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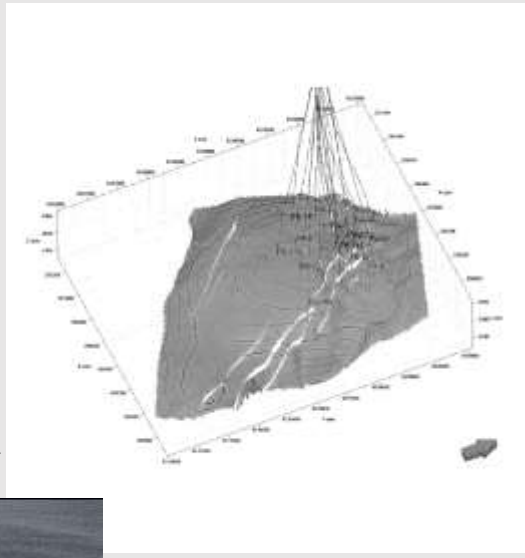
Chasing hydrocarbon reserves in Carbonate Buildups: Examples from the Eastern Mediterranean



IENE, Athens 30-31, Oct. 2018

www.greekhydrocarbons.gr

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Outline

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- Introduction
- Data and Methods
- Geological Setting
- Carbonate Buildups in the East Mediterranean
- Conclusions and Future work

What is a Carbonate Platform?

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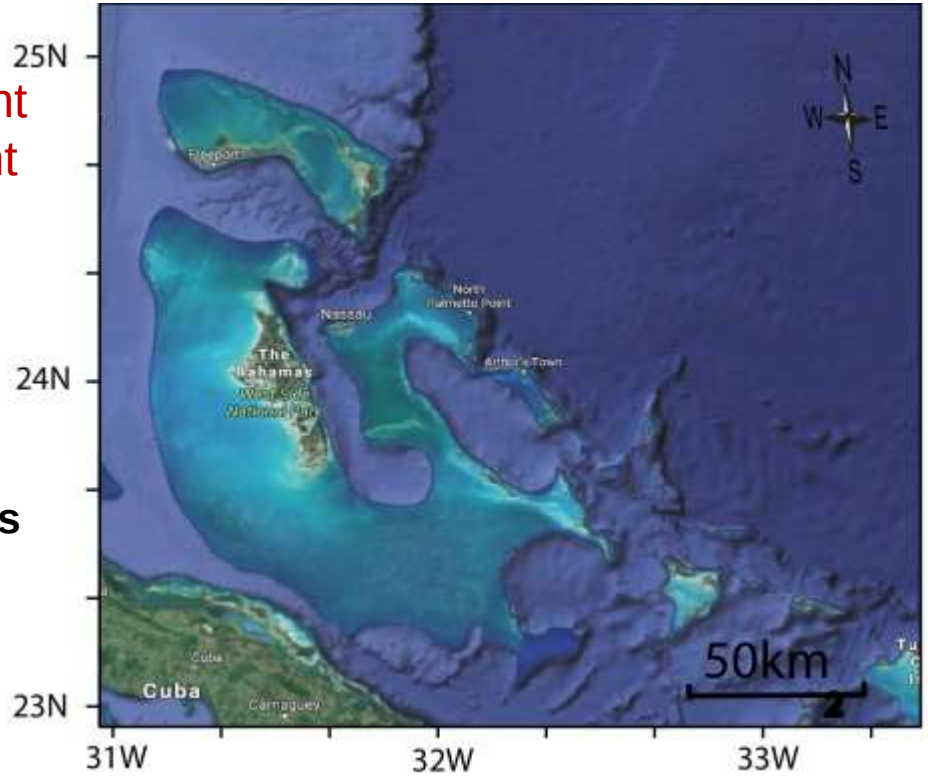
A body of shallow carbonate strata deposited as a geomorphic feature adjacent to deeper-water strata and include different facies
(reefs, lagoons, tidal flat deposits).



Why it is important;

They host significant hydrocarbon resources

Examples of good reservoirs:

- The Carboniferous of North America (360-299 Ma)
- The Permian of the United States (298-250 Ma)
- **The Mesozoic in the Mediterranean (200- 65 Ma)**
- Tertiary Southeast Asia and Brazil. (24- 5 Ma)

Geophysical studies

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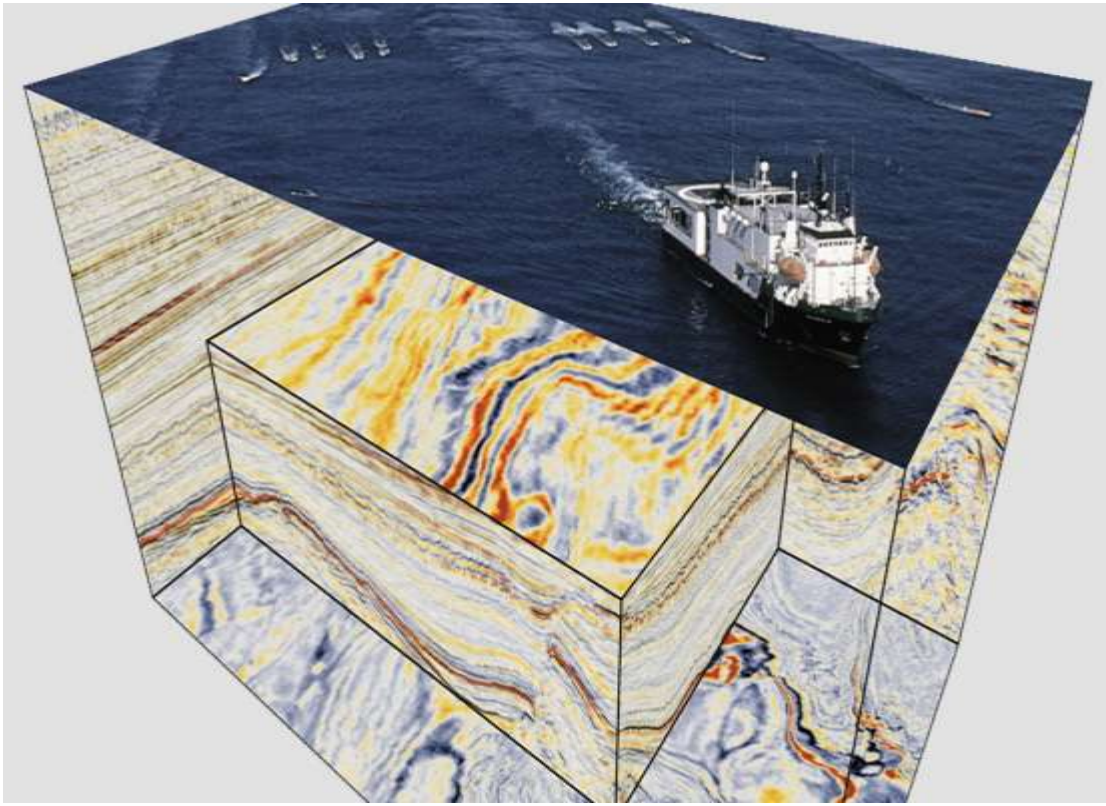
- **Seismic Interpretation**
- **Well data**
- **Magnetic anomalies map** *(UGGS)*
- **Gravity map**



Study Area

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(a) Mountain belts due to continental Collison

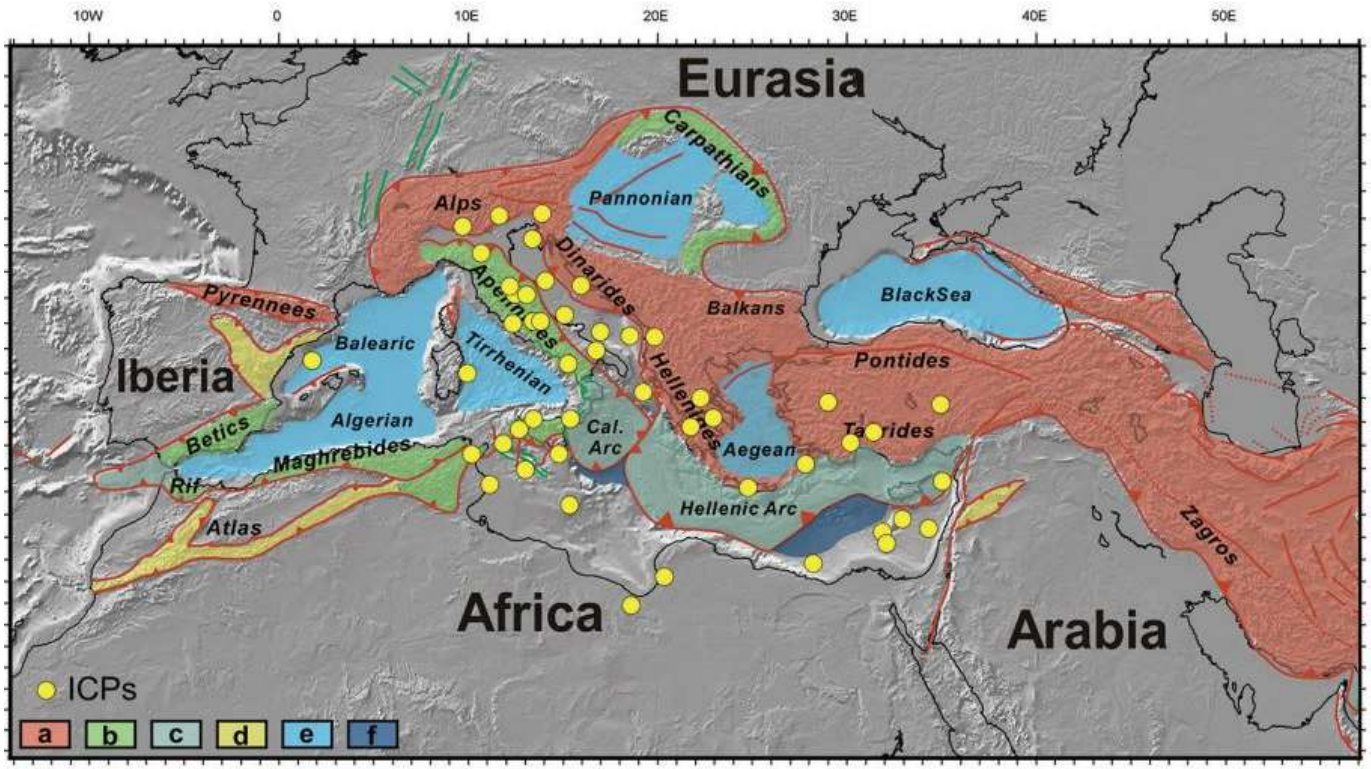
(b) Fold and thrust belts

(c) Accretionary complexes

(d) Intracontinental belts

(e) Back – Arc basins

(f) Tethyan ocean



Distribution of Isolate Carbonate Platforms in the Mediterranean *(Giovanni Rusciadelli and Peter Shiner, 2018)*

