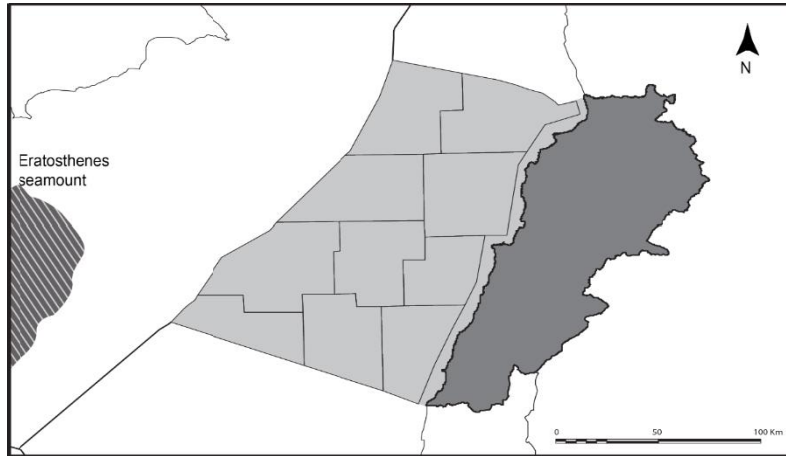


# PLAYS OFFSHORE LEBANON

## Pliocene

Age Range: 5.3 ma – present

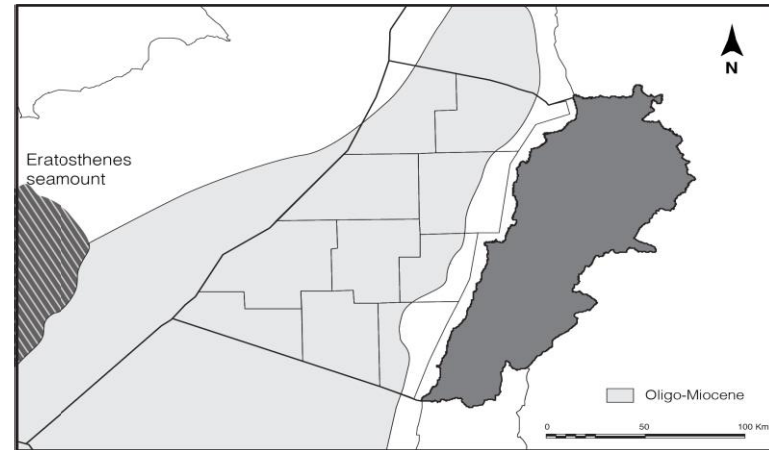
Depth Range: 1600 – 2300 meters subsea



## Oligo-Miocene

Age Range: 33.9 ma – 5.3 ma

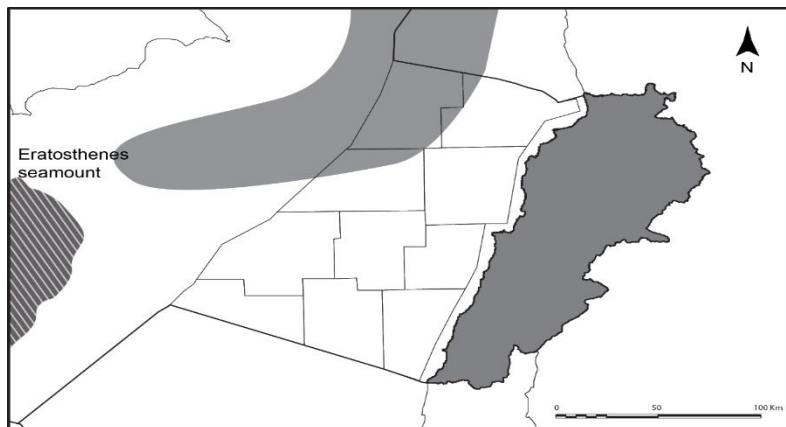
Depth Range: 3500– 6500 meters subsea



## Eocene

Age Range: 56 ma – 33.9 ma

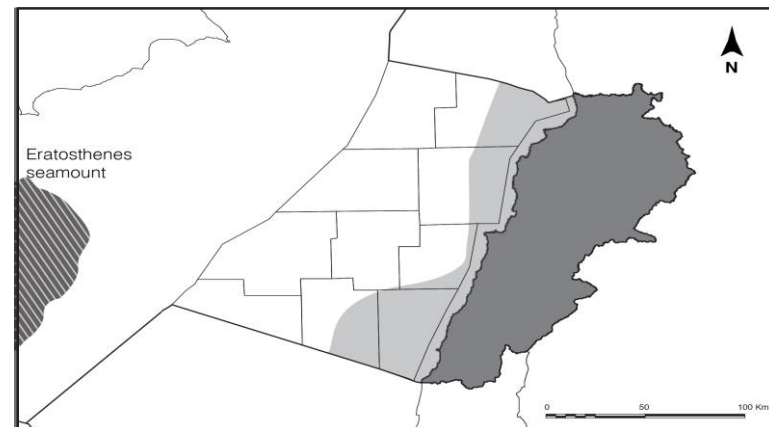
Depth Range: ~2000 – 4500 meters subsea



## Jurassic-Paleogene -Carbonates

Age Range: 251 ma – 5.3 ma

Depth Range: 2000 – 8500 meters subsea





# PETROLEUM SYSTEM ELEMENTS



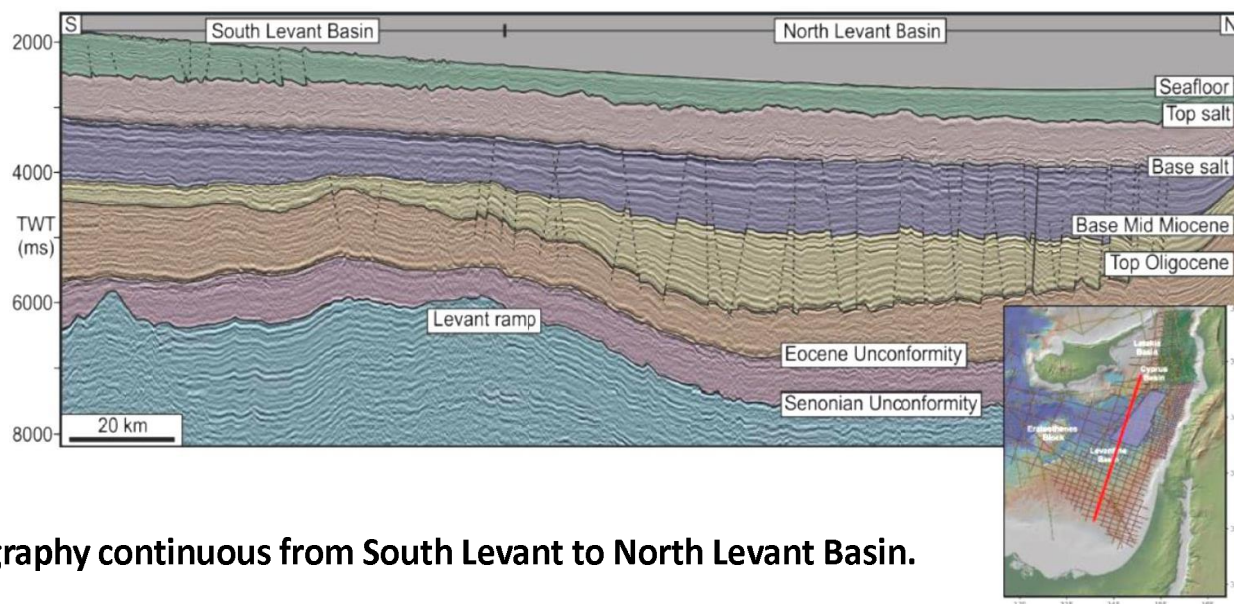


# BIOGENIC SYSTEM – SOURCE ROCKS

- Levant Basin has proven presence of Biogenic Gas in Pliocene reservoirs (Egypt, Gaza) and is reported in Miocene reservoirs (Tamar and nearby fields).

- Biogenic Source Rocks:**

- Oligocene - most productive in the South and extend northwards into Lebanon.
- Lower & Middle Miocene – Methane believed to be expelled from the Messinian to the present day.



- Stratigraphy continuous from South Levant to North Levant Basin.
- Pre –salt stratigraphy thicker in North Levant Basin, particularly Oligo-Miocene which hosts the main reservoirs and source rocks in the South Levant.



