# OFFSHORE LEBANON: GEOLOGY , PLAY TYPES & 2ND LICENSING ROUND

**AAPG San Antonio**
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**Wissam E. Chbat**
**LPA Board Member – Head of GnG**

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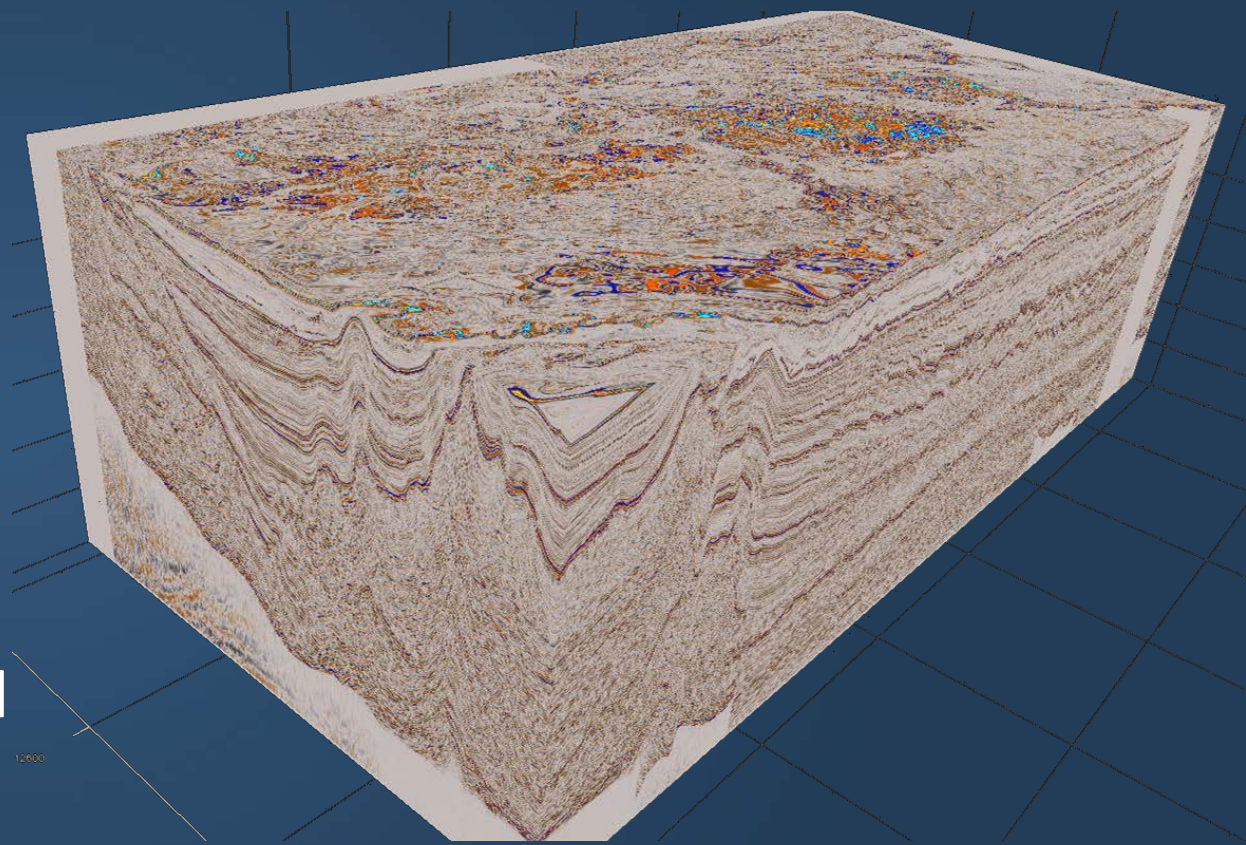
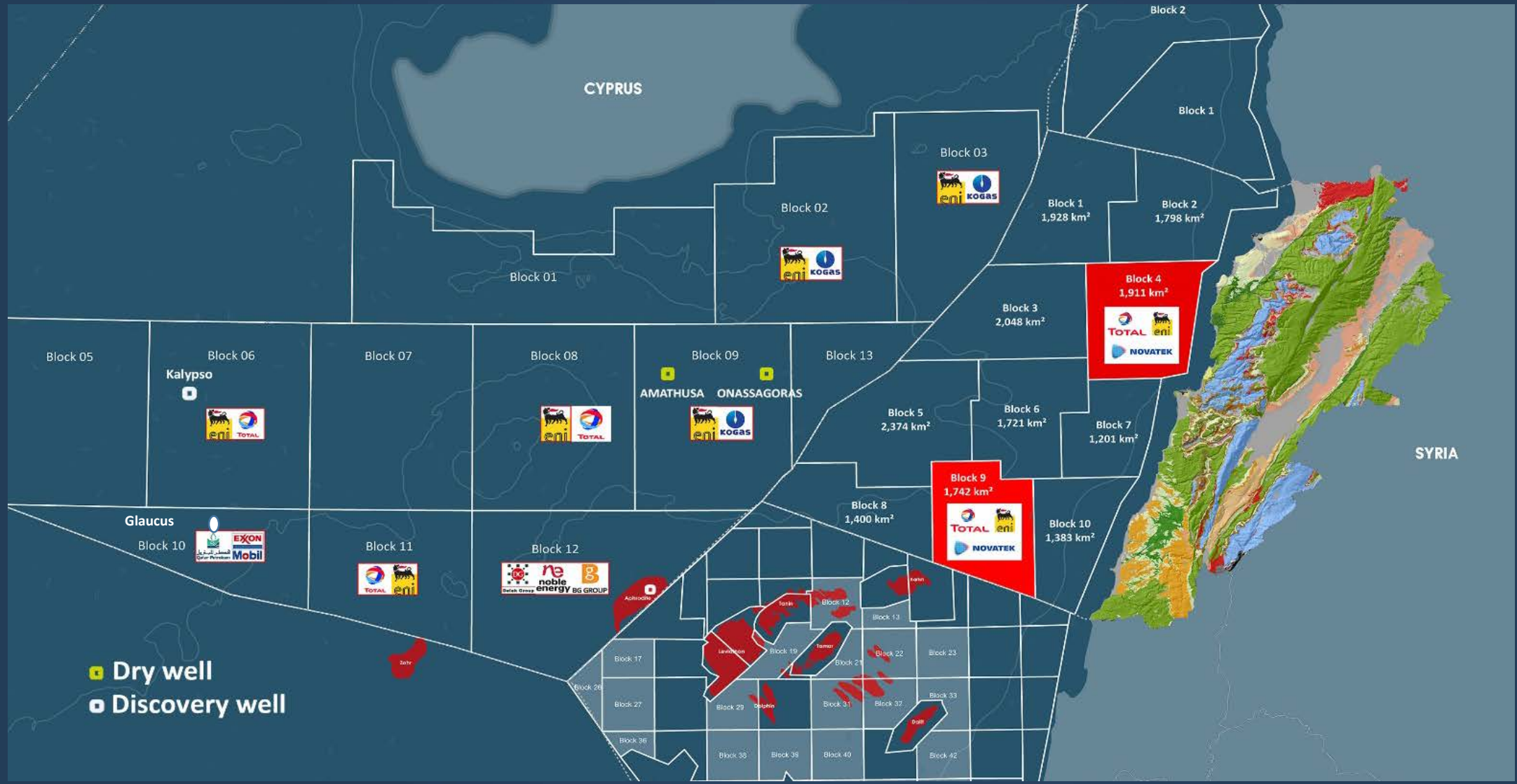
LEBANESE PETROLEUM ADMINISTRATION

# OUTLINE

- Regional Exploration activities
- Play types mapped offshore Lebanon
- Prospectivity examples
- Open blocks for the 2nd licensing round
- Conclusion