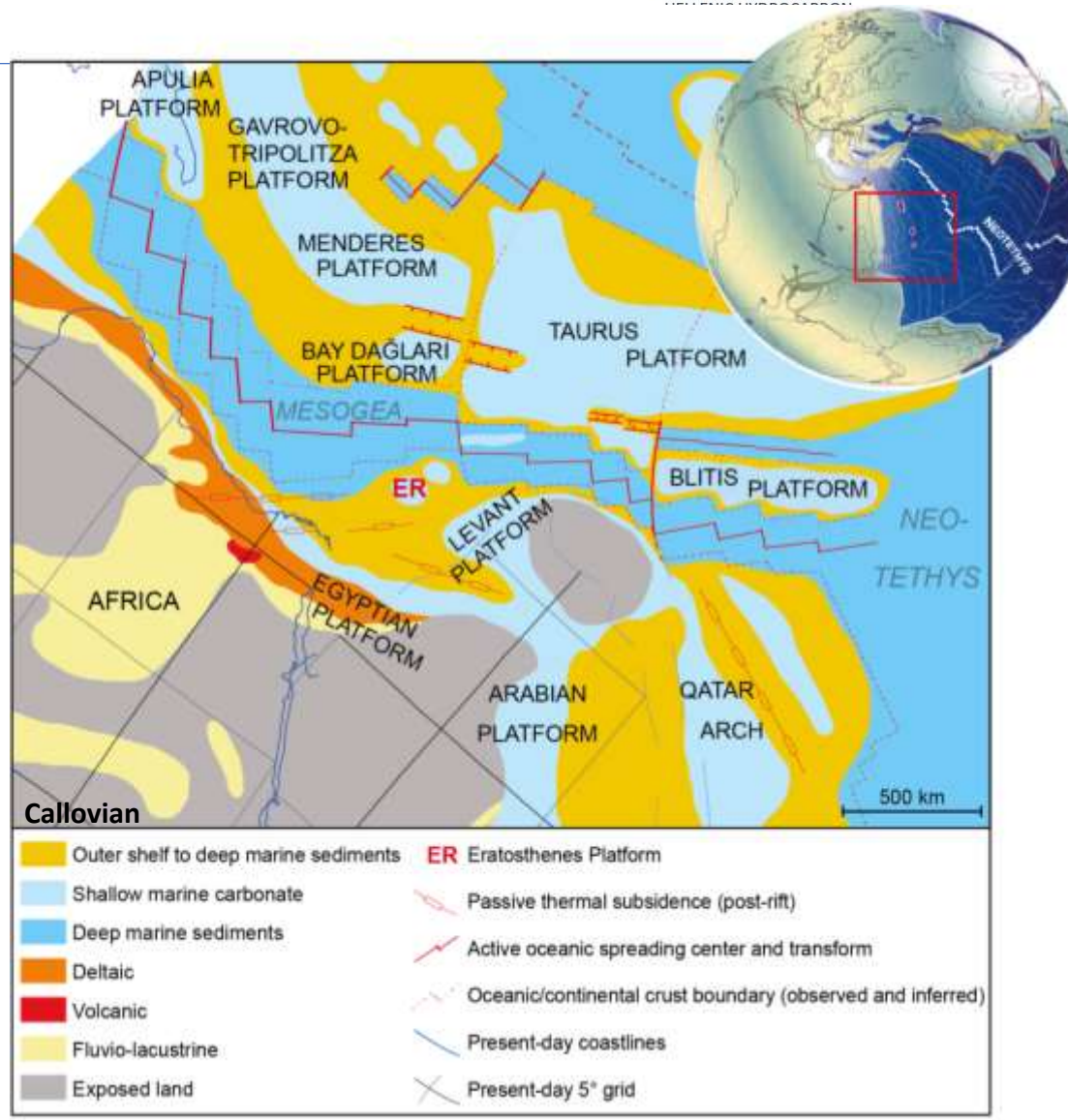
Geological Setting

Late Permian-Triassic-Jurassic
Tethyan rifting
Opening of Neo-Tethys ocean

Examples:

North:
- ICPs developed on the Adriatic microcontinent (Apulian, Adriatic-Gavrovo-Tripolitza)
- Menderes platform
- Taurus platforms

South:
- Eratosthenes Carbonate Platform
- Levant and Egyptian Margin



(after Vrielynck et al., 2014)

Examples from Eastern Mediterranean

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Hyper extended margin with thin continental crust (Inati et al., 2016)

Experience several tectonic processes:

- Rifting
- Passive margin development
- Convergence and ophiolite emplacement

(e.g., Dewey et al., 1973; Garfunkel, 2004; Aksu et al., 2005; Le Pichon and Kreemer, 2010).

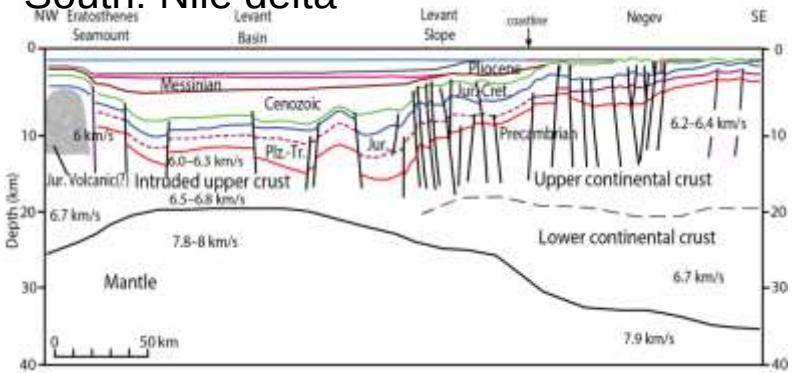
Bounded:

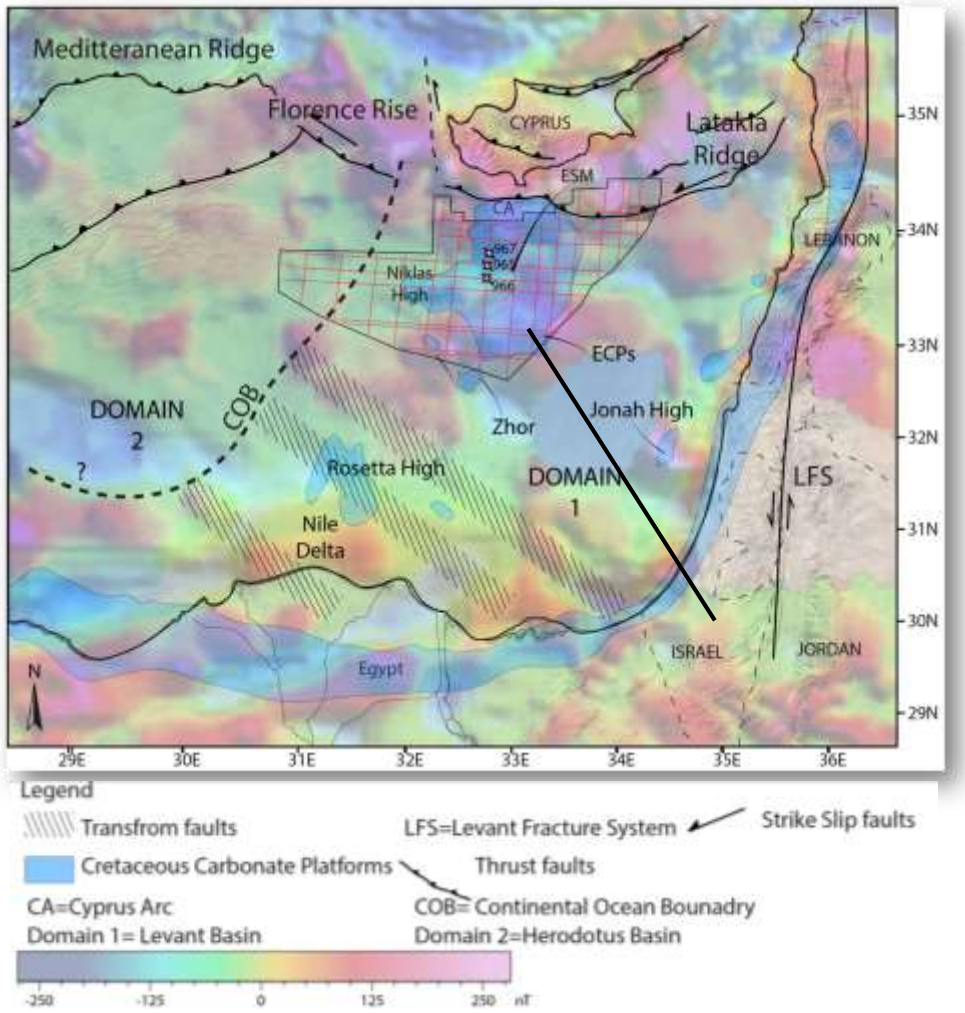
North: Collision zone

East: Stike-slip (major plate boundary)

West: Isolate Carbonate platform to the west

South: Nile delta





(Gardosh et al., 2010)

Seismic interpretation

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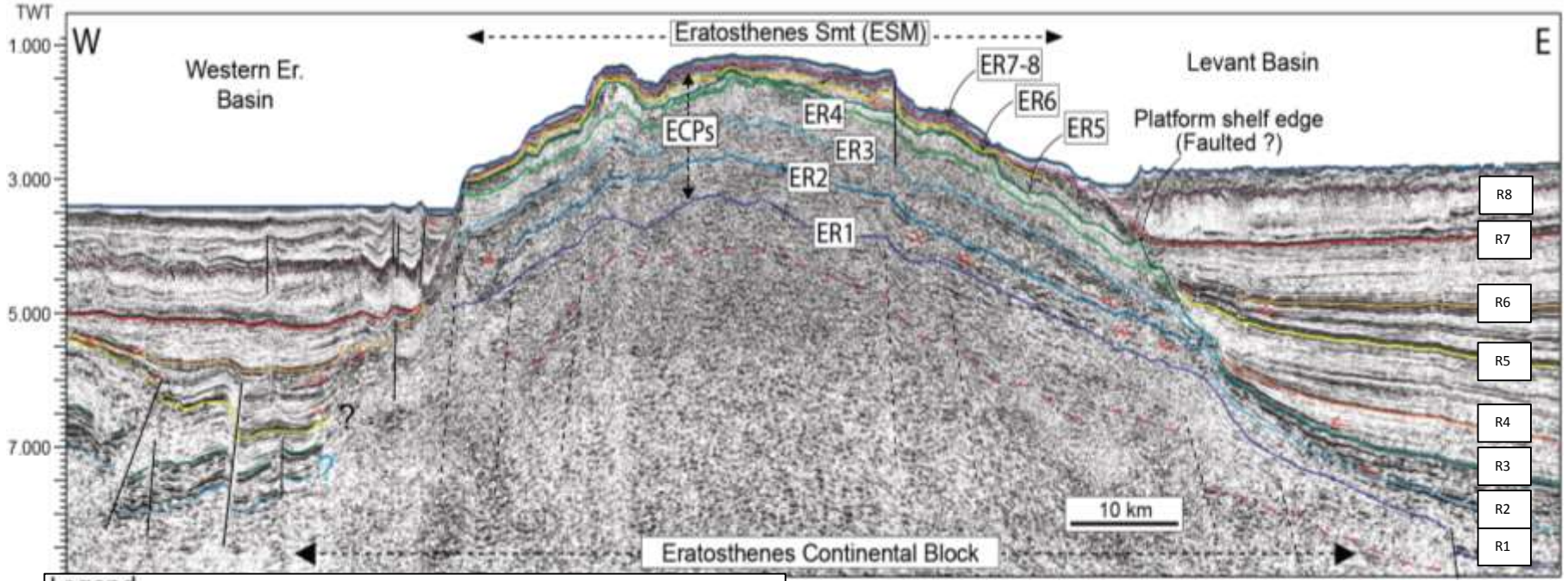
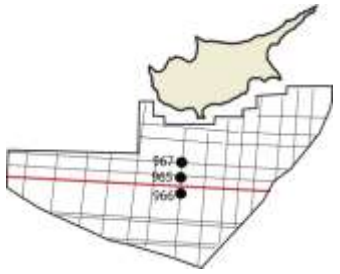