# THERMOGENIC SYSTEM – SOURCE ROCKS

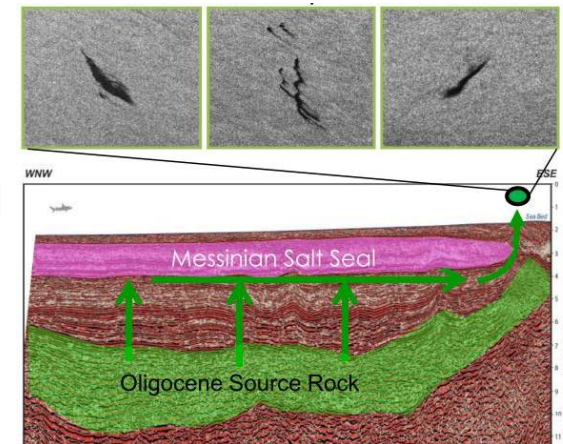
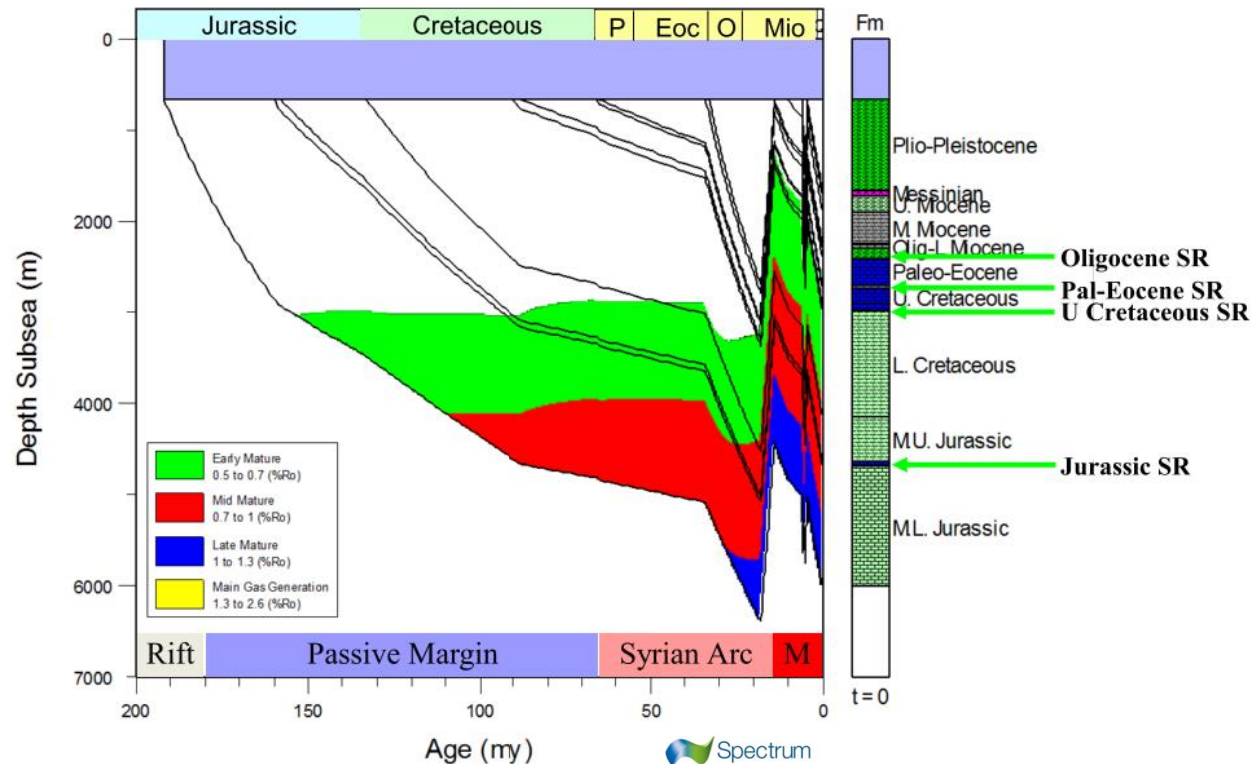
- Analogue data suggests the extension of thermogenic SR into offshore Lebanon.

Thermogenic SR		Kerogen Types	TOC (%)	Comments
Oligocene		II	2	Karish – majorly a gas discovery but also producing thermogenic light oil. SR encountered in Amathusa and Onasagoras offshore Cyprus.
Eocene		II - III	2	Possible SR in Egypt - possible offshore Lebanon.
Upper Cretaceous	Campanian	II	12	High potential SR onshore (Lebanon, Palestine, Egypt) - possible offshore Lebanon.
Middle to Upper Jurassic	Oxfordian	II - III	1.5	Well known SR in S. Levant (offshore & onshore) – possible offshore Lebanon
	Callovian	II - III	2	
Middle Triassic		II - III	2	Well known SR in Syria (Palmyride)



# EVIDENCE FOR OIL POTENTIAL OFFSHORE LEBANON

## Burial History and Thermal Maturity



**Levant Basin 15 to 20°C/km  
Oligocene Source generating oil**

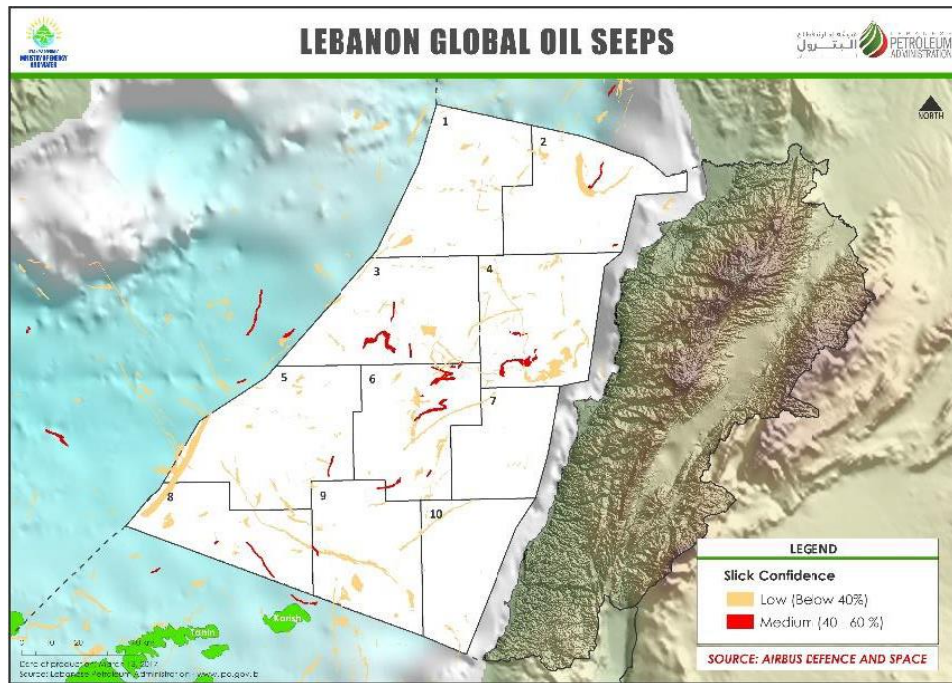
## Present Day:

- U. Cretaceous to Oligocene SR modeled as early Mature.
- Oligocene Source expelling oil from Messinian to recent. Long distance oil migration from Oligocene source rock kitchen in North Levant basin explains light oil in Karish.
- Oligocene and Paleocene – Eocene source rocks are currently in the Mid-Mature.
- Jurassic SR modeled as Late Mature.