# REGIONAL EXPLORATION ACTIVITIES



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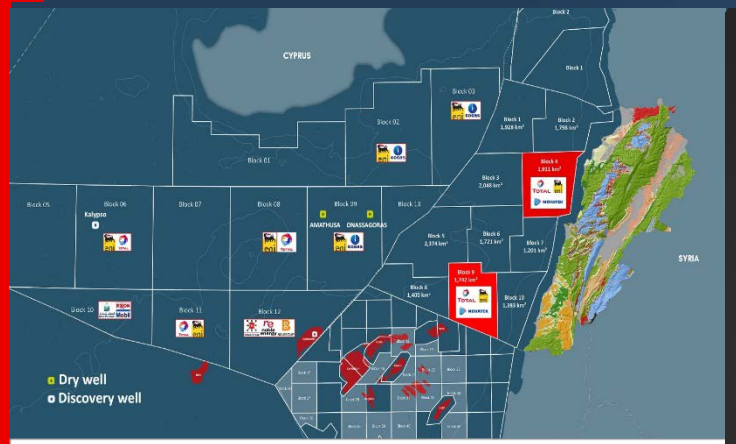
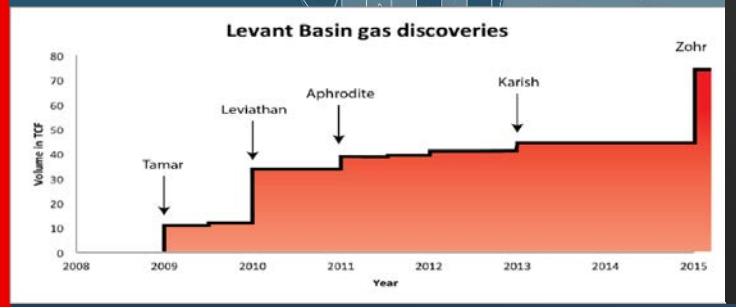
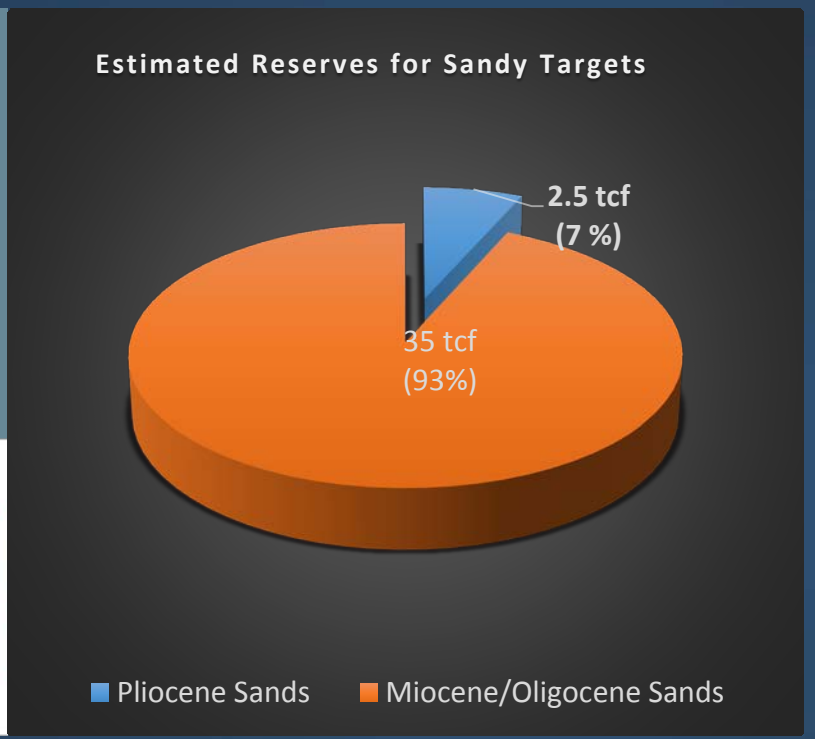
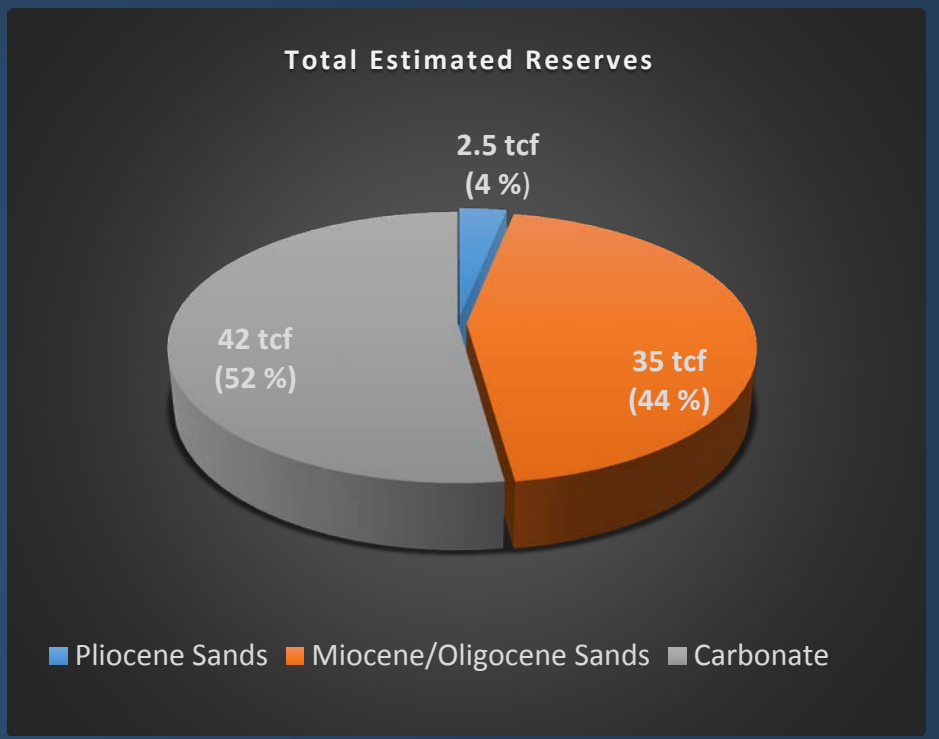


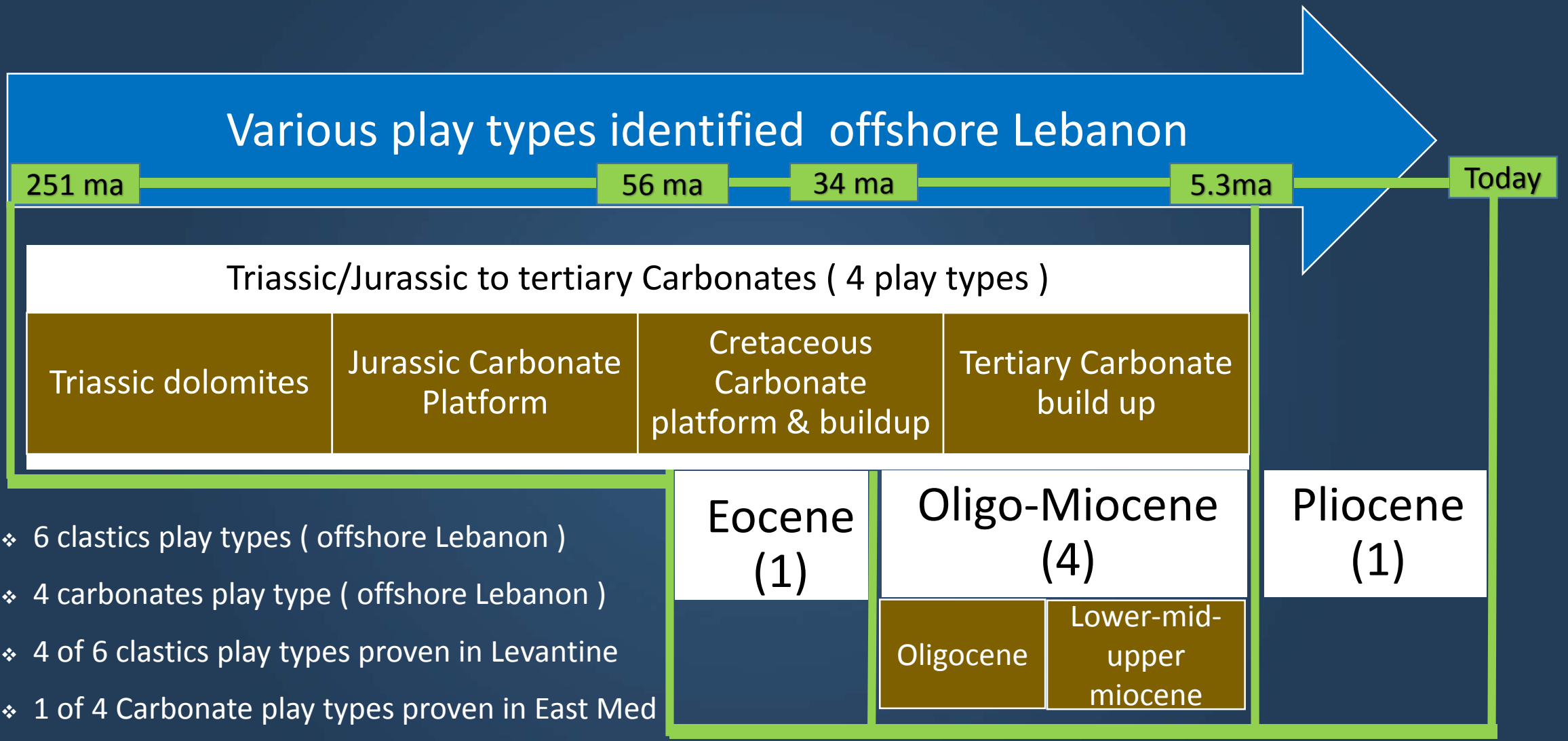




*Source: IHS Market*

- **Offshore Lebanon embeds all the proven play types in the East med and many more**