Legend

- Base Pliocene
- ME5 (Messinian erosional surface)
- Top Messinian evaporites
- Base Messinian
- Base Mid Miocene
- SP1 Seismic Package
- Fault
- Top Oligocene
- Eocene Unc.
- Senonian Unc.
- Intra Cretaceous
- Top Jurassic
- Intra Late Jurassic
- Mid Jurassic
- Basement boundary

M1 = Levant Basin
M2 = Messinian
M3 = Pliocene
M4 = ECPs (Eratosthenes Carbonate Platforms)



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Eratosthenes Carbonate Platform

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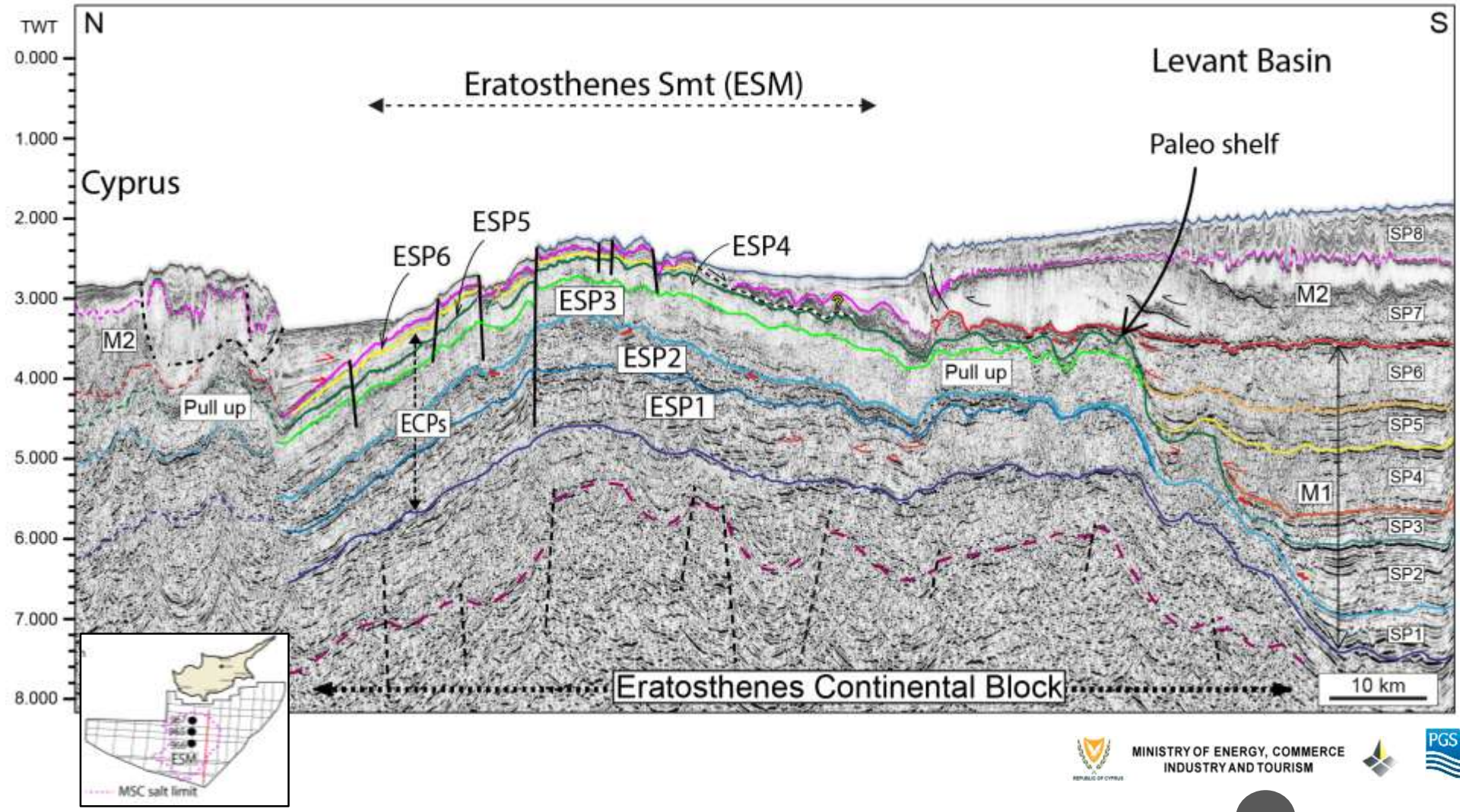

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Seismic Interpretation

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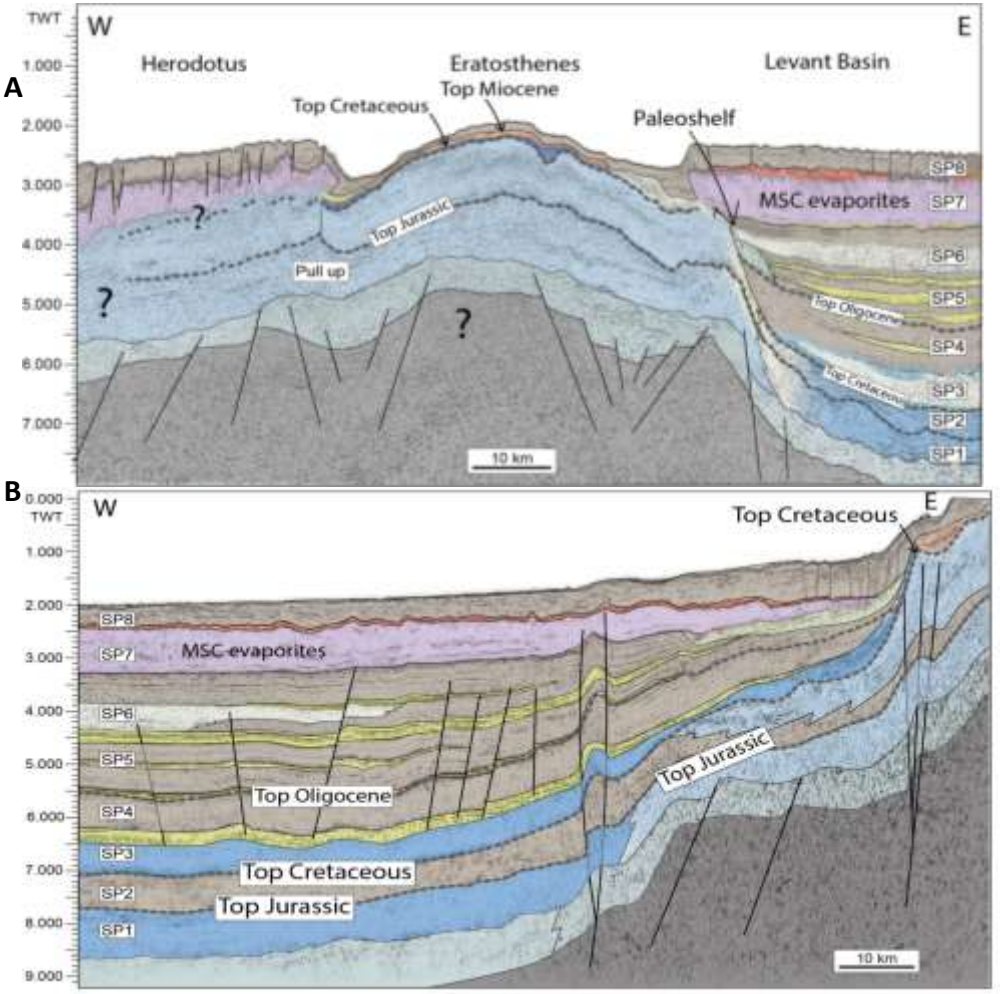
Seismic Packages	Age	Events	Lower Bounding surface	Upper Bounding surface	Reflection configuration
SP 8	Pliocene		Irregular surface/truncation	Irregular surface/truncation	Parallel to subparallel configuration
SP 7	Messinian	MSC	Irregular surface/truncation	Irregular surface/truncation	Reflection free configuration (transparent)
SP 6	Late Miocene	CONVERGENCE PHASE COLISION (silisiclastic influx)	Onlaps Onlaps on the margin	Irregular surface/ truncation	Parallel to subparallel reflection and minor chaotic reflections
SP 5	Early Miocene		Conformable Onlaps on the margin	minor truncation	Subparallel configurations with some high amplitude condensed intervals
SP 4	Oligocene		Irregular surface/truncation	Conformable	parallel to subparallel configurations/ Progradational sigmoid configuration with minor chaotic intercalations
SP3	Late Cretaceous-Eocene		Onlap surface	Irregular surface/truncation	Parallel to subparallel reflections intercalated with some chaotic configuration
SP2	Cretaceous	POST RIFT PHASE	Baselap	Comformable	High amplitude parallel to subparallel configuration with some mounded intervals
SP1	Late Jurassic		-Onlaps	Baselap	Parallel to subparallel reflections with some minor chaotic intervals



(Hawie et al., 2013)

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Seismic Interpretation

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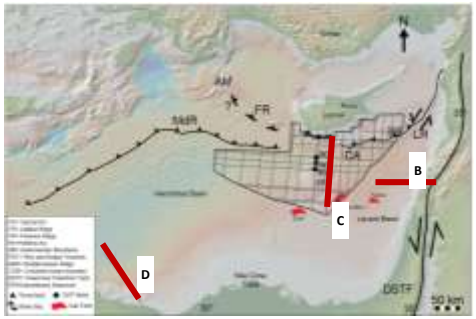