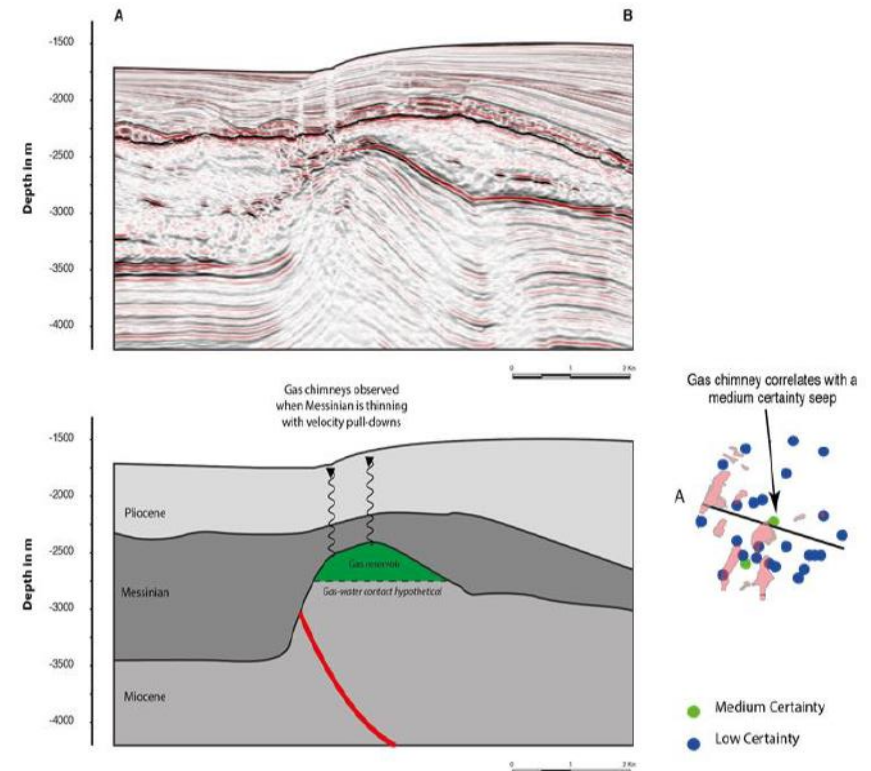


# OCCURRENCE OF OIL SEEPS

- Widespread occurrence of oil seeps (over 200) suggest that offshore Lebanon is prospective.



Seeps locations (1984-2011)



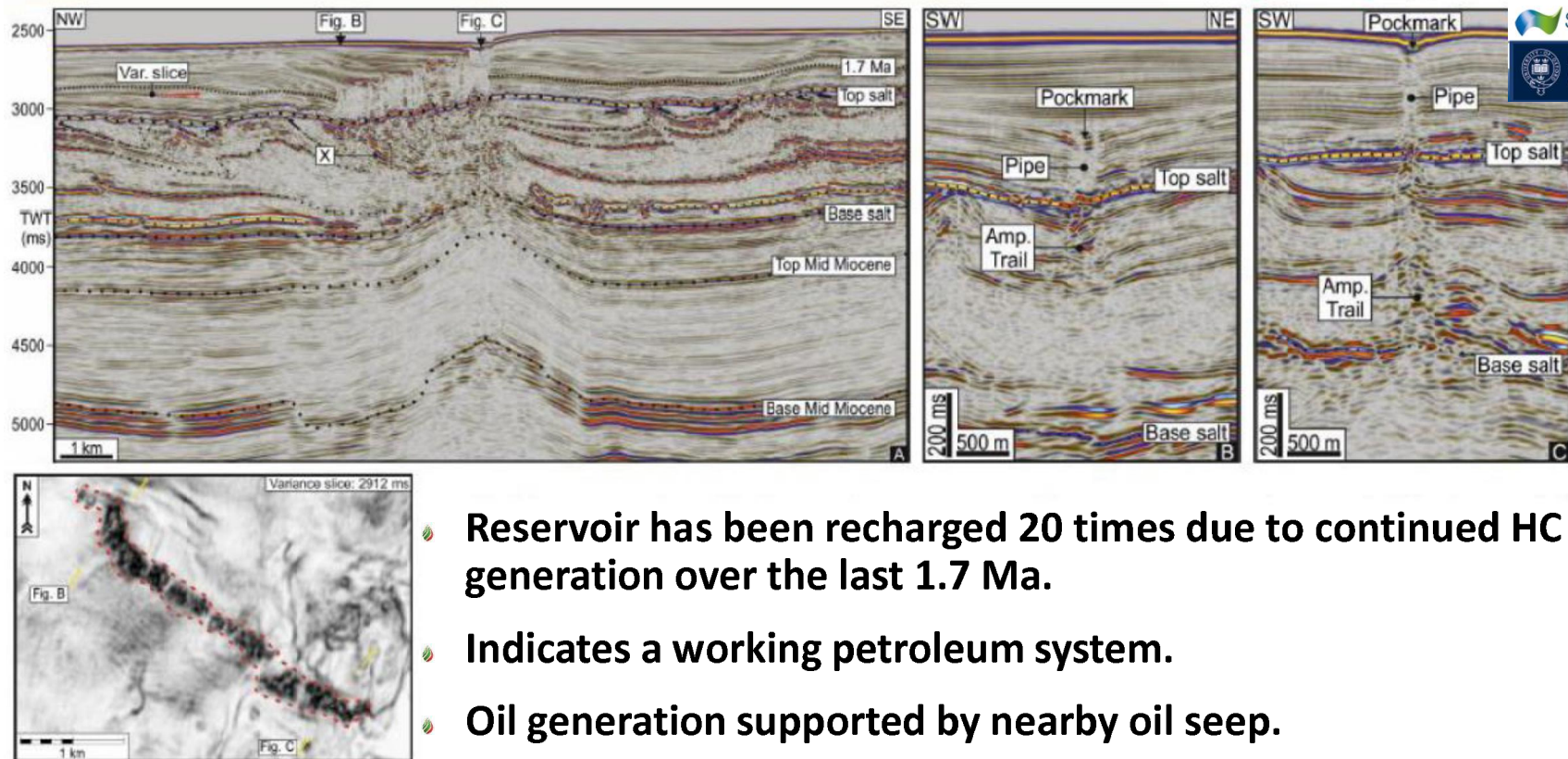
- HC oil seeps closely correlate to hydrocarbon indication on seismic associated with possible migration pathways.





# MULTIEPISODE FLUID ESCAPE

Nearby oil seep ●

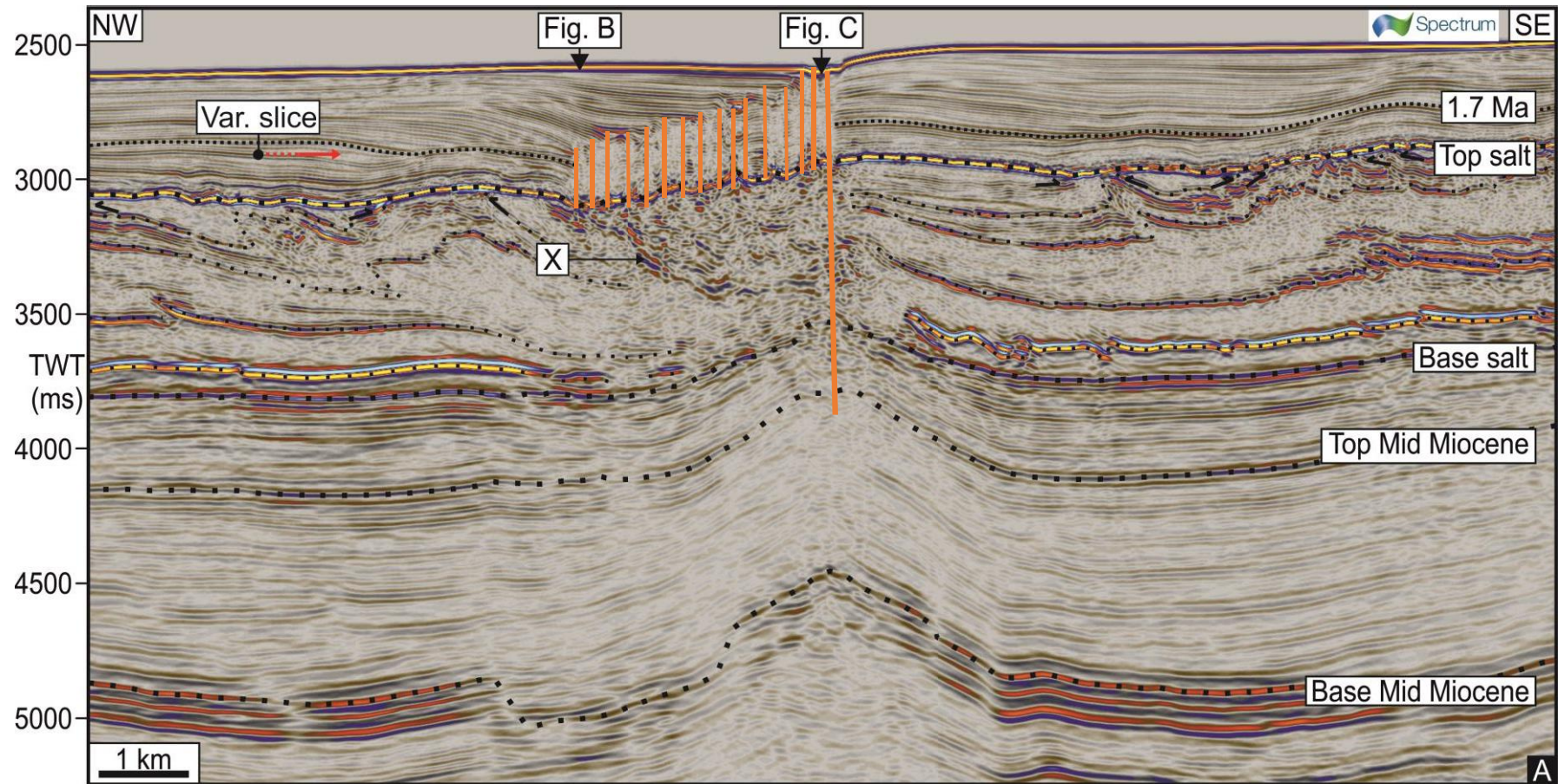


- Reservoir has been recharged 20 times due to continued HC generation over the last 1.7 Ma.
- Indicates a working petroleum system.
- Oil generation supported by nearby oil seep.