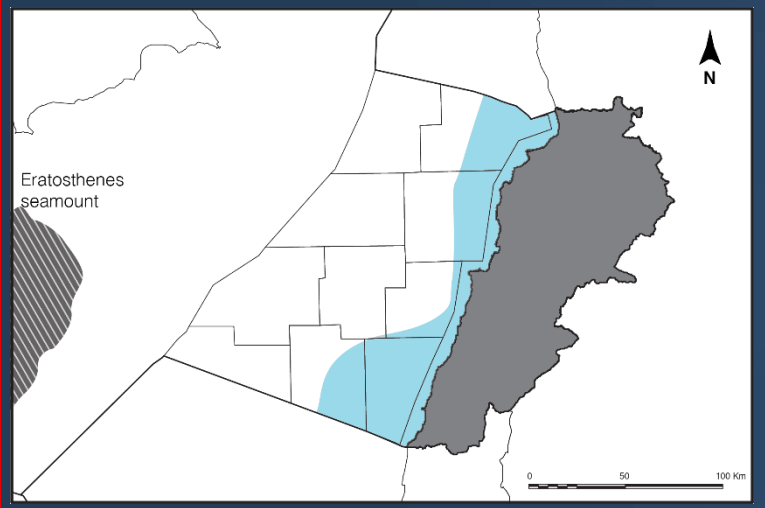
# EXPLORATION PLAYS OFFSHORE LEBANON



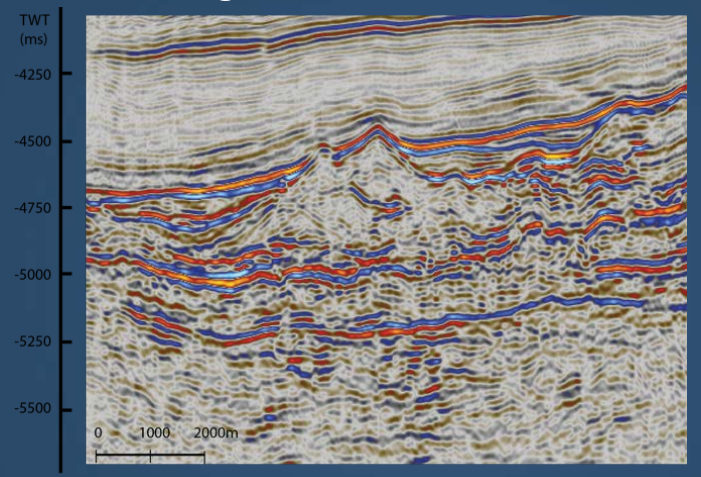

- 6 clastics play types ( offshore Lebanon )
- 4 carbonates play type ( offshore Lebanon )
- 4 of 6 clastics play types proven in Levantine
- 1 of 4 Carbonate play types proven in East Med

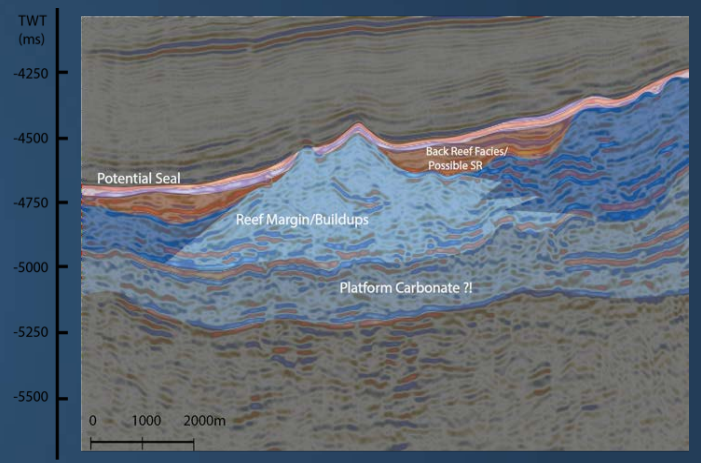
# JURASSIC TO TERTIARY CARBONATIC PLAY - OFFSHORE LEBANON

**Carbonate**
Age Range: 251 ma – 5.3 ma
Depth Range: ~2000– 8500 meters MSL




- Carbonate reservoirs sealed by intraformational shale and sourced by Biogenic or Thermogenic source rock

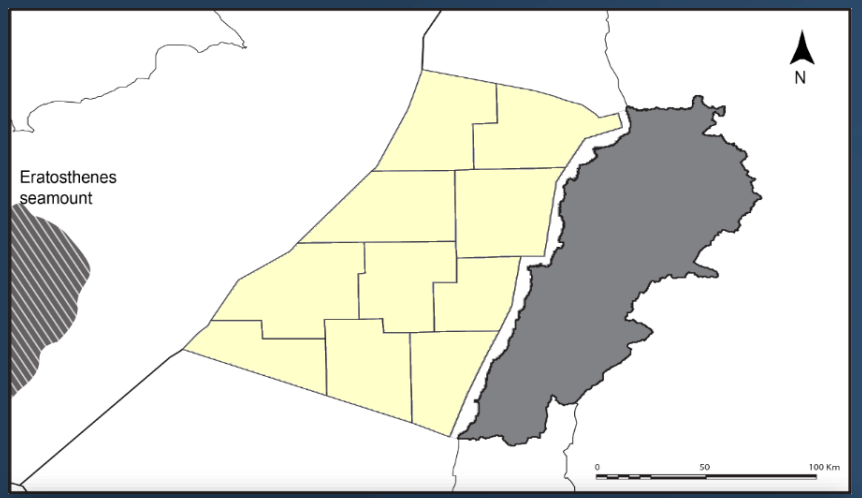


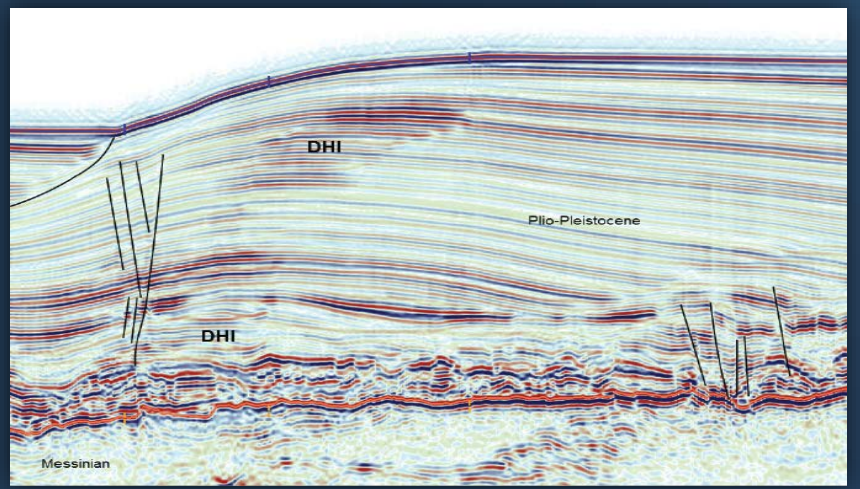




- Localized on the Levant margin
- Analogous in age to carbonate discoveries in the East Mediterranean
- An additionally deeper Carbonate play type is possible
- Found as carbonate buildups

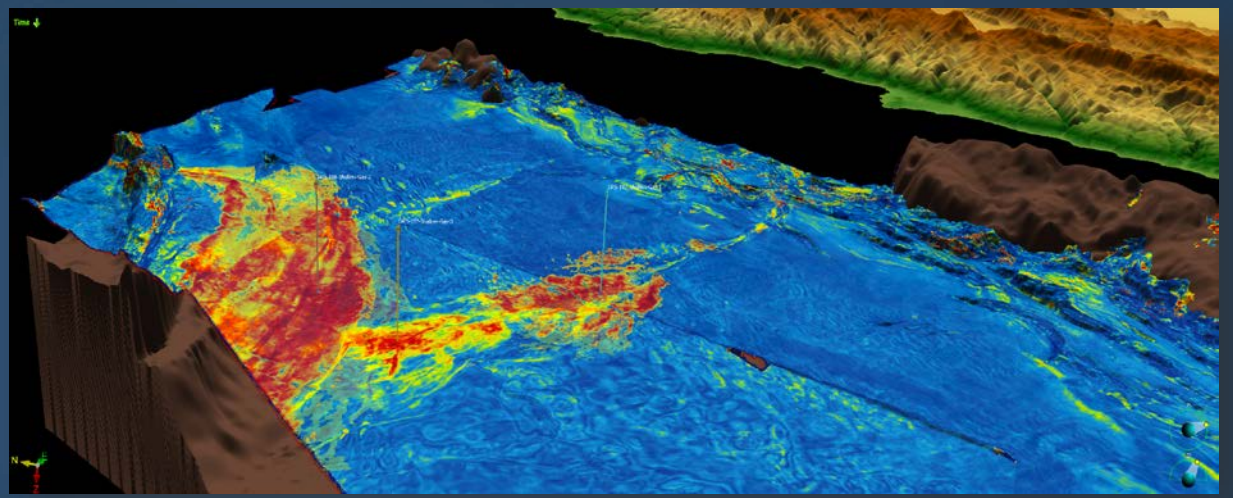
# Pliocene Play - Offshore Lebanon

**Pliocene**
Age Range: 5.3 ma – present
Depth Range: 1600 – 2300 meters MSL



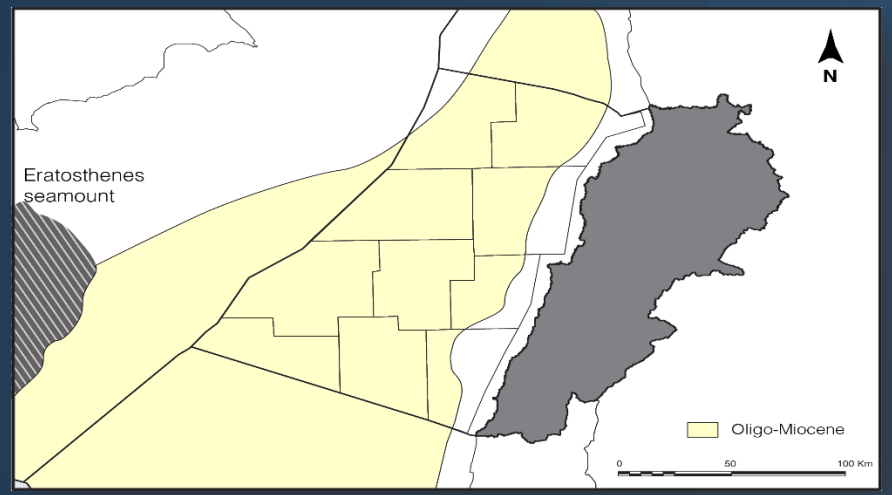

- Plio-Quaternary Sand sealed by Pliocene shale and sourced by Pliocene Biogenic source rock