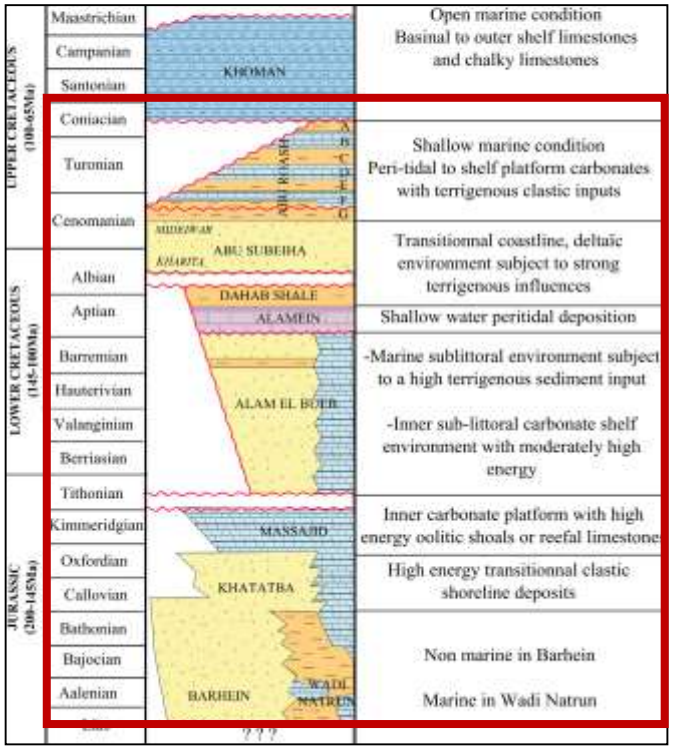

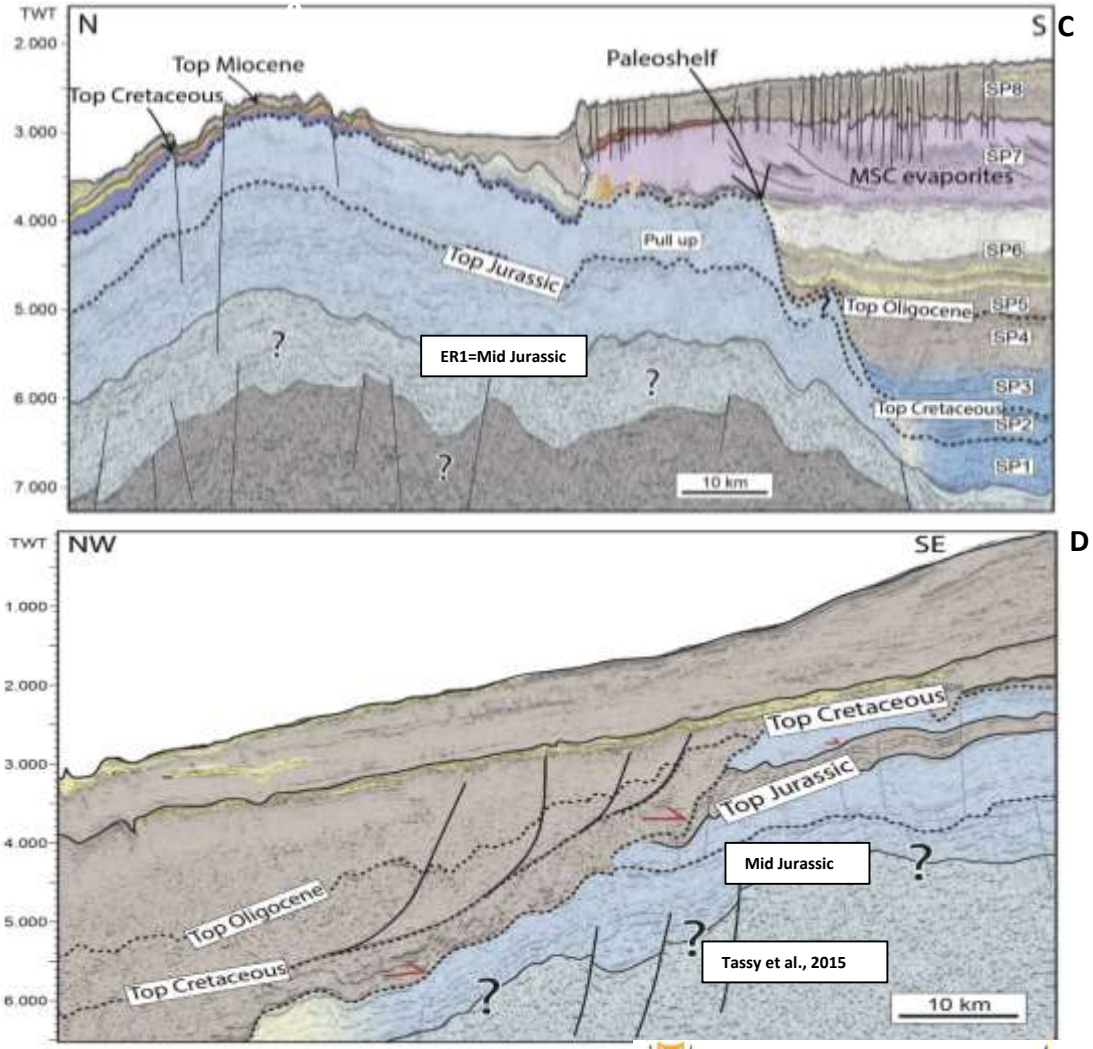

Tassy et al., 2015

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Tethyan Carbonate Platforms (Apulia)

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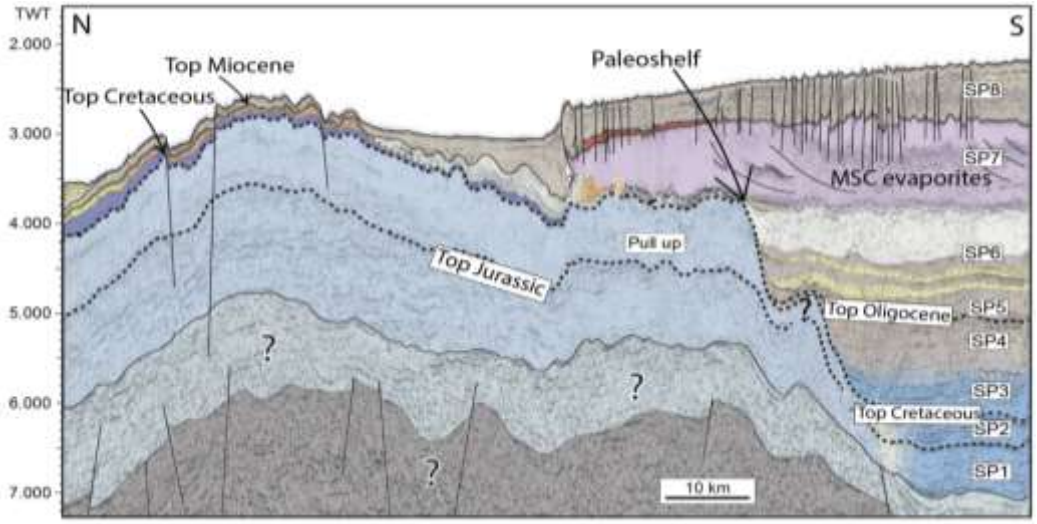
- Similarly during the Mesozoic, the Apulian platform was isolated and could be a good analogue.
- Deep-water gravity flow carbonates of Late Cretaceous outcropping in the Gargano Peninsula and the Maiella Mountain are analogous with Eratosthenes gravity driven deposits .

D



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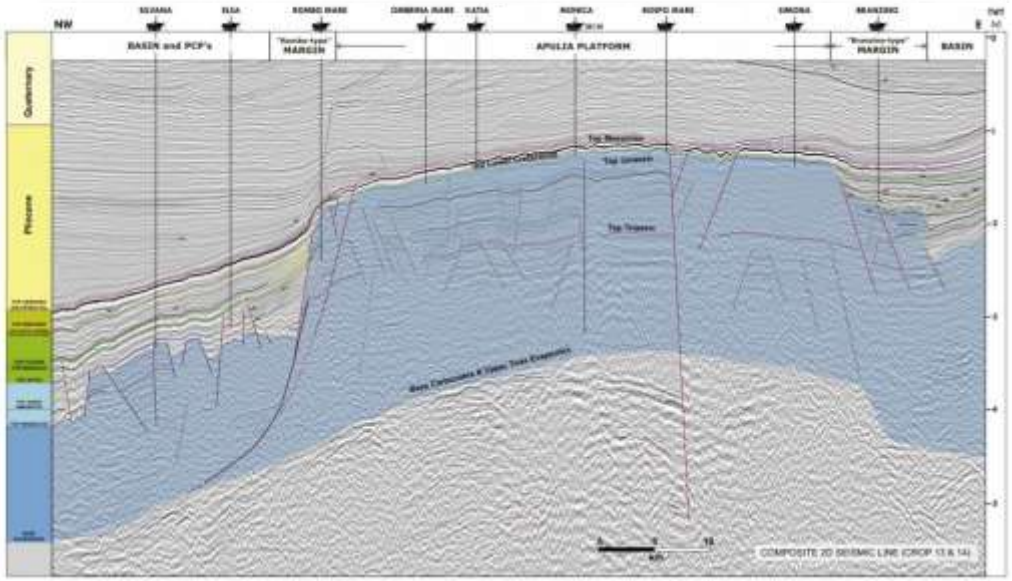

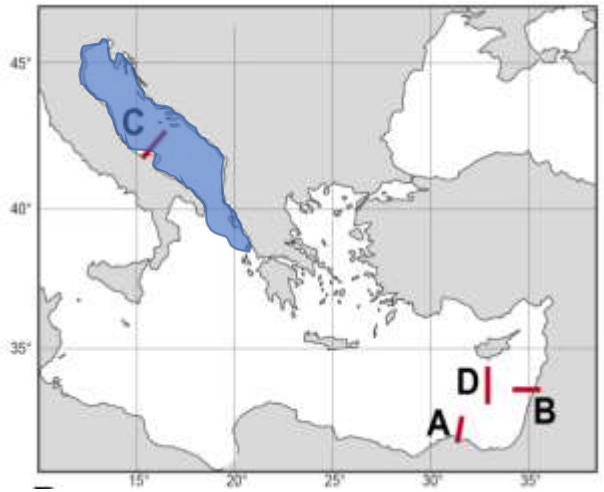

Santantonio et al., 2013

Hellenic Arc (Offshore Crete)