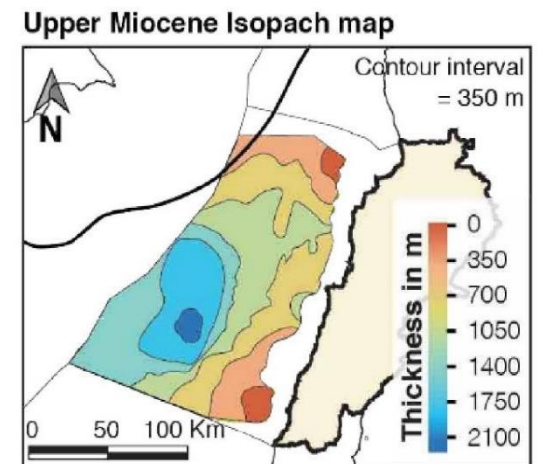
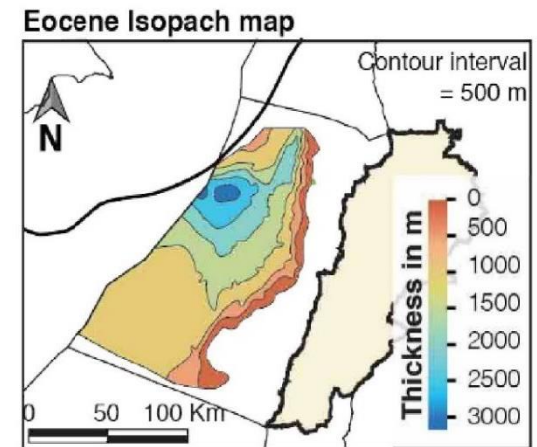
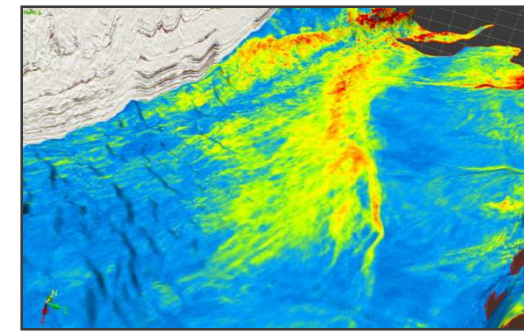
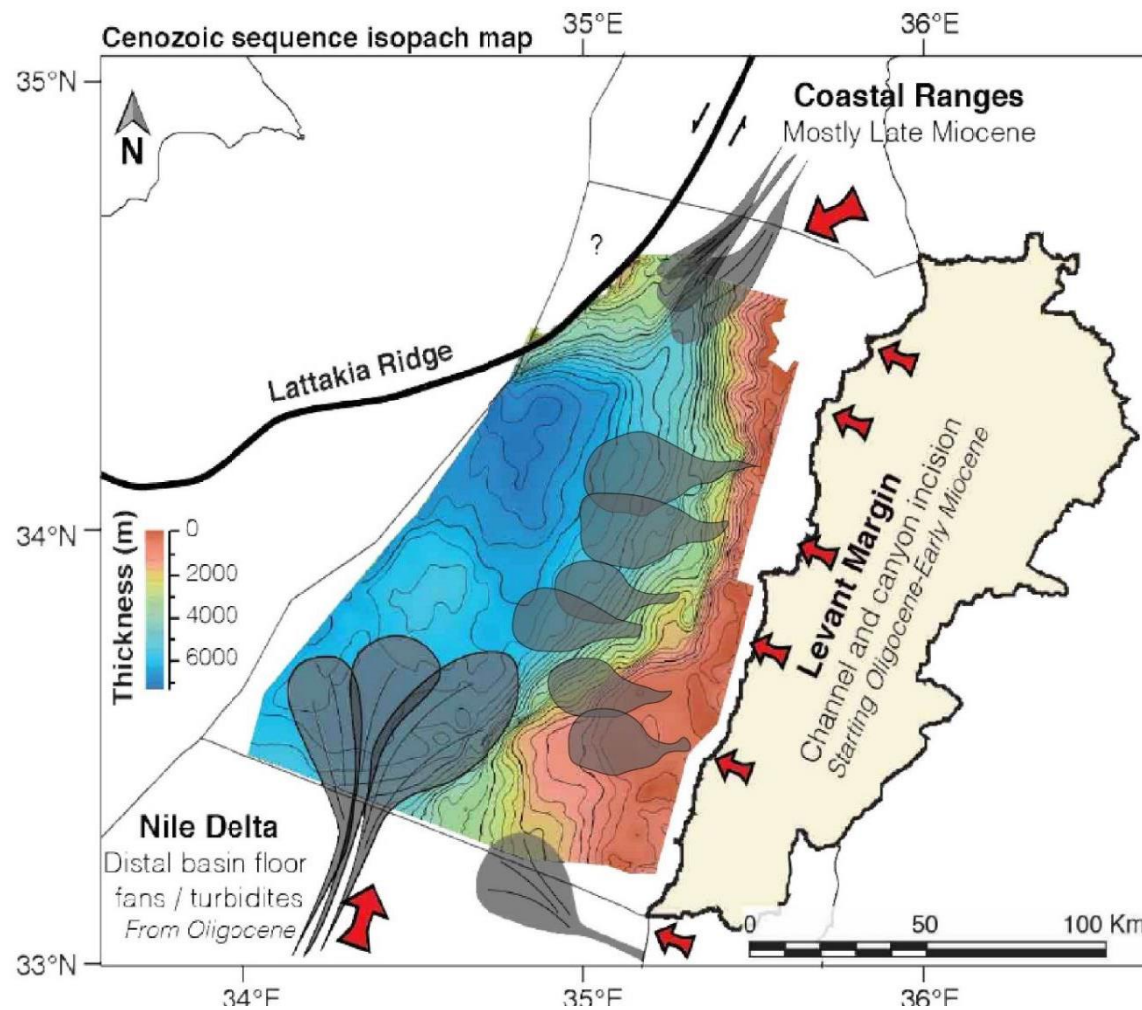
Messinian