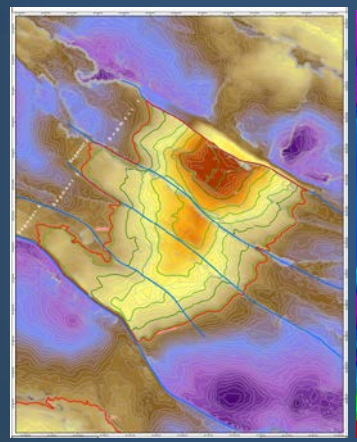
- Proven in Egypt and Gaza
- Extends across the whole basin
- DHIs identified on seismic data
- Primarily Stratigraphic

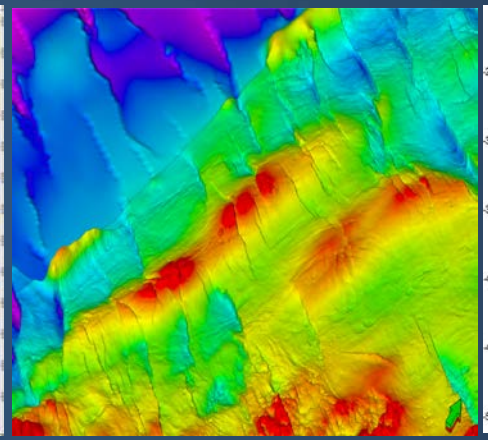
# Oligo- Miocene Play - Offshore Lebanon

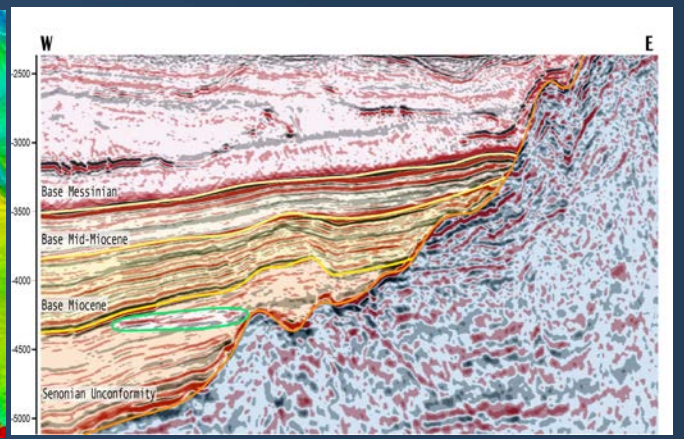
**Oligo-Miocene**
Age Range: 33.9 ma – 5.3 ma
Depth Range: 3500 – 6500 meters MSL




- Miocene Sand sealed by intraformational shale and Messinian salt and sourced by Oligo-Miocene Biogenic source rock with a possible deeper Thermogenic Component





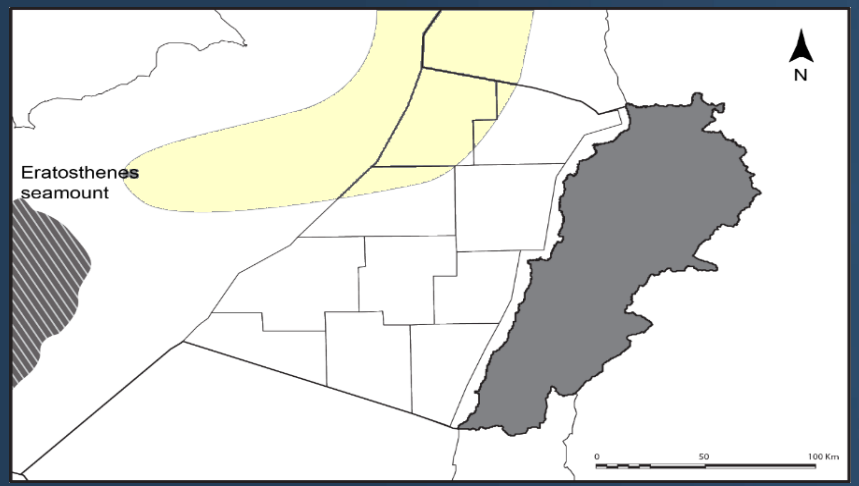


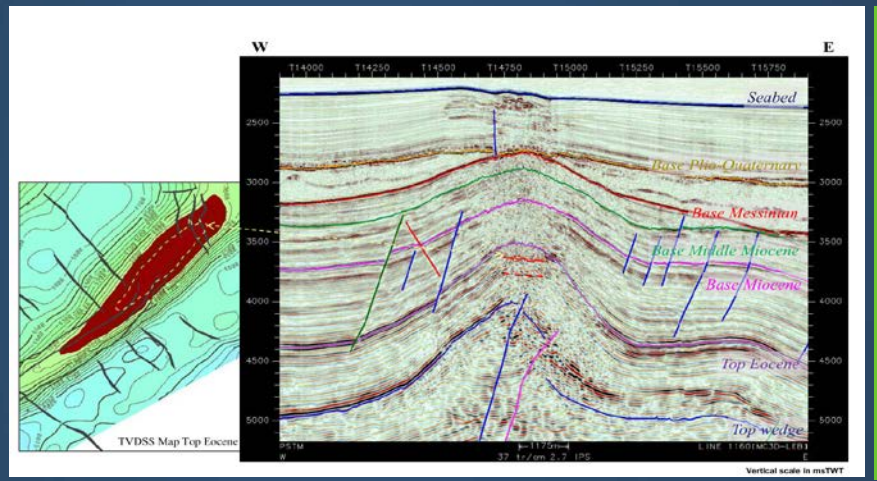

- Proven in South Levant Basin and Eastern Mediterranean
- Extends Across the Majority of the Basin
- Found in Found in 3-way dip (fault blocks), 4-way dip anticlines and Pinchouts

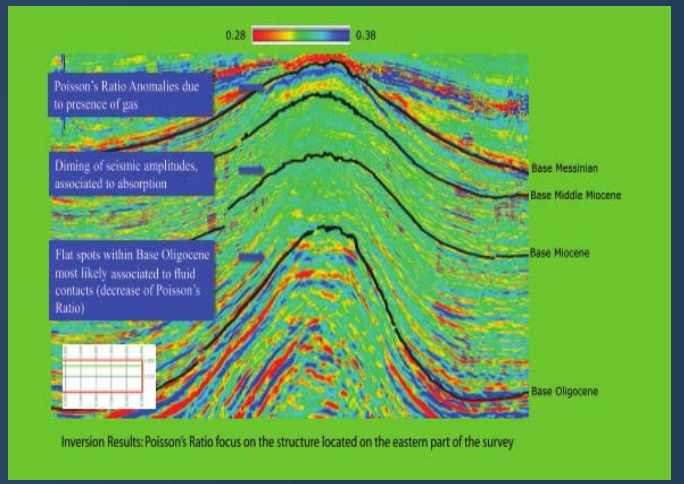
# Eocene Play - Offshore Lebanon

**Oligo-Miocene**
Age Range: 33.9 ma – 5.3 ma
Depth Range: 3500 – 6500 meters MSL

- Eocene Sand/calciturbidite limestone? reservoirs sealed by Eocene intraformational shale and sourced by Eocene and Mesozoic Thermogenic source rock