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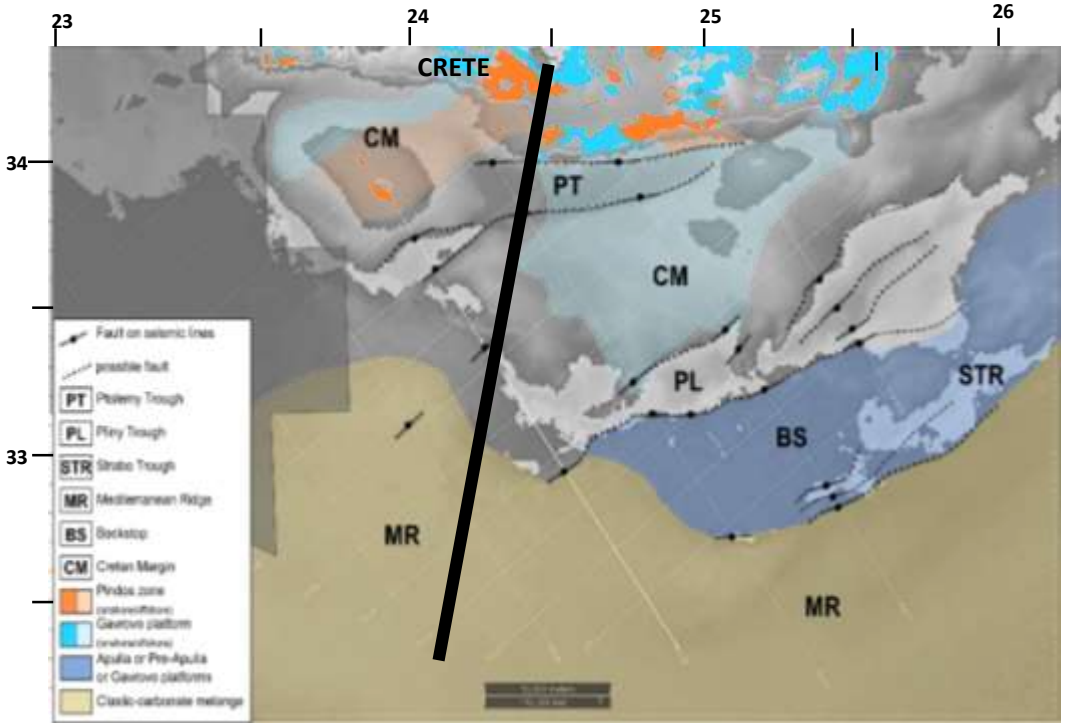
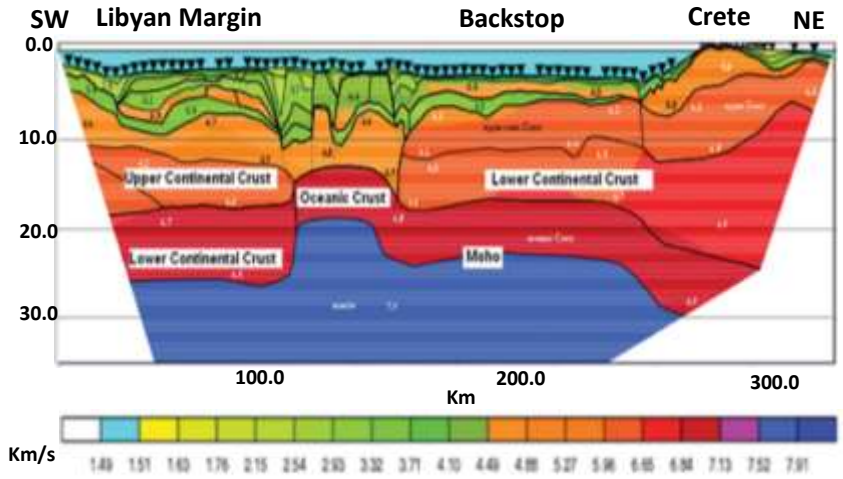
Hellenic Arc
Fold belt

CM: Cretan margin
BS: Backstop
MR: Accretionary prism

Bounded
North: Crete
South: African plate
East: Herodotus Basin
West: Hellenic trench





Makris et al., 2013

Hellenic Arc (Offshore Crete)

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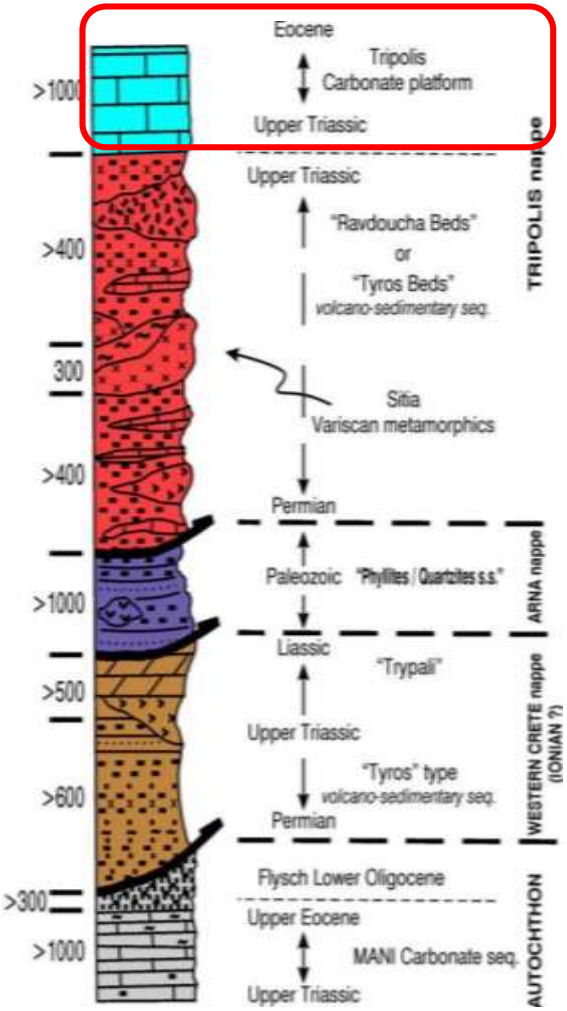
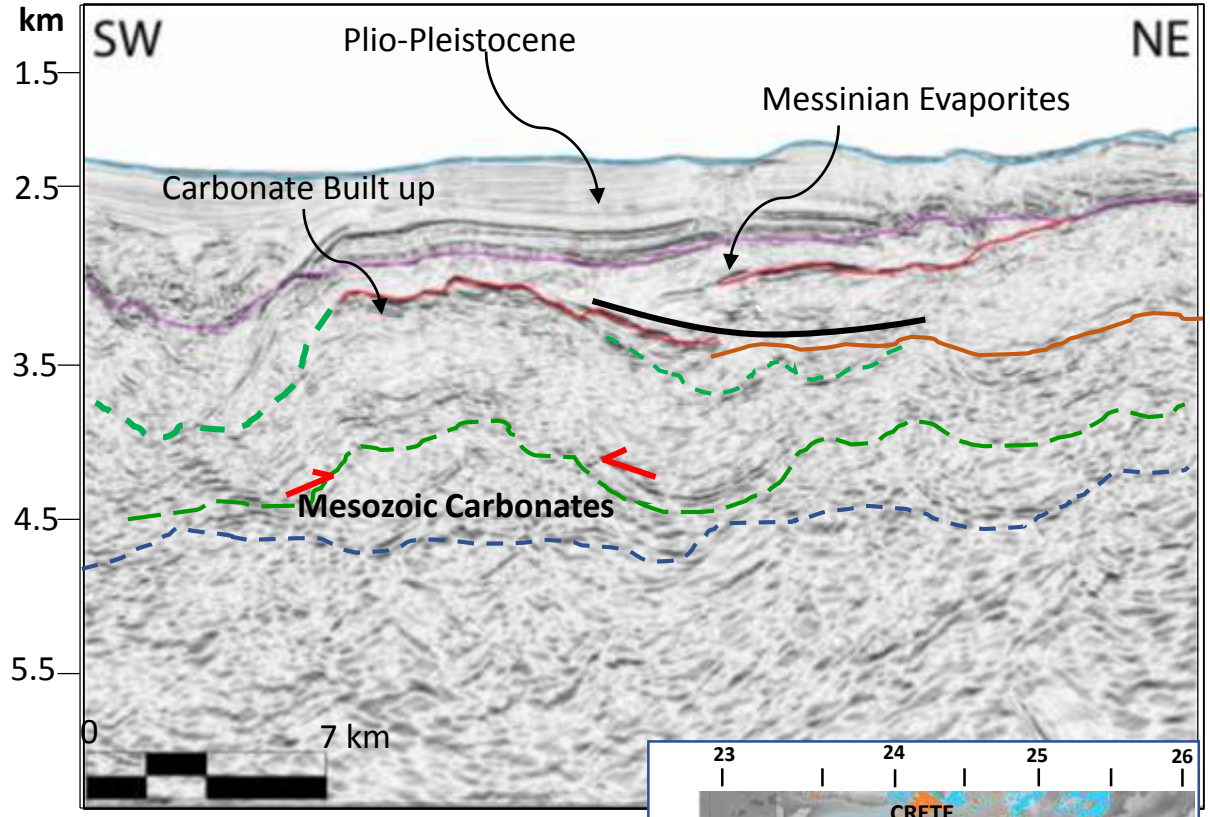
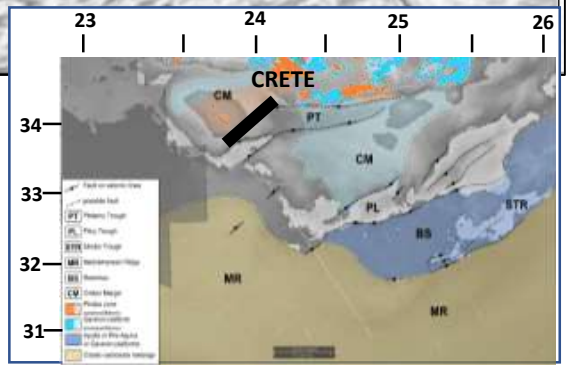


(after Papanikolaou et al., 2010)



Shallow carbonates corerspond to the Gavrovo-Tripolis Zone outcropping onshore along the southern coastline of Crete

?



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Hellenic Arc (Offshore Crete)