Present  
Time

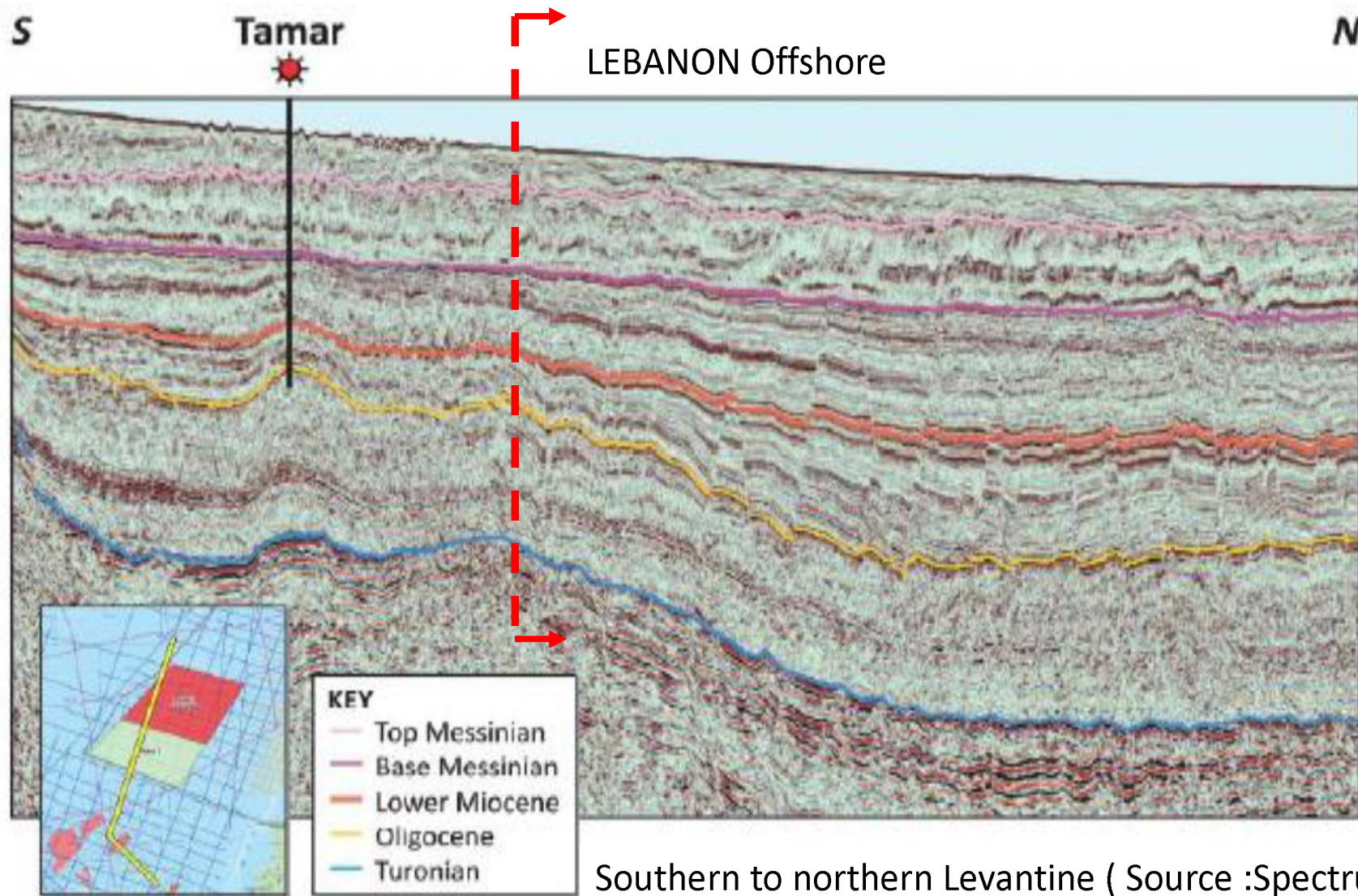




# SEDIMENTS INPUT

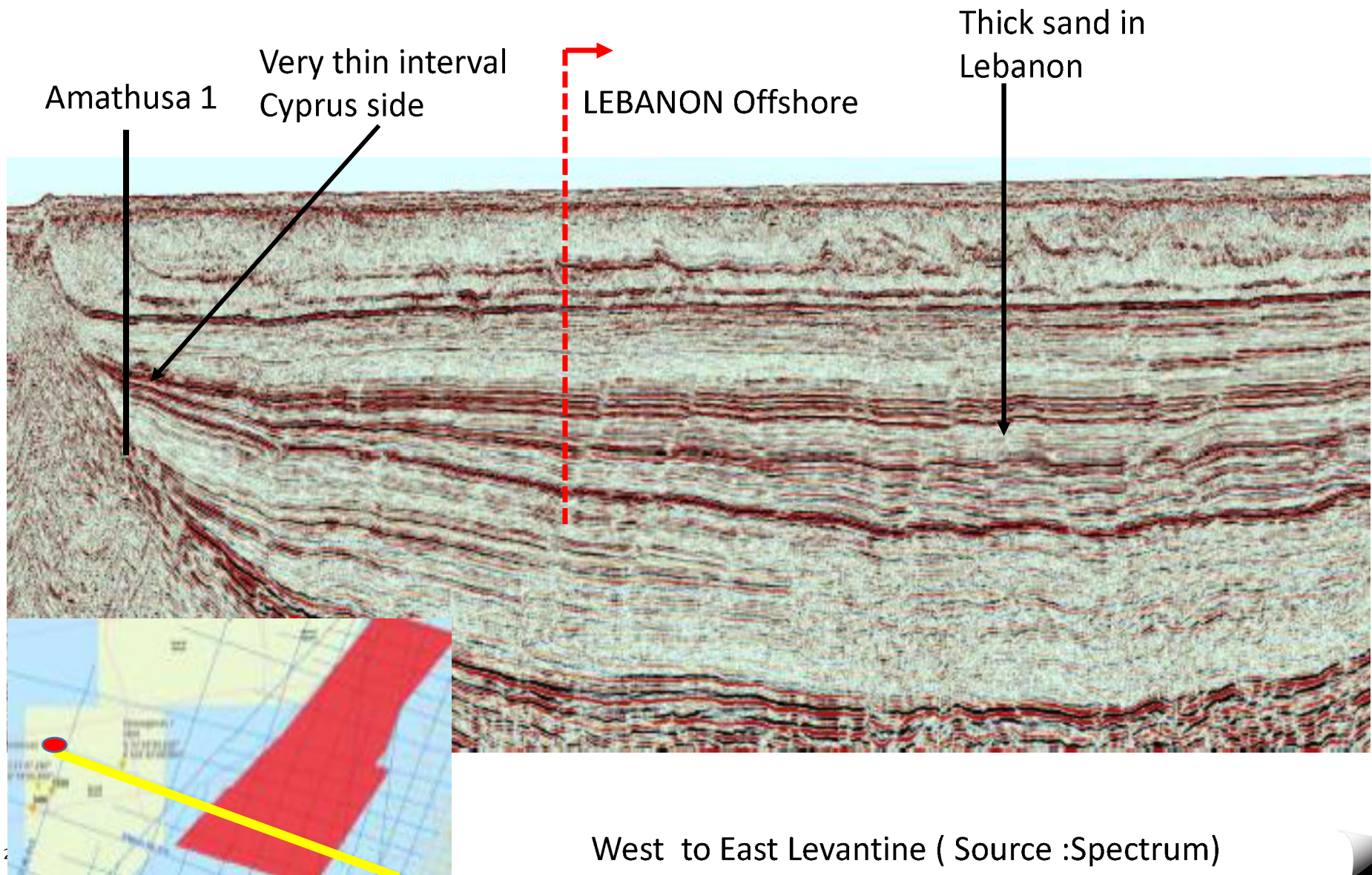


# SEDIMENTS THICKNESS OFFSHORE LEBANON

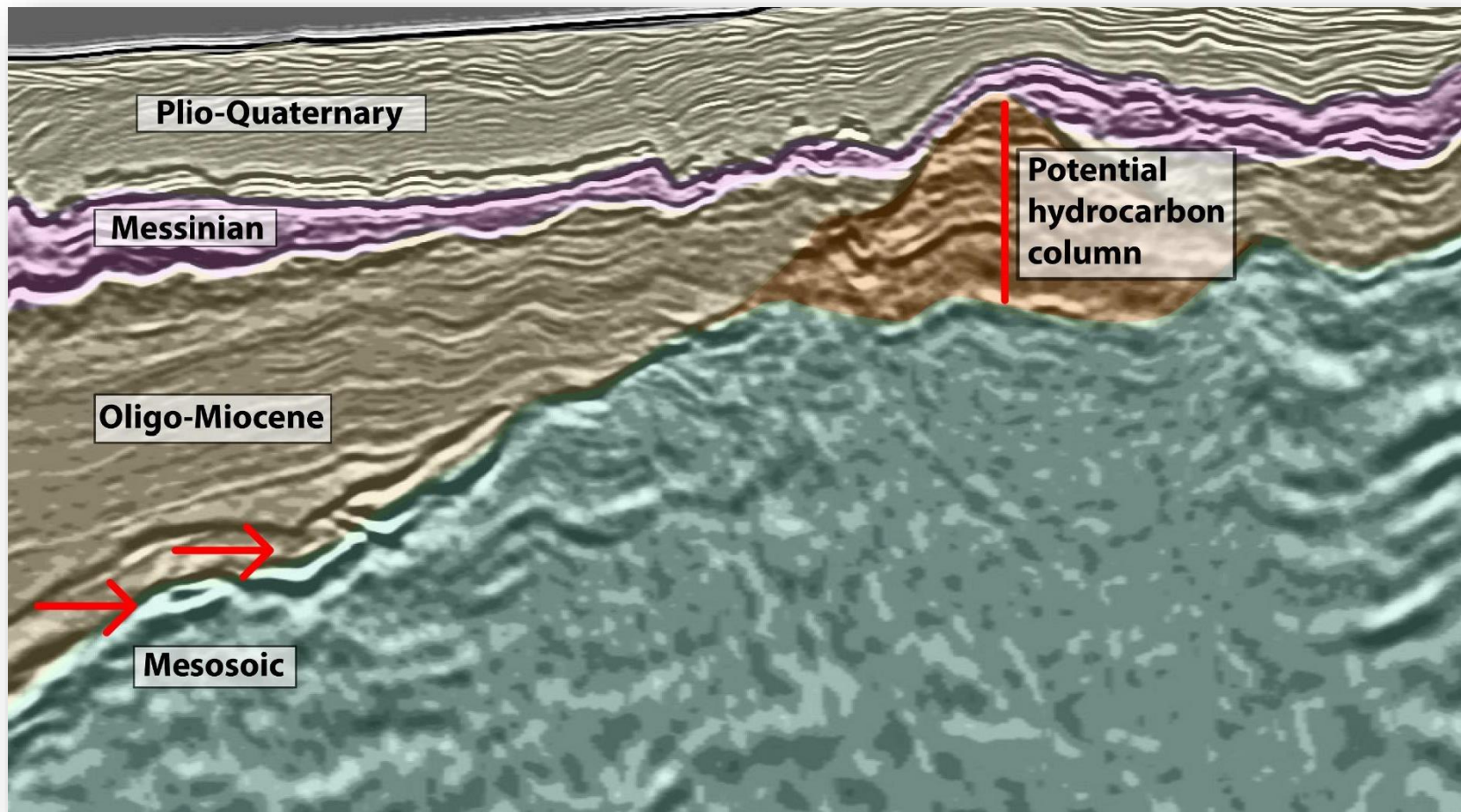




# SEDIMENTS THICKNESS OFFSHORE LEBANON



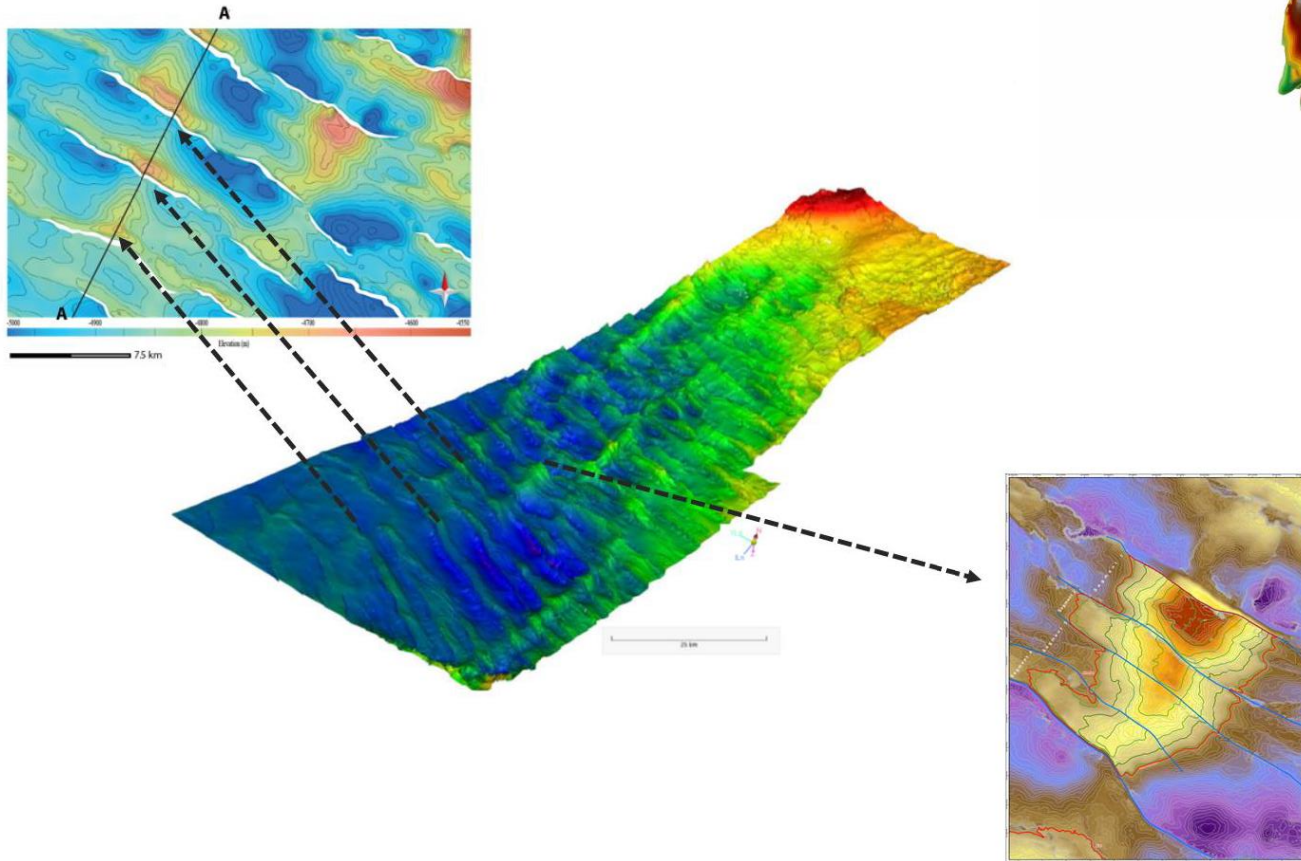
