

# **Valencia Trough (Offshore Spain): Petroleum Systems and Play Types\***

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## **Abstract**

The Western part of the Mediterranean Region is one of the least explored areas for hydrocarbons in the entire Tethys region. The Valencia Trough, offshore Spain, is located between the Catalan coast and the Balearic Islands and it represents one of the most attractive basins for HC exploration, using new concepts and technologies. The petroleum system of the Valencia Trough has been recently reviewed and integrated with 1D basin models on some wells, focusing on the evaluation of the source rock, the reservoir, and the seals. The oldest reported source rock in the area is the Upper Jurassic Mas D'Ascla Formation (highest TOC value 1.26%). In the easternmost part of the Valencia Trough, Paleogene continental rift basins formed before the early Miocene major rifting phase are characterized by the presence of continental and lacustrine sediments. Locally there are evidence of coal, with TOC values up to 11.5%, and a thickness of 150m. In the Miocene Alcanar Group there are organic-rich units that are considered to be the most prolific source rock of the Valencia Trough. The intervals rich in organic matter are in the Burdigalian-Langhian sequences. The most important reservoir of the Valencian Trough is characterized by karst limestones and dolostones of Cretaceous and Jurassic age. The karst development generated diffuse vuggy porosity and enhanced fracture porosity. Clastic reservoirs are not exploited, but traces of hydrocarbons have been found in the Castellon Group, whereas the Pliocene Ebro sandstones are considered a potentially good reservoir for biogenic gas. The main seals are represented by the Cambrils Group shales, Castellon Shales, and shales intercalated in the Ebro Group. A review of all the available data (seismic and wells) allow the definition of 4 different plays in the area. The petroleum plays in the Valencia Basin involve both carbonates and clastic sequences and range from Mesozoic structural and structural-stratigraphic traps to Plio-Pleistocene delta and turbidite deposits. They can be sub-divided into: Casablanca and Amposta Play, Castellon Play, Ebro Play, and Rosas Play.

## **References Cited**

Lomando, A.J., P.M.Harris, and D.E. Orlopp, 1993. Casablanca Field, Tarragona Basin, offshore Spain: A karsted carbonate reservoir, *in* R.D. Fritz, J.L. Wilson, and D.A. Yurewicz, editors, Paleokarst Related Hydrocarbon Reservoirs: Society of Economic Paleontologists and Mineralogists, Core Workshop 18, p. 201-225.

Maillard, A., C. Gorini, A. Mauffret, F. Sage, J. Lofi, and V. Gaullier, 2006, Offshore evidence of polyphase erosion in the Valencia Basin (Northwestern Mediterranean: Scenario of the Messinian Salinity Crisis: *Sedimentary Geology*, v. 188-189, p. 69-91.

Rodríguez-Morillas, N., E. Playà, A. Travé, and J.D Martín-Martín, 2013 Diagenetic processes in a partially dolomitized carbonate reservoir: Casablanca oil field, Mediterranean Sea, offshore Spain: *Geologica Acta*, v. 11/2, p. 195-214.





# VALENCIA TROUGH (OFFSHORE SPAIN): PETROLEUM SYSTEMS & PLAY TYPES

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# OUTLINE

1. DATASET & OBJECTIVES OF THE STUDY
2. GEOLOGICAL FRAMEWORK
3. PREVIOUS EXPLORATION
4. STRATIGRAPHY
5. OIL TYPES & BASIN MODELLING
6. PLAY TYPES
7. CONCLUSIONS