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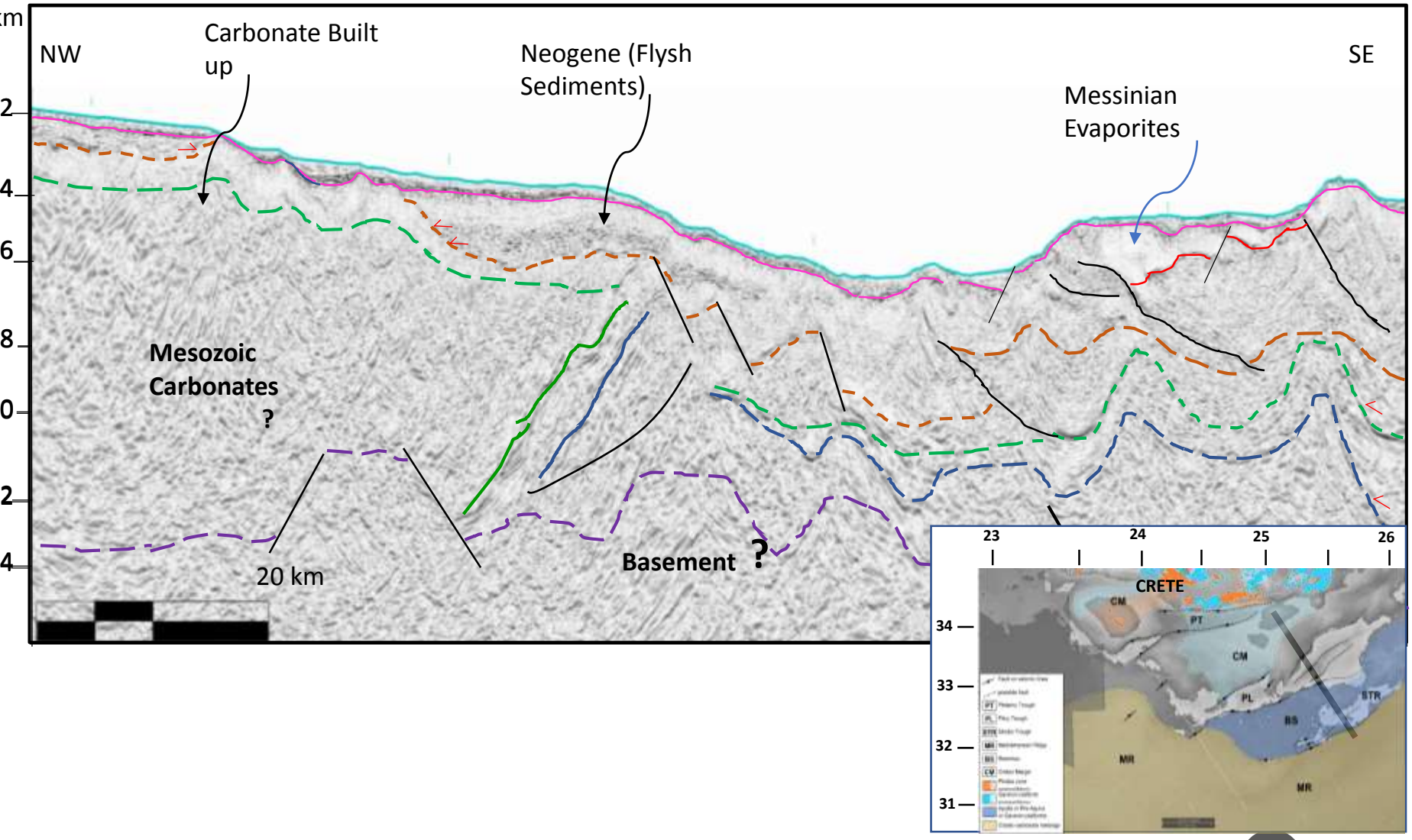

Conclusions

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- The **position of basement-high (ICPs)** is controlled by structures inherited from the rifting.
- Studies on **Eratosthenes and Apulia** carbonate platforms point out the fundamental **differences** between platform facies and basinal facies.
- **Tectonism is related with the initiation and the drowning of carbonate platform** (including both compressional and extensional tectonics).
- The **distance** of the paleo-relief from the continent has a fundamental role in the evolution of a carbonate platform.

Understanding the regional geology is great tool for HC exploration!

Thank you for your attention!

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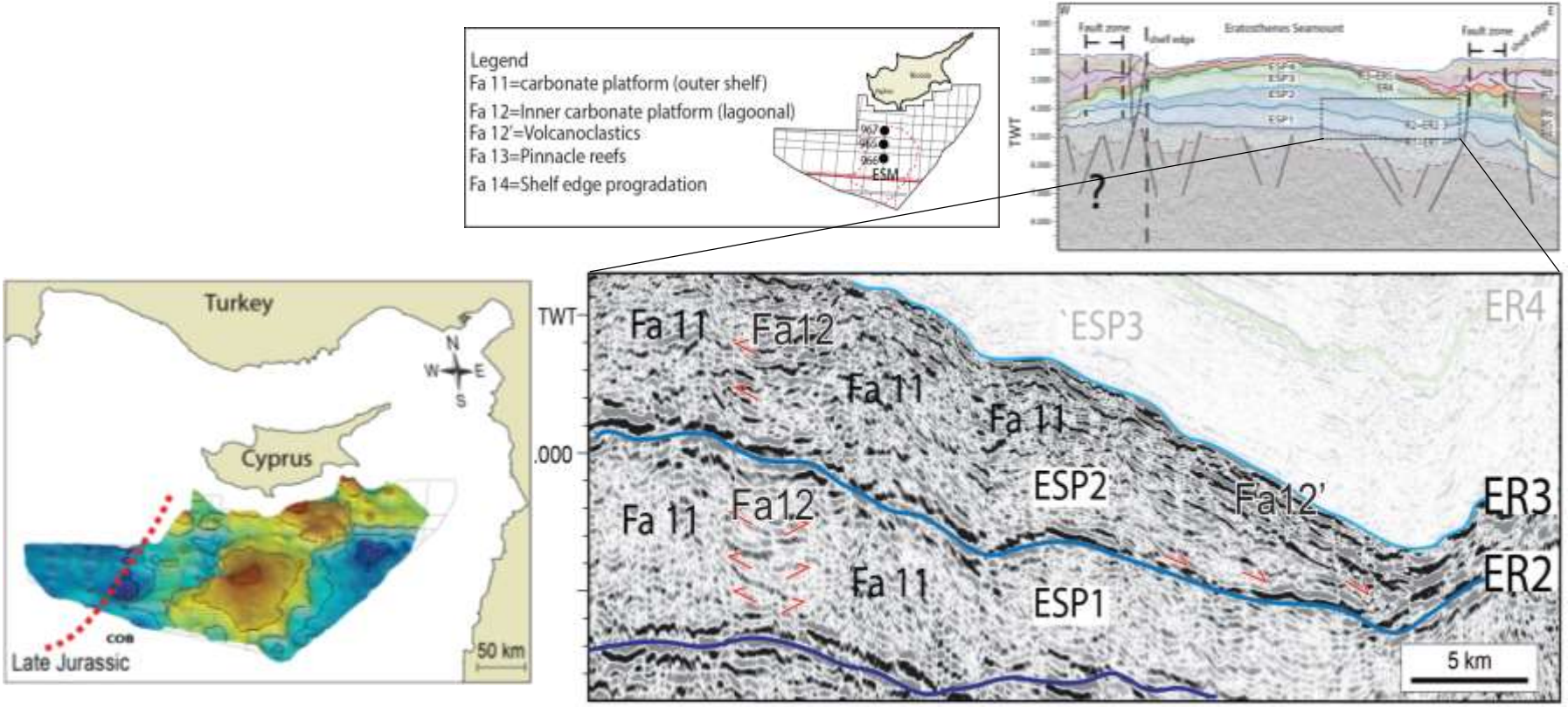
ESP1- 2: LATE JURASSIC?



Depth map of top ESP1-2 seismic unit.

Hellenic Arc (Offshore Crete)

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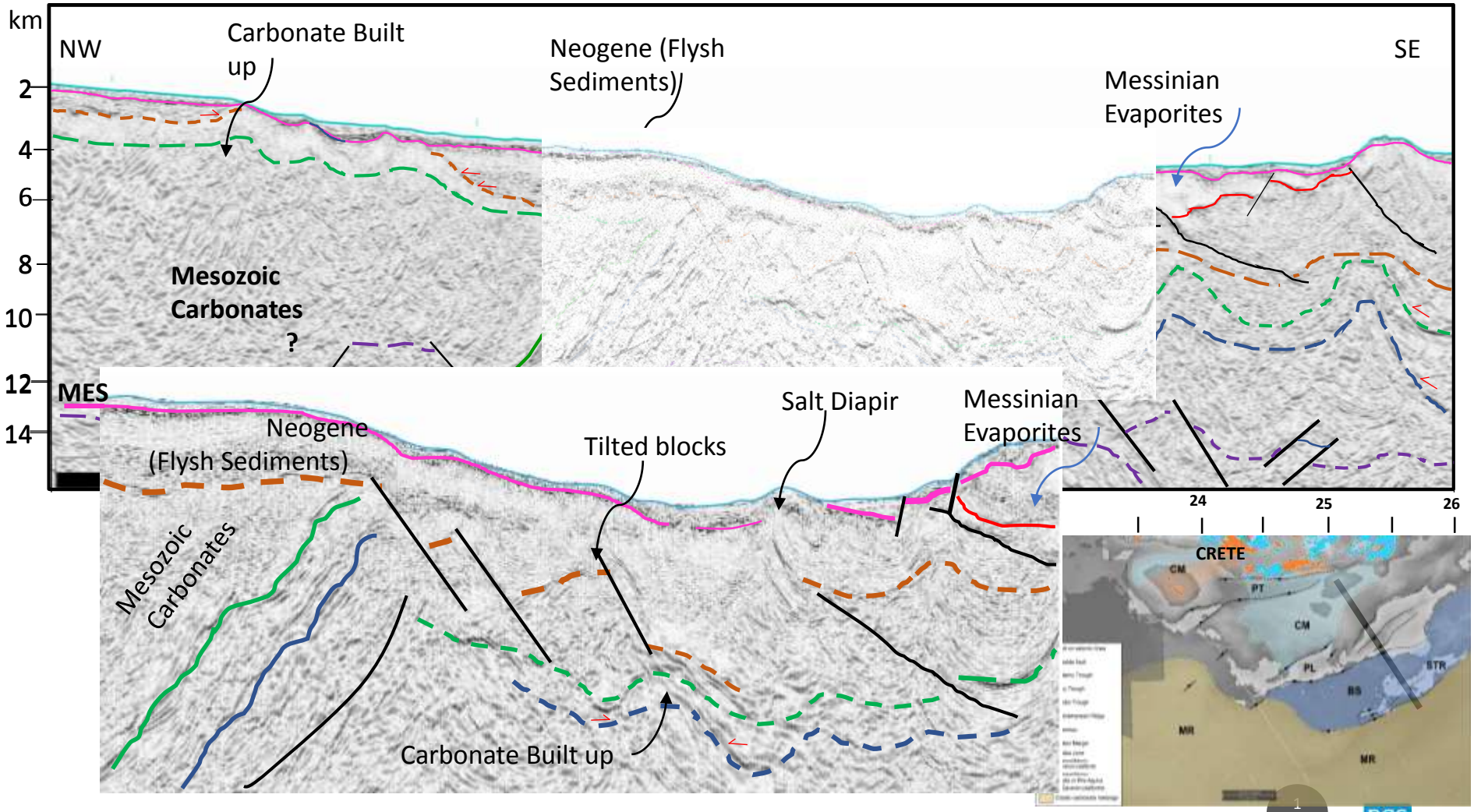
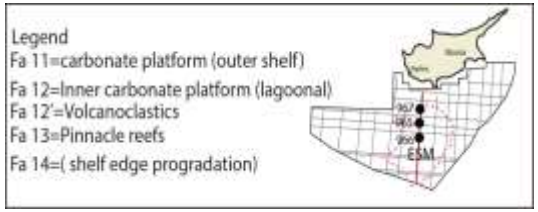
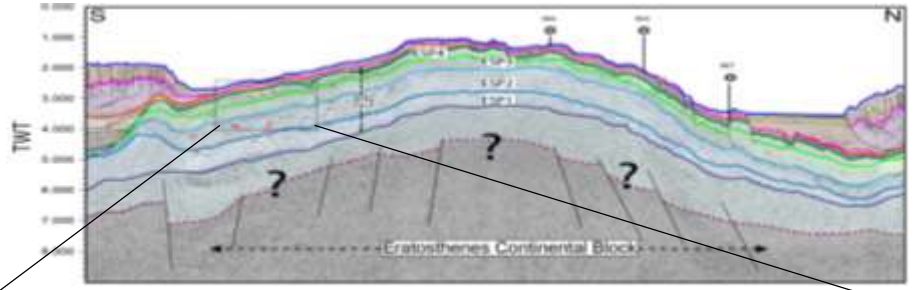
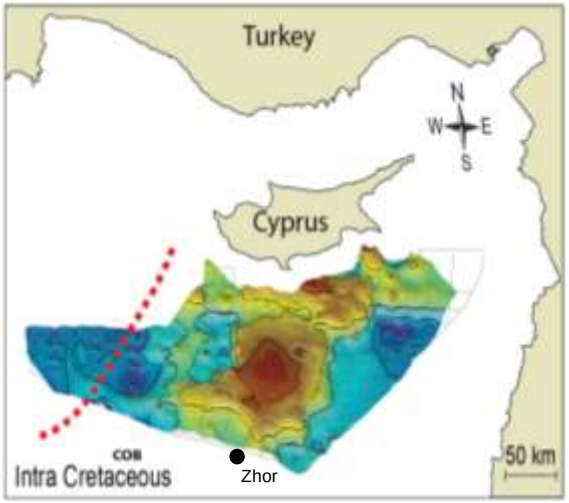
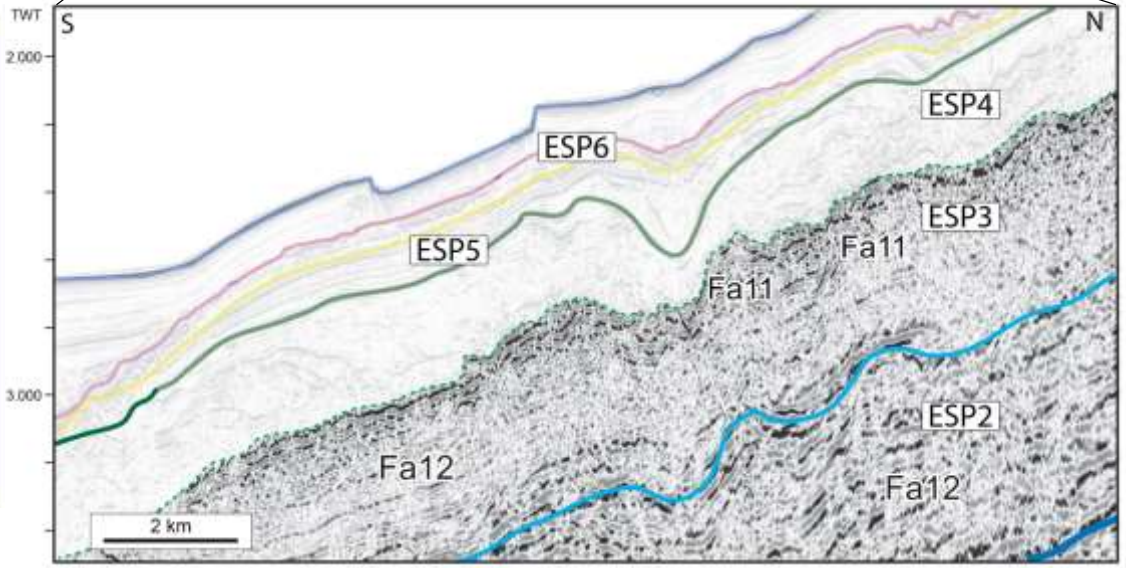