# CARBONATE POTENTIAL



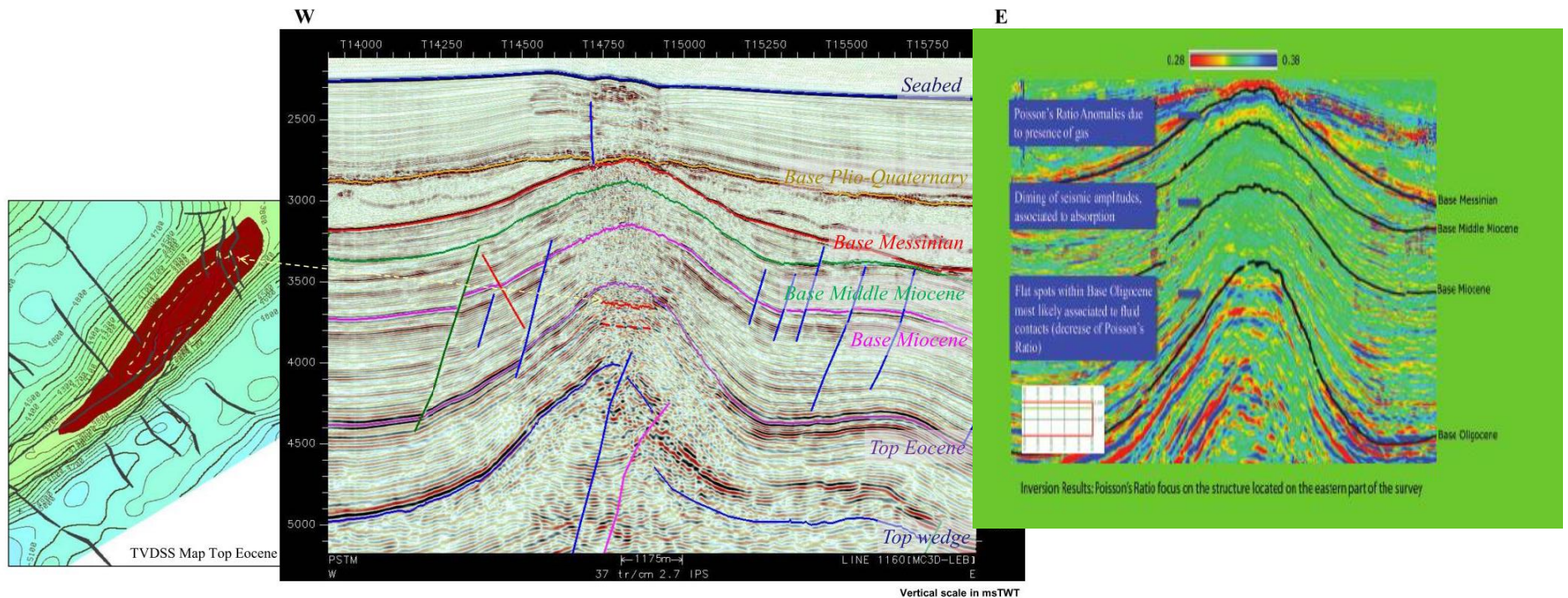


# PETROLEUM SYSTEM ELEMENTS - TRAPS

- Structural Traps
  - Anticlinal Traps
  - Faulted Anticlinal Traps



# PETROLEUM SYSTEM ELEMENTS - ANTICLINES



- Long NE trending anticline
- Symmetrical closure
- Prospects are superimposed increasing the attractiveness