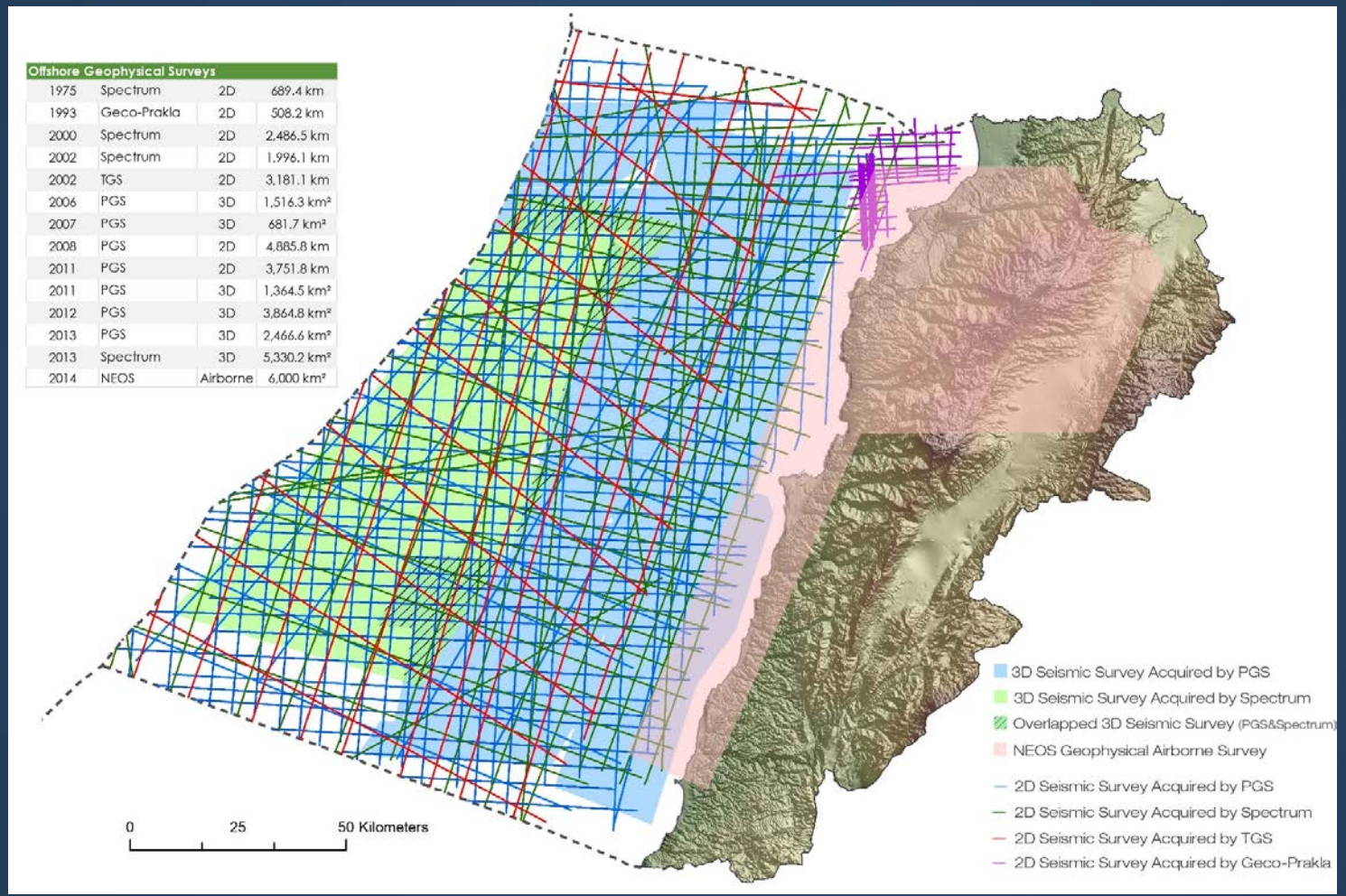


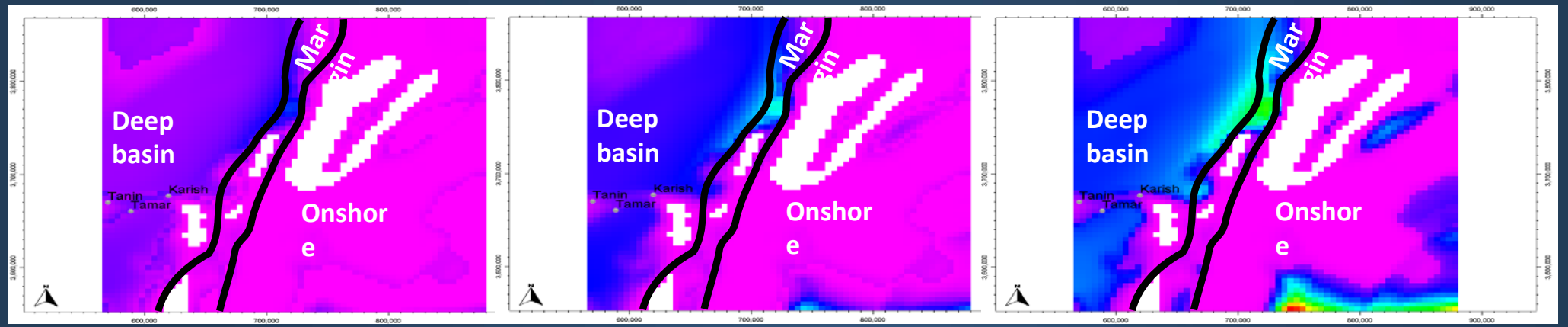

- Localized NW of the basin
- Flatspots and DHI indicators identified on seismic data
- Found as 4 way dip anticlines

# GEOPHYSICAL DATA COVERAGE OFFSHORE LEBANON

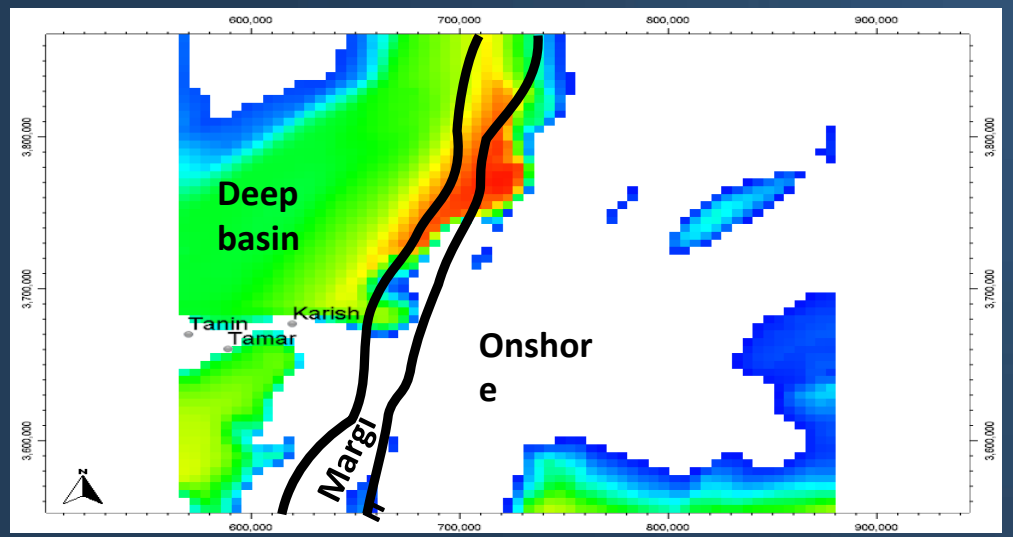



40 Companies have Licensed Lebanese Offshore Data

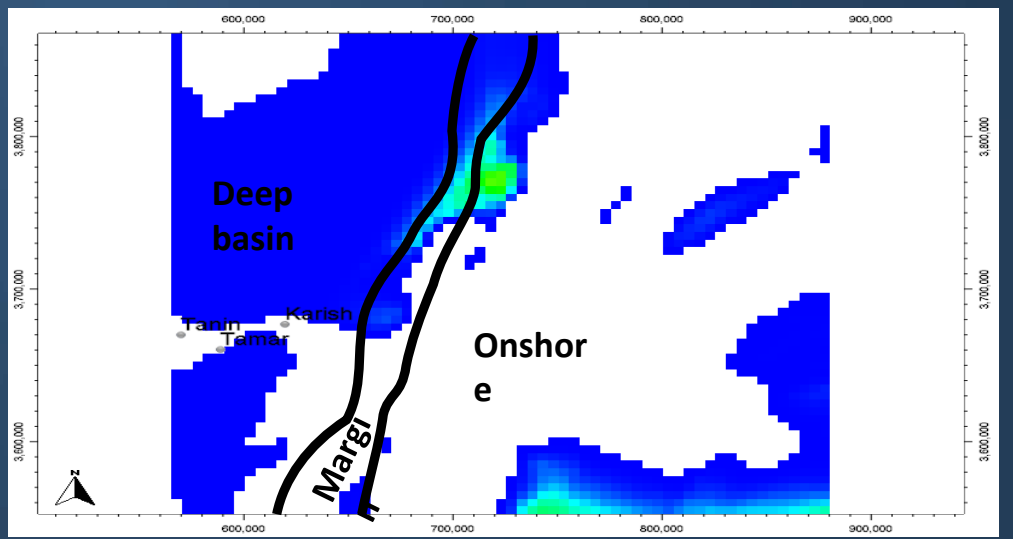
# CAMPANIAN SOURCE ROCK EXPELLED OIL PROBABILITY ( IFPEN )




P10 (Worst Case) P50 P90 (Best Case)