ESP3: EARLY CRETACEOUS

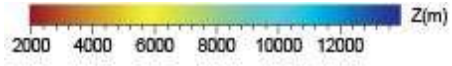








Depth map of top ESP3 Seismic unit.



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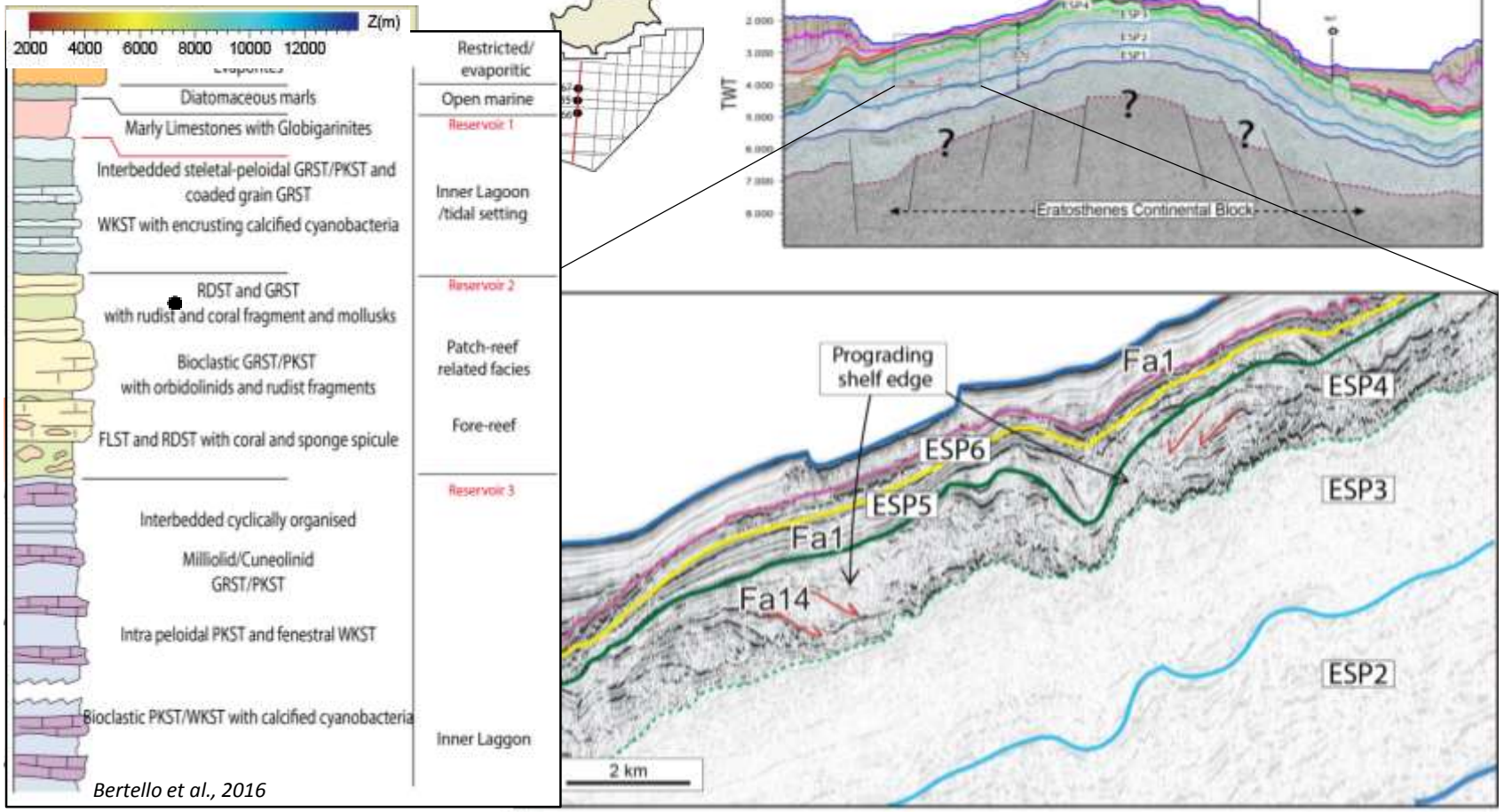
ESP4: CRETACEOUS



ESP6- Miocene

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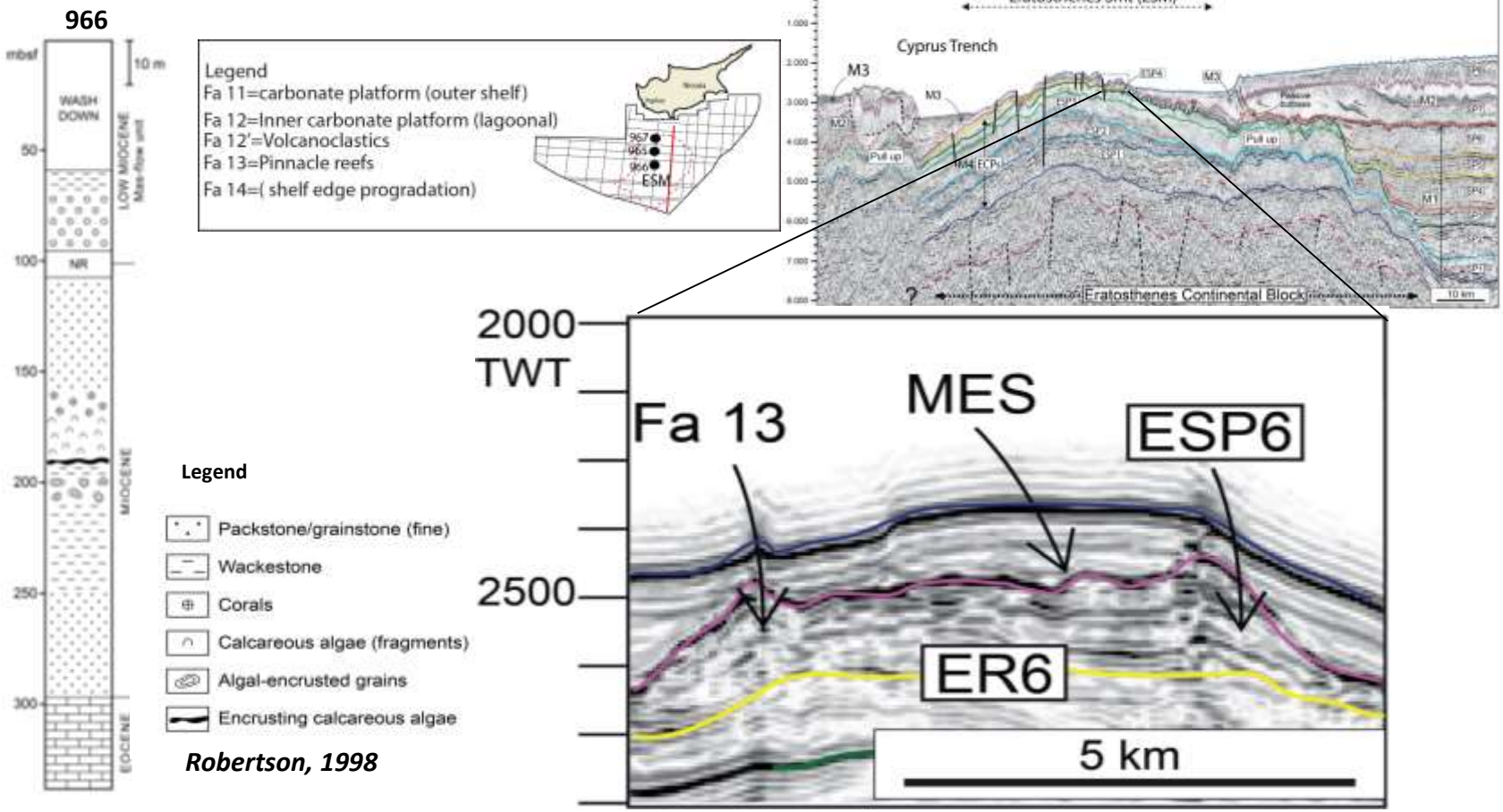