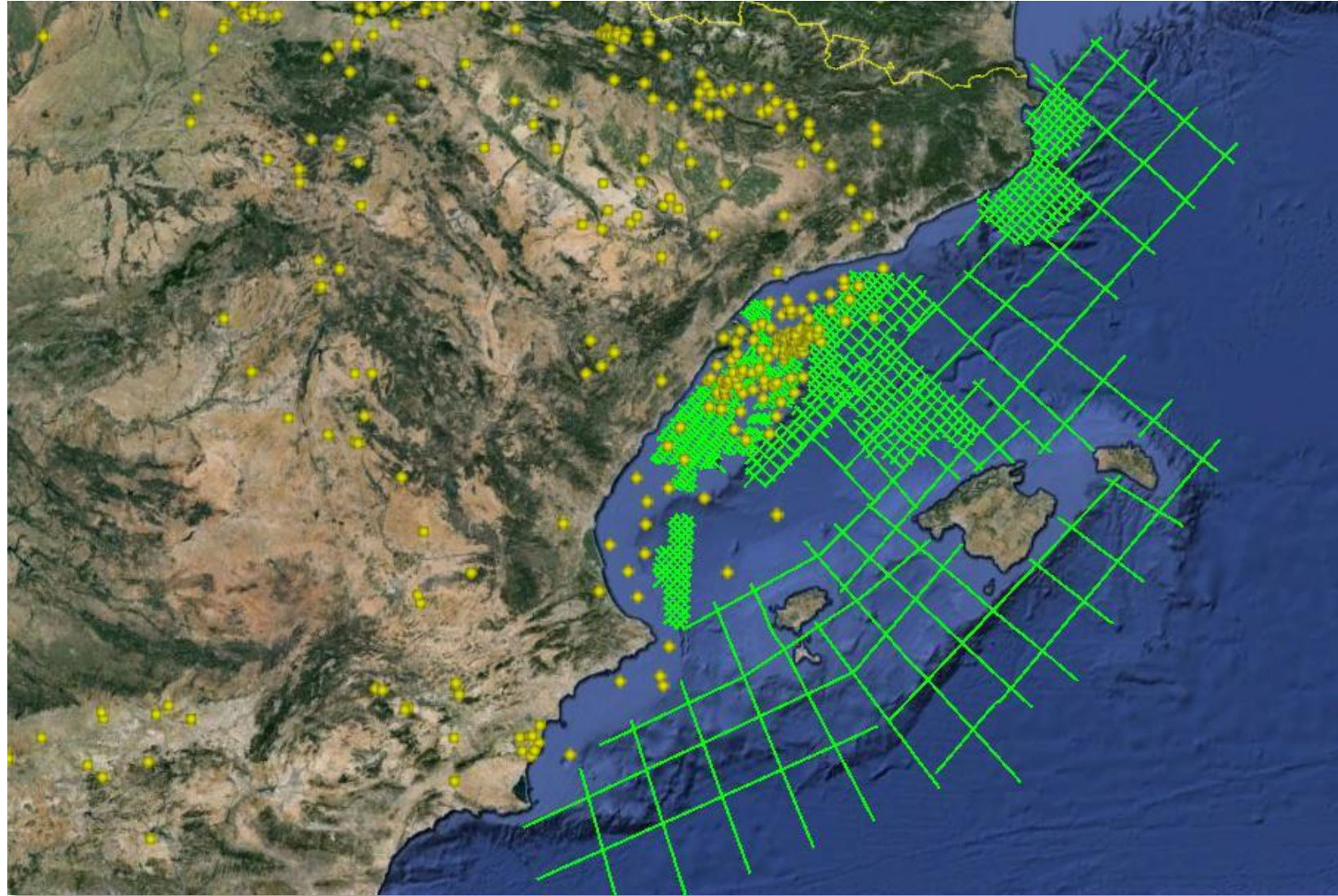
# OBJECTIVES & DATASET

## OBJECTIVES:

1. DESCRIBE THE PROVED AND POTENTIAL PETROLEUM SYSTEMS
2. EVALUATE THE EXPLORATION POTENTIALS OF THE DEEP WATER PART OF THE BASIN