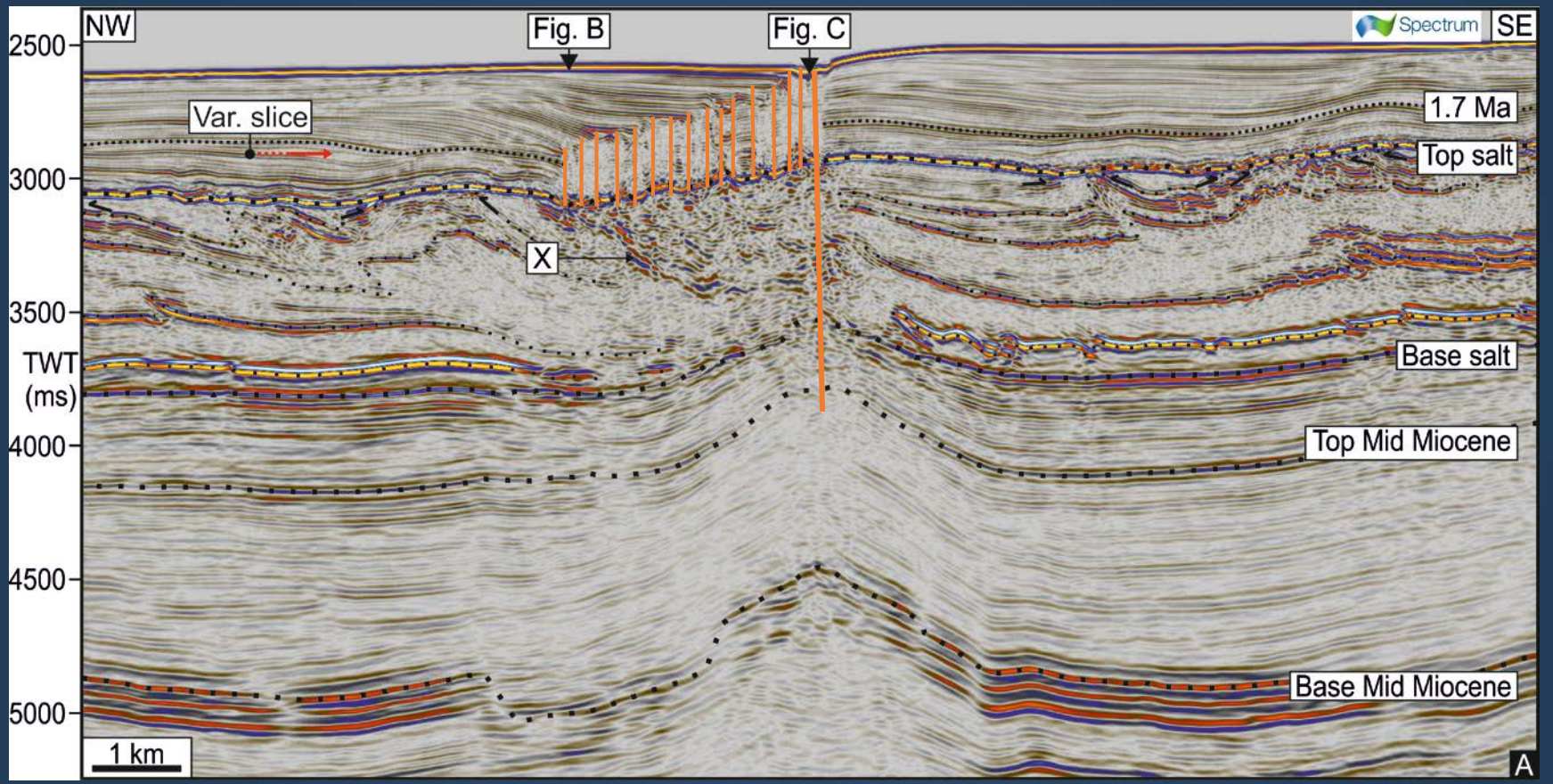

Probability that expelled oil > 1000kg/m²



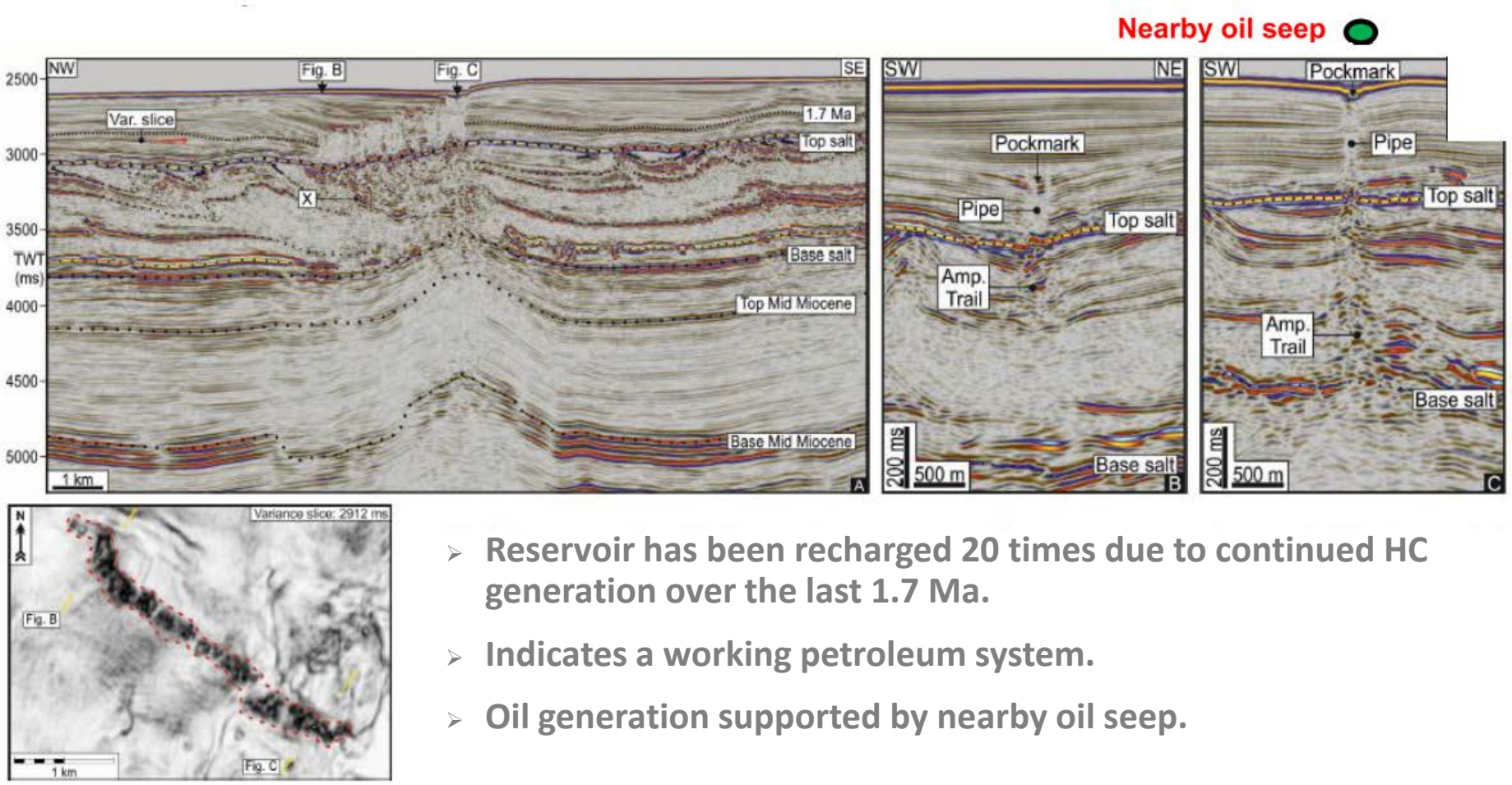

Probability(%) that expelled oil > 2500kg/m²

*Ducros, Nader et al. 2019*

Messinian
Present Time

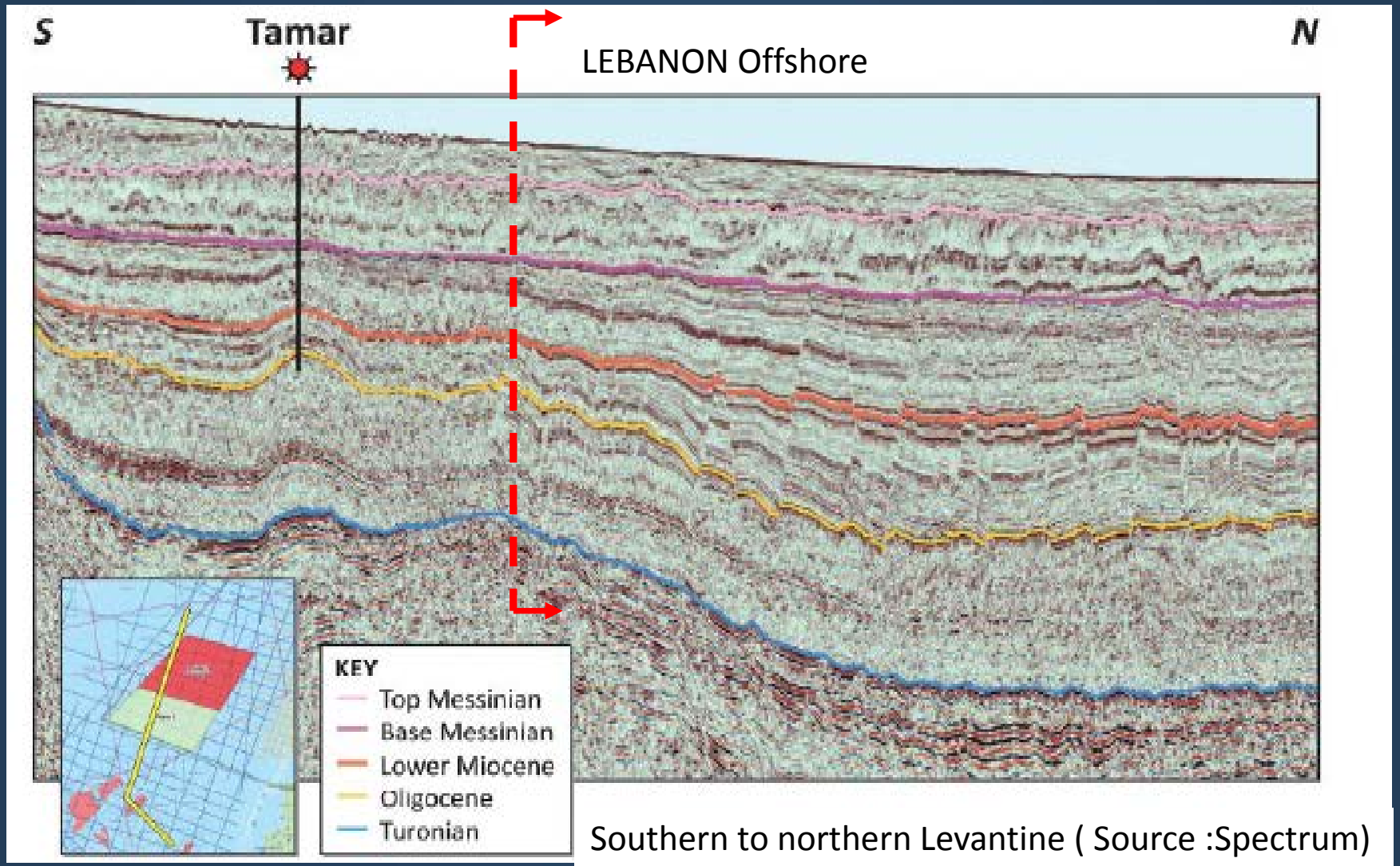

NW
SE
Spectrum
Fig. B
Fig. C
Var. slice
X
1.7 Ma
Top salt
Base salt
Top Mid Miocene
Base Mid Miocene
2500
3000
3500
4000
4500
5000
TWT (ms)
1 km
A