Miocene Carbonate Platform
Collision of Africa- Eurasia

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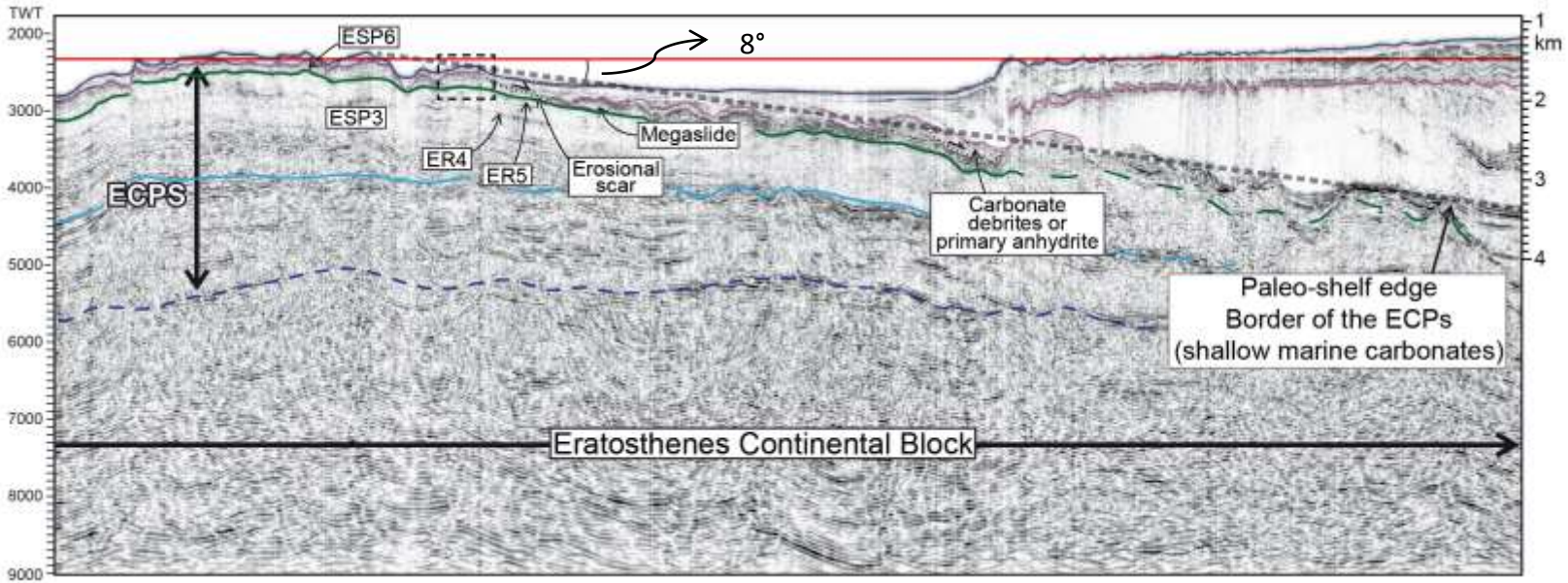

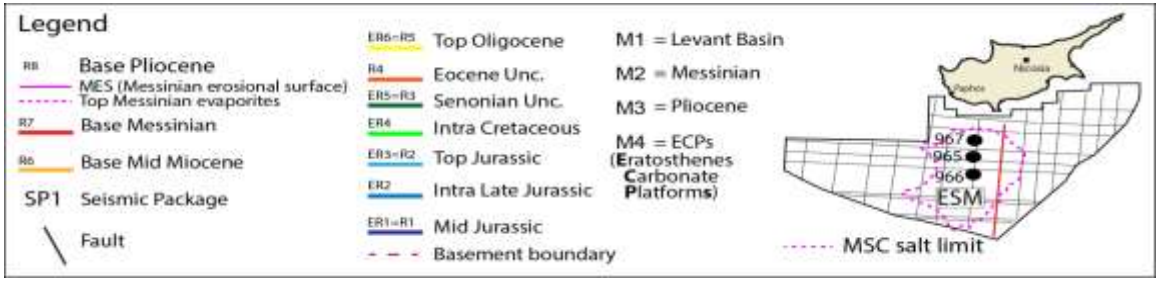

Offshore Israel

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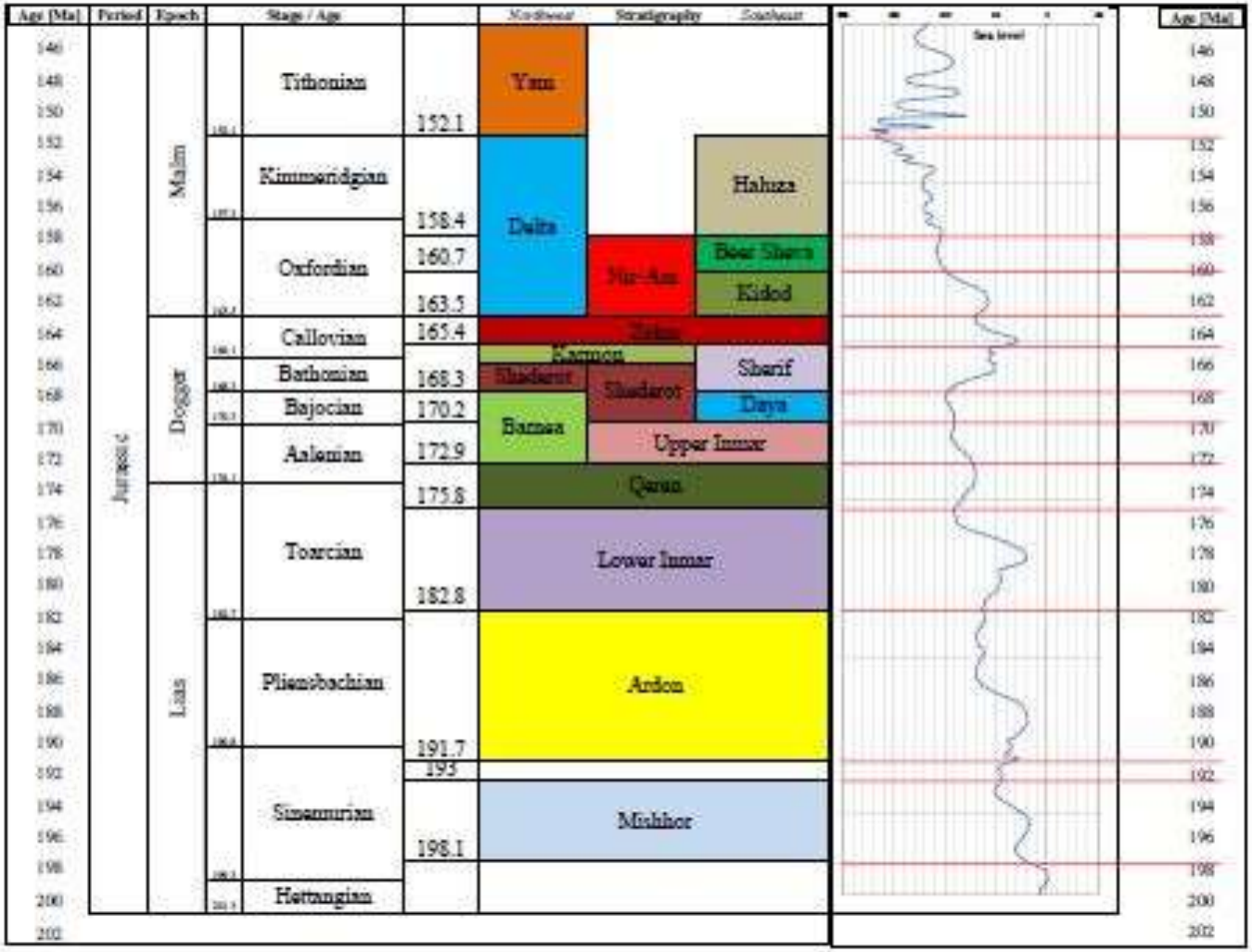

Offshore Western Greece: The current study

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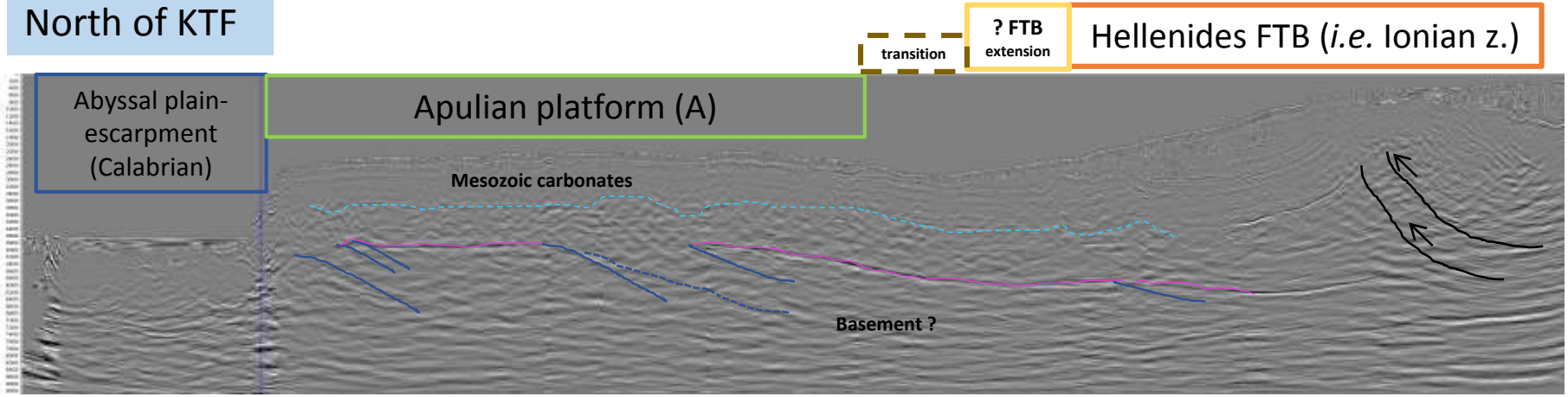
North of KTF



Top Cretaceous-Paleocene carbonates corresponds to the top of undifferentiated, i.e. pelagic versus shallow-water carbonates belonging to the Hellenides Thrust and Fold Belt.

The top undifferentiated carbonates is most often represented by the base Neogene Flysch but these carbonates could also be directly onlapped by Messinian or Pliocene sediments.

The distinction between shallow-water versus pelagic carbonates is made on the base of regional knowledge and seismic facies comparison with the North Ionian Offshore. Then shallow-water carbonates are mostly characterized by a massive transparent facies showing little internal stratification as on seismic line 3014 across the Chryssi-Koufonissi block between the Ptolemy and Pliny troughs and on previous figures showing seismic Knowing that only future drilling will enable further distinction, carbonates that does not look like shallow-water carbonates are by default attributed to the Pindos series in the continental margin