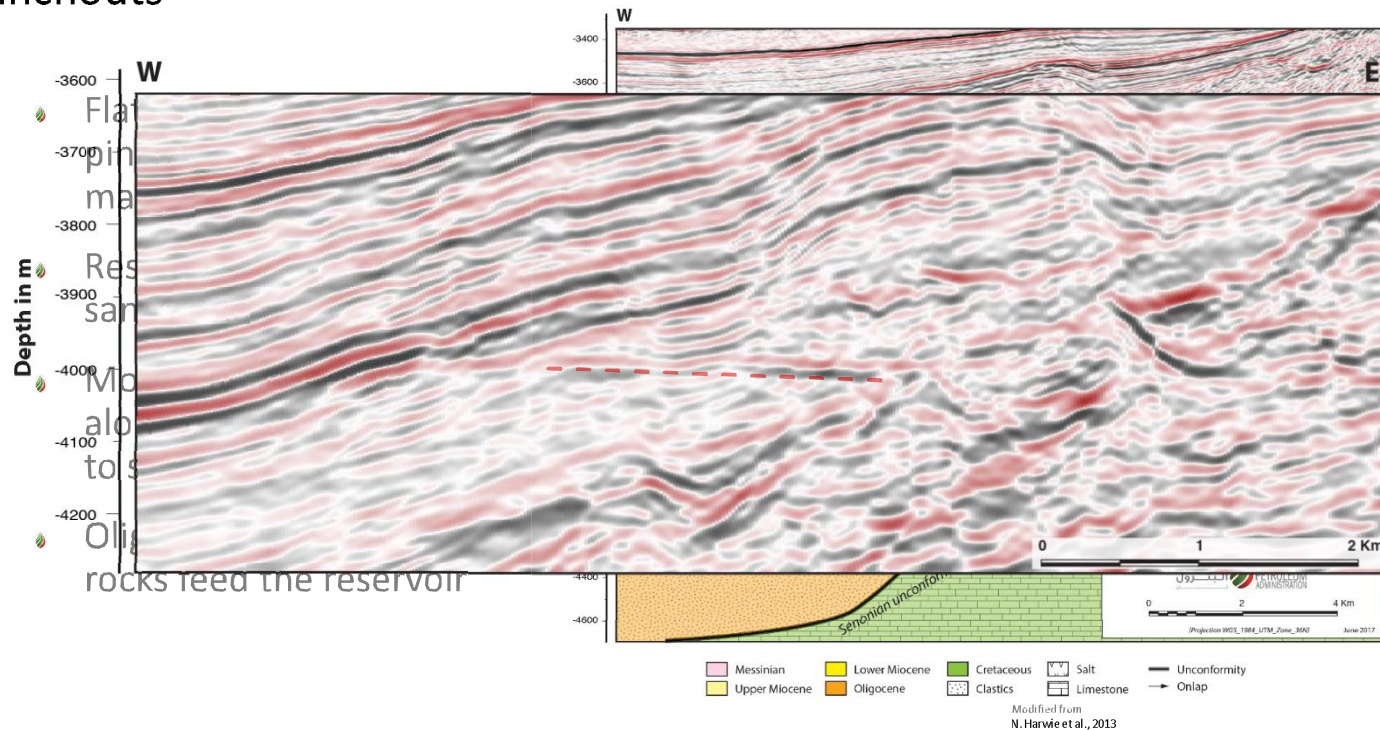




# PETROLEUM SYSTEM ELEMENTS – STRATIGRAPHIC TRAPS

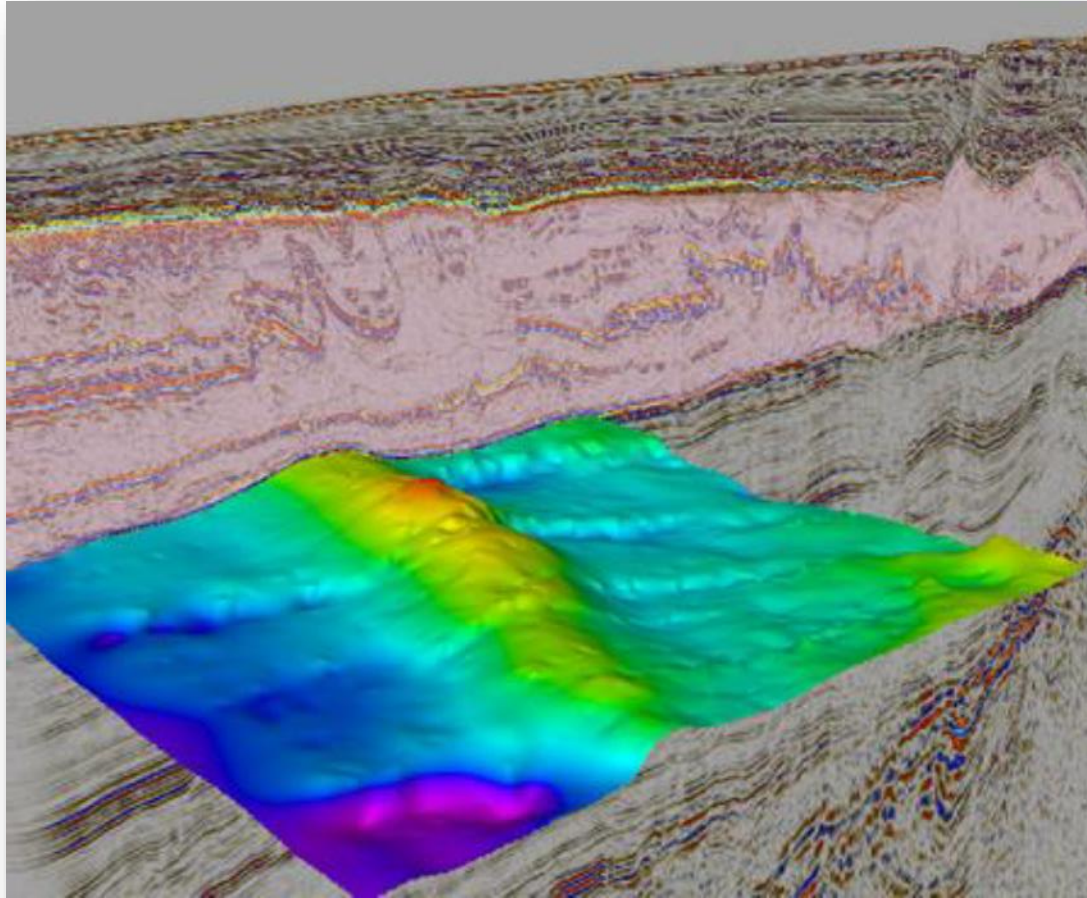
## Stratigraphic Traps

### Pinchouts



# PETROLEUM SYSTEM ELEMENTS – SEALS

- Major messinian evaporite layer

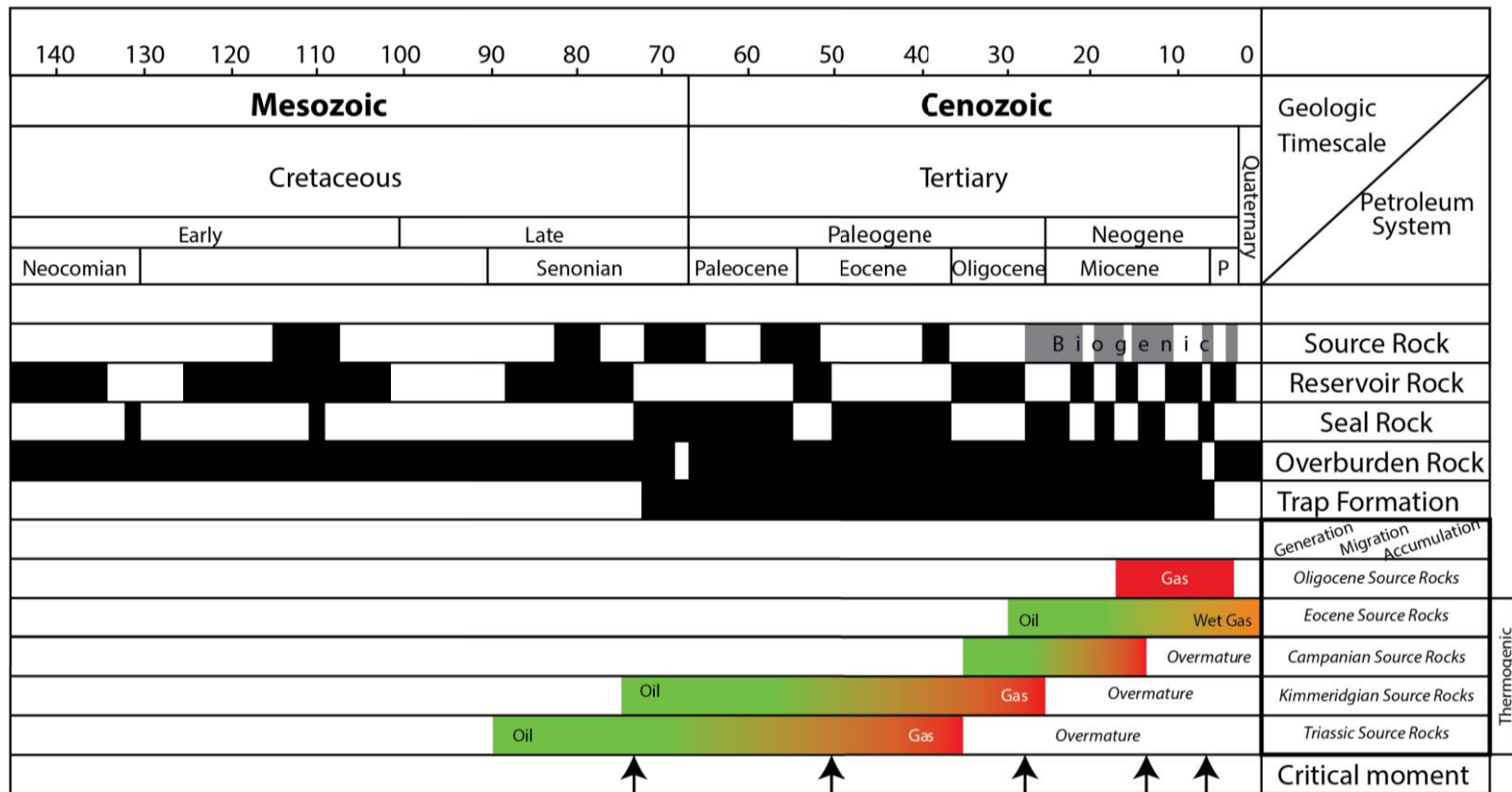


- Intercalated shales proven in the early Miocene interval (south Levant Basin)



# PETROLEUM SYSTEM CHART ( FAVORABLE TIMING )

**PETROLEUM SYSTEM CHART  
4 WAY DIP CLOSURE PLAY: DEEP BASIN**





# ATTRACTIVENESS FACTORS





# ATTRACTIVE EXPLORATION PLAYS

## Biogenic

### Structural traps

PROVEN

PROVEN

- Oligo-Miocene anticlinal closures sourced and biogenic Oligo-Miocene SR
- Oligo-Miocene faulted anticlines sourced biogenic Oligo-Miocene SR

### Stratigraphic plays

PROVEN

NEW PLAY  
CONCEPT

- Pliocene sourced by Pliocene biogenic SR
- Oligocene and Miocene pinchouts sourced by Oligo-Miocene biogenic SR

## Thermogenic (Oil and Gas)

### Structural traps

NEW PLAY  
CONCEPT

PROVEN

PROVEN

- Late Cretaceous anticlinal closures sourced by Jurassic thermogenic source rocks
- Oligo-Miocene anticlinal closures sourced by thermogenic Oligo-Miocene SR