# MULTI-EPISODE FLUID ESCAPE



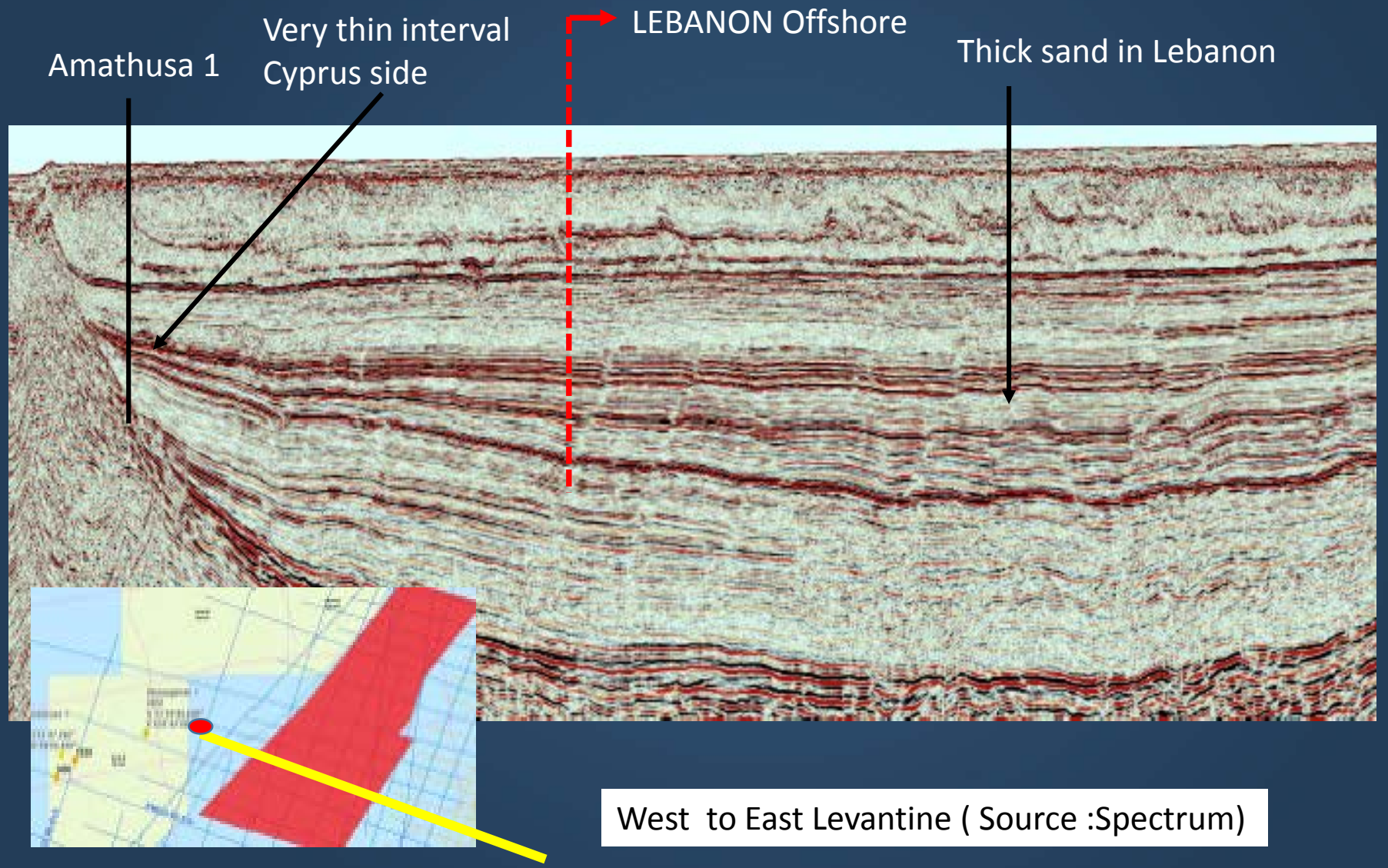

- Reservoir has been recharged 20 times due to continued HC generation over the last 1.7 Ma.
- Indicates a working petroleum system.
- Oil generation supported by nearby oil seep.

# SEDIMENTS THICKNESS OFFSHORE LEBANON



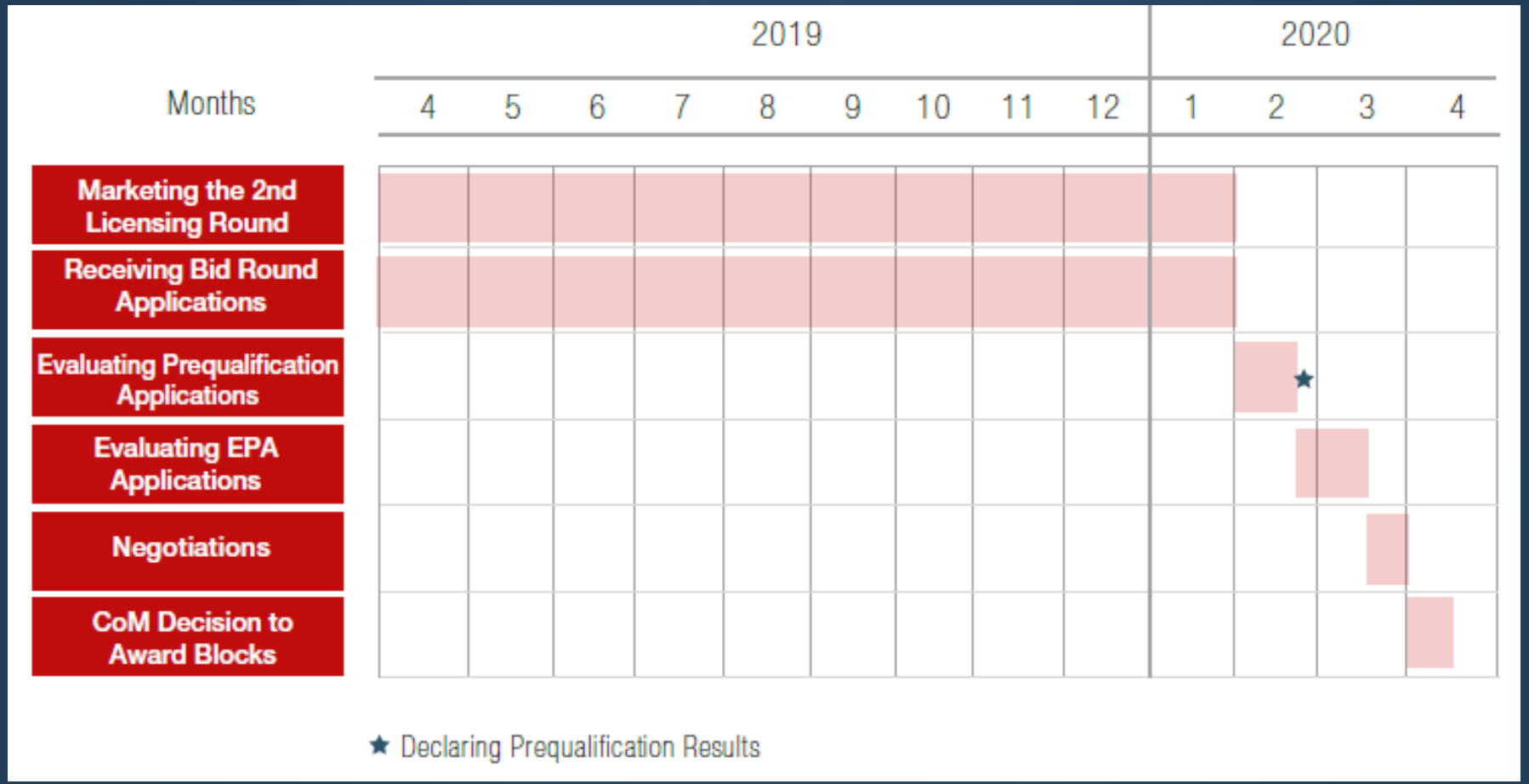

Southern to northern Levantine ( Source :Spectrum)

# SEDIMENTS THICKNESS OFFSHORE LEBANON

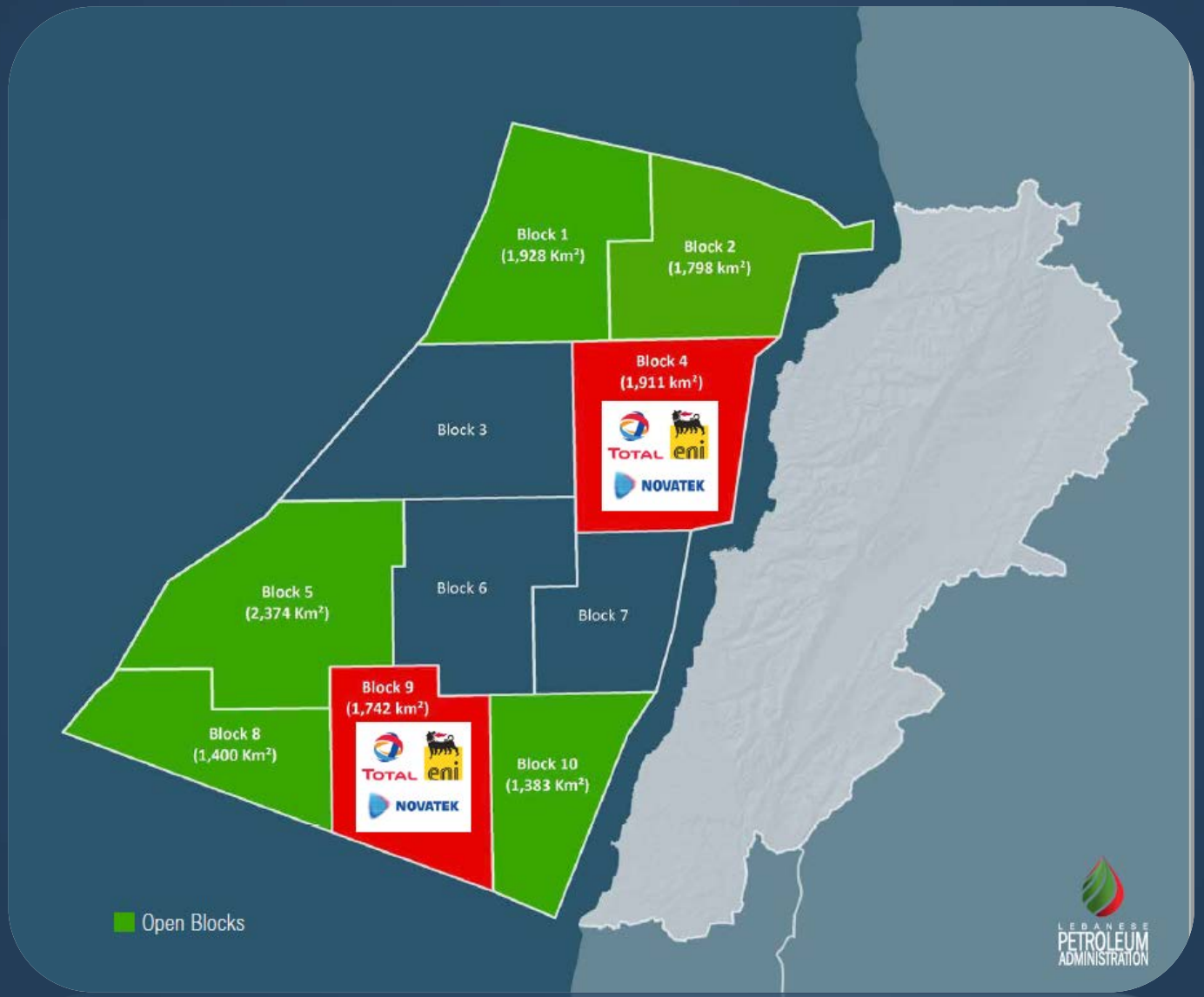



West to East Levantine ( Source :Spectrum)

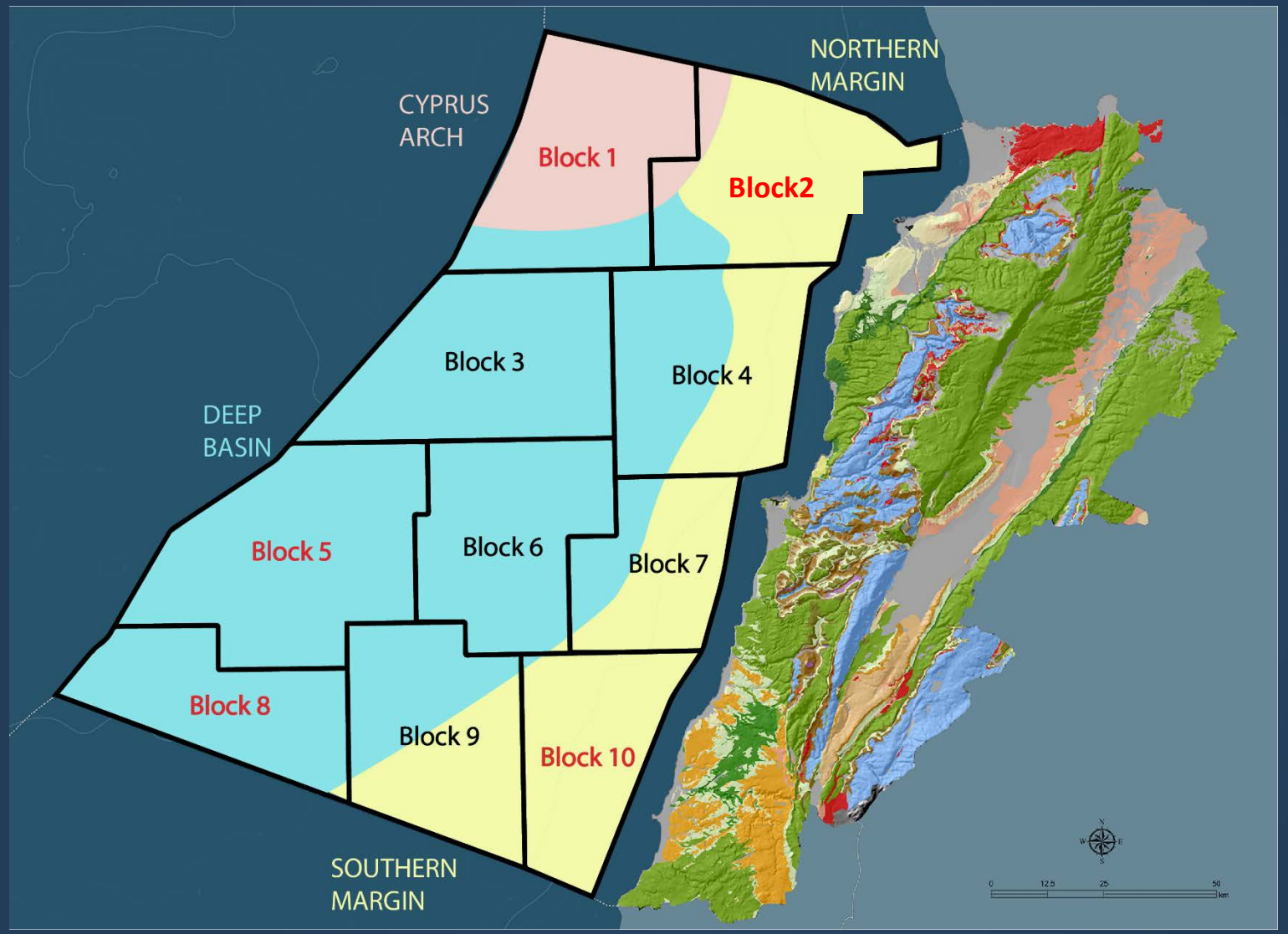
# TIMELINE FOR 2ND LICENSING ROUND



# BLOCKS OPEN FOR 2ND LICENSING ROUND



# 2nd Licensing Round – Blocks Opened ( geologic zones)



# 2nd Licensing Round – Blocks Opened ( Matrix )

| B#1 Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge | Anticline | Silici-clastic |
| Deep Basin | 3 – Way Dip (Fault Blocks) | Calci-clastic |
| Margin | Stratigraphic | Carbonate Buildup |

| B#2 Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge | Anticline | Silici-clastic |
| Deep Basin | 3 – Way Dip (Fault Blocks) | Calci-clastic |
| Margin | Stratigraphic | Carbonate Buildup |

| B#5 Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge | Anticline | Silici-clastic |
| Deep Basin | 3 – Way Dip (Fault Blocks) | Calci-clastic |
| Margin | Stratigraphic | Carbonate Buildup |

| B#8 Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge | Anticline | Silici-clastic |
| Deep Basin | 3 – Way Dip (Fault Blocks) | Calci-clastic |
| Margin | Stratigraphic | Carbonate Buildup |

| B#10 Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge | Anticline | Silici-clastic |
| Deep Basin | 3 – Way Dip (Fault Blocks) | Calci-clastic |
| Margin | Stratigraphic | Carbonate Buildup |

| All Geological Zones | Trap | Lithology |
|---|---|---|
| Latakia Ridge ( block 1) | Anticline (block 1) | Silici-clastic (blocks 1,2,5,8) |
| Deep Basin (blocks 5,8) | 3 – Way Dip (Fault Blocks) (blocks 5,8) | Calci-clastic (blocks 1,5,8) |
| Margin (2,10) | Stratigraphic (blocks 2,10) | Carbonate Buildup (blocks 2,10) |

# CONCLUSION

## Biogenic

### Structural traps

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

### Stratigraphic plays

- PROVEN — Pliocene sourced by Pliocene biogenic SR
- NEW PLAY CONCEPT — Oligocene and Miocene pinchouts sourced by Oligo-Miocene biogenic SR
- PROVEN — Cretaceous to Miocene carbonate reservoirs sourced by biogenic SR

## Thermogenic (Oil and Gas)

### Structural traps

- NEW PLAY CONCEPT — Late Cretaceous anticlinal closures sourced by Jurassic thermogenic source rocks
- PROVEN — Oligo-Miocene anticlinal closures sourced by thermogenic Oligo-Miocene SR
- PROVEN — Oligo-Miocene faulted anticlines sourced thermogenic Oligo-Miocene SR

### Stratigraphic plays

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

# THANK YOU

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