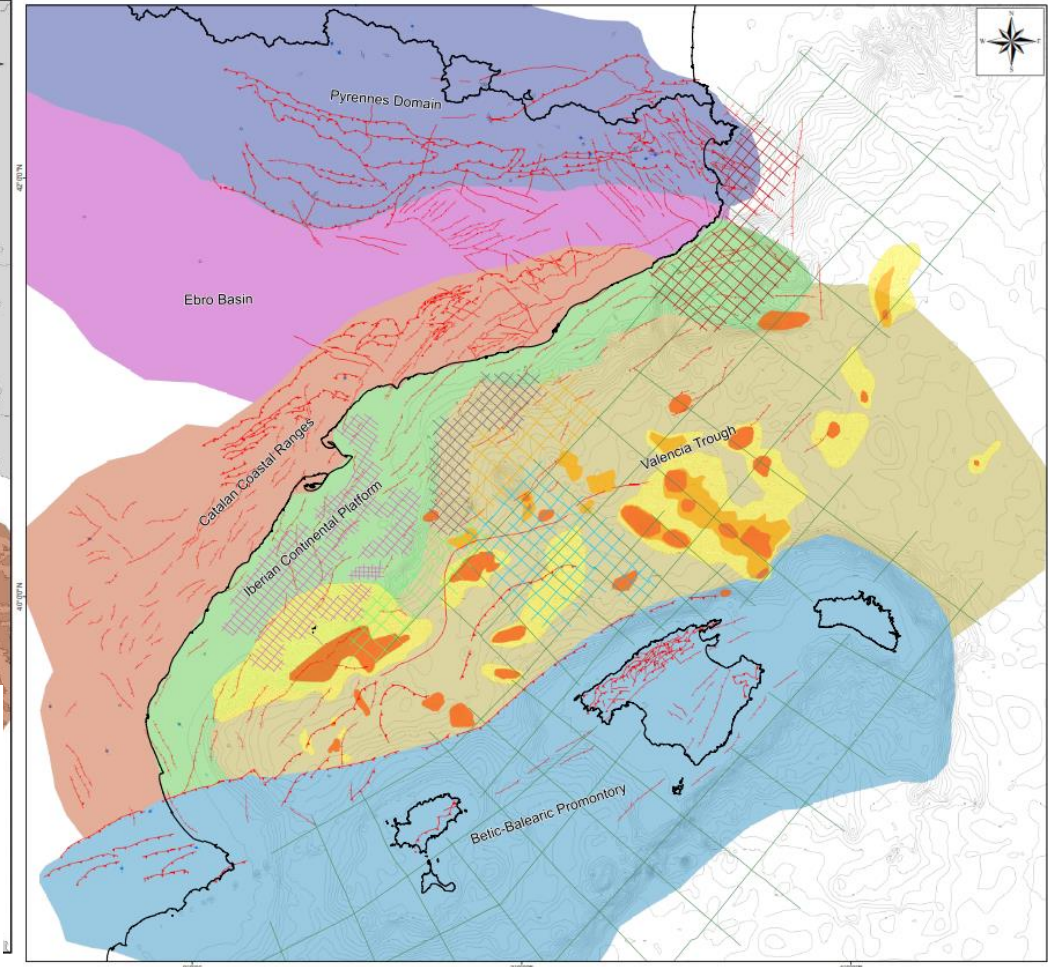
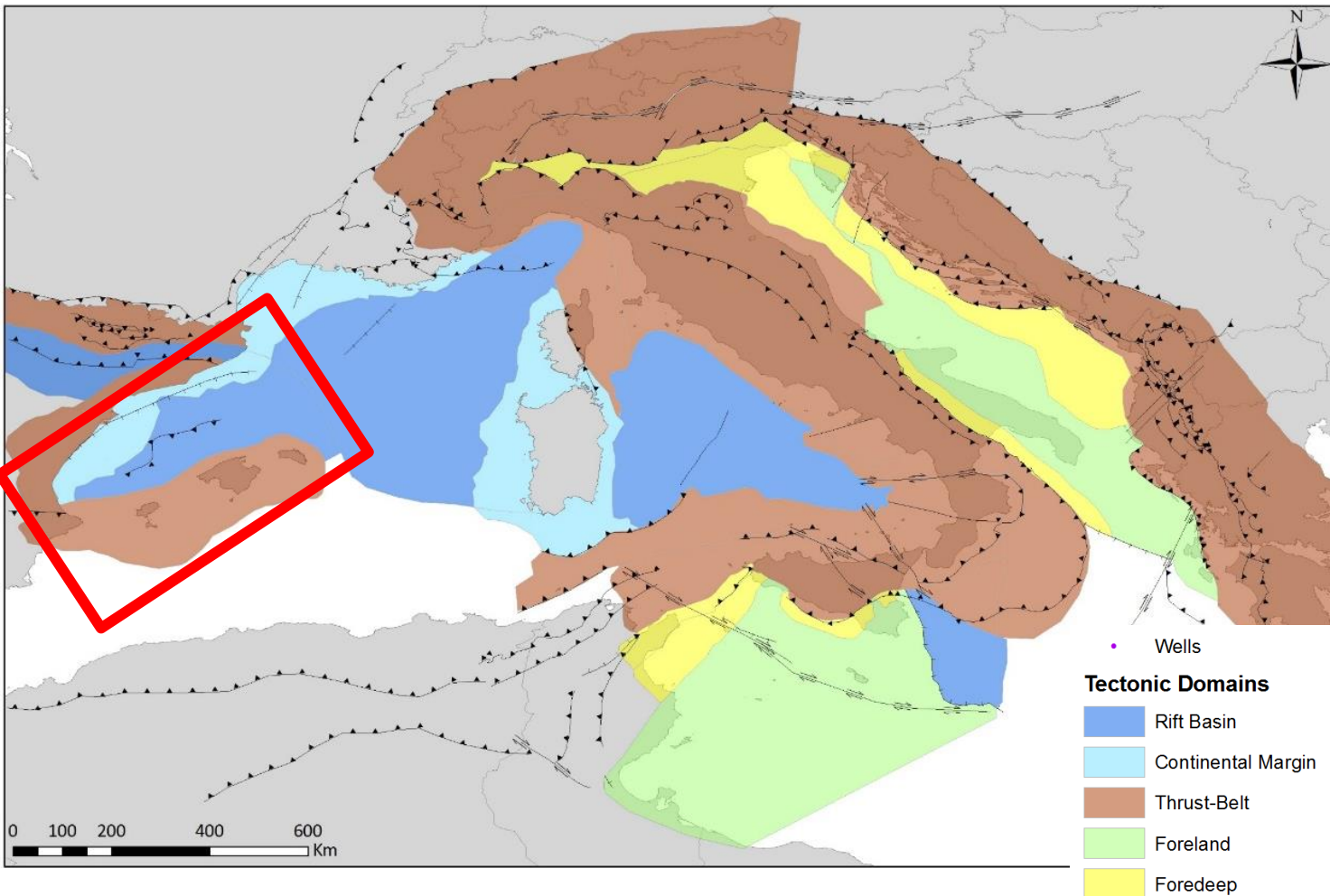
## DATASET:

- >13000 km 2D SEISMIC LINES
- WELL REPORTS
- WELL LOGS
- PUBLICATIONS & OUTCROP DATA





# GEOLOGICAL FRAMEWORK

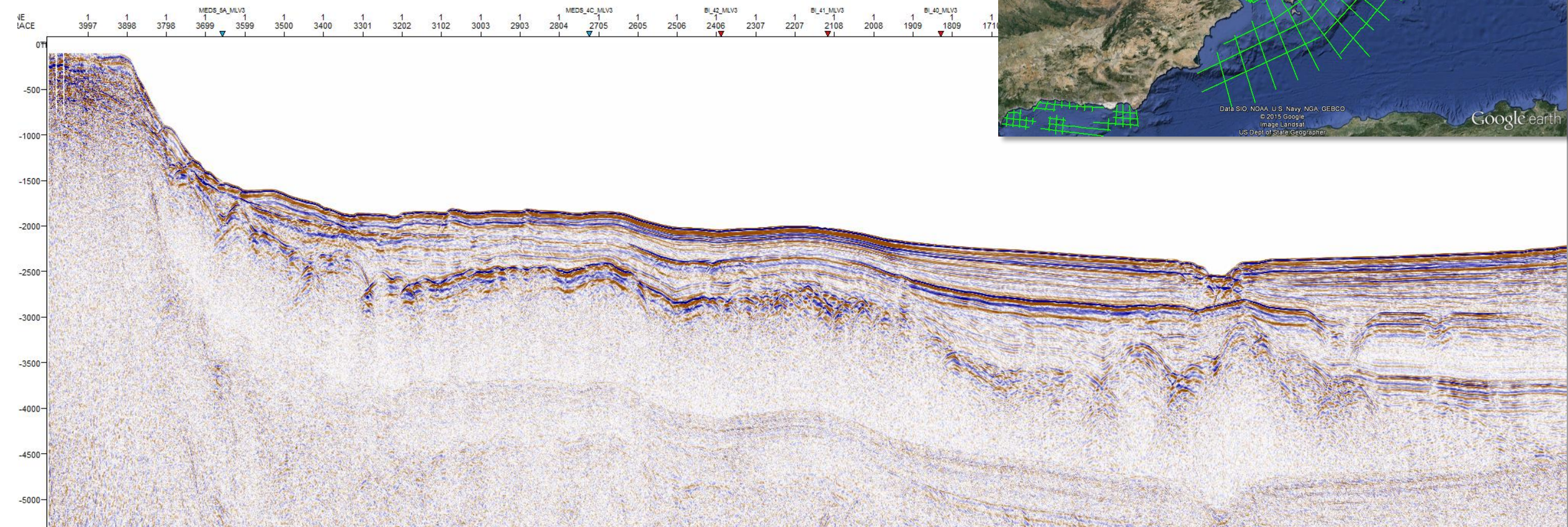


- THE VALENCIA TROUGH IS OLDEST TERTIARY WESTERN MEDITERRANEAN BASIN,
- THE TERTIARY SEQUENCE RELATED TO THE FORMATION OF THE BASIN IS 2 TO 6 KM THICK
- THE BASIN IS SURROUNDED BY TERTIARY THRUST BELT SYSTEMS (BETIC-BALEARIC