- Oligo-Miocene faulted anticlines sourced thermogenic Oligo-Miocene SR

### Stratigraphic plays

NEW PLAY  
CONCEPT

NEW PLAY  
CONCEPT

NEW PLAY  
CONCEPT

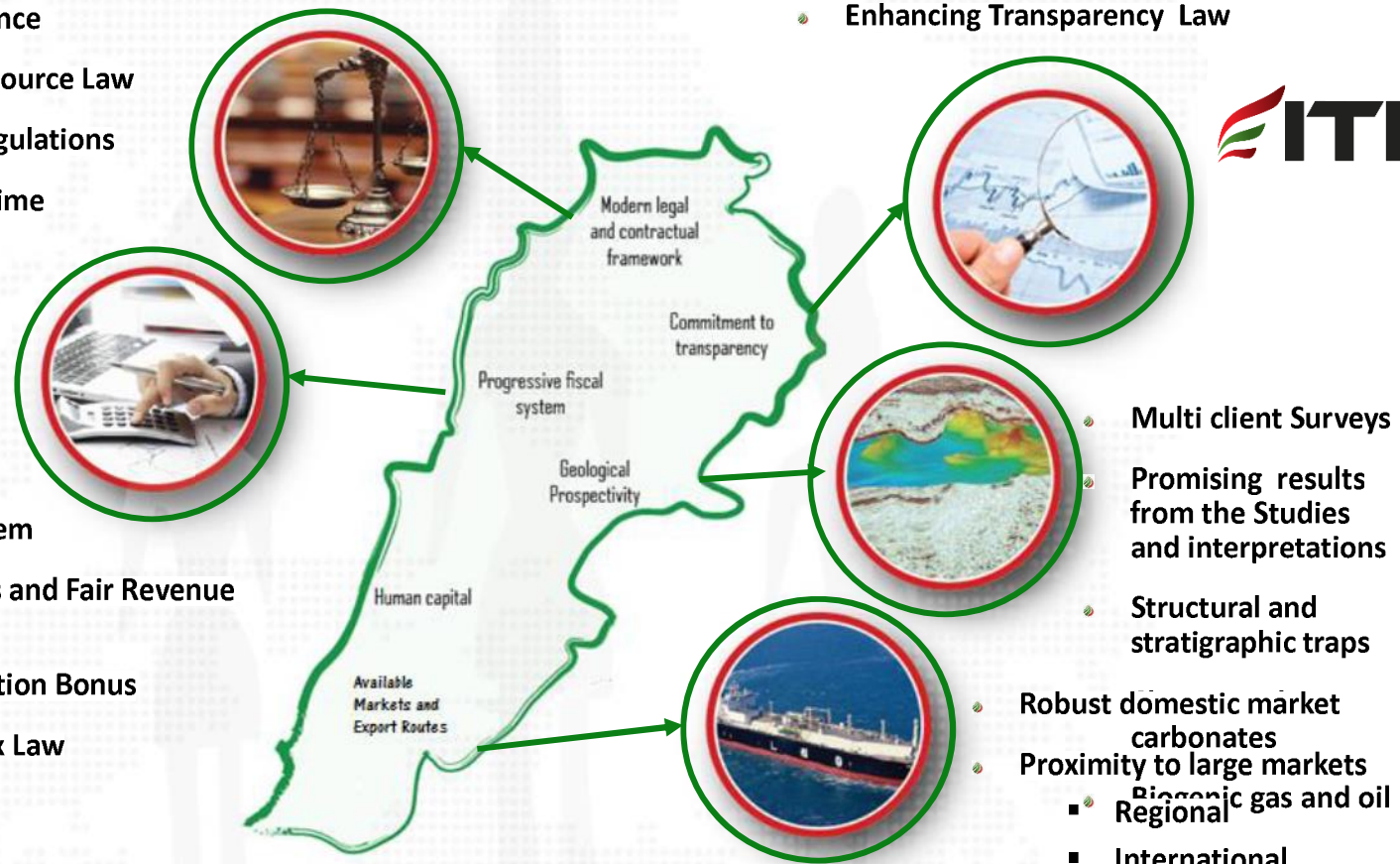
- Lower Cretaceous pinchouts sourced by Triassic and Jurassic thermogenic source rocks
- Lower to Mid Cretaceous carbonate reservoirs sourced by Triassic and Jurassic thermogenic source rocks
- Oligocene and Miocene pinchouts sourced by Oligo-Miocene thermogenic SR



# ATTRACTIVENESS FACTORS

- Clarity, Predictability and Stability
- Three layers of governance
- Offshore Petroleum Resource Law
- Petroleum Activities Regulations
- Production Sharing Regime

- Published Evaluation Criteria for Prequalification, Bidding and Award
- Extractive Industries Transparency Initiative (EITI)
- Right of Access to Information Law
- Enhancing Transparency Law





**A:** Marfaa 200, First Floor, Georges Akouri Street, Down Town, Beirut , Lebanon

**W:** [www.lpa.gov.lb](http://www.lpa.gov.lb) **E:** [info@lpa.gov.lb](mailto:info@lpa.gov.lb) **T:** +961 1 998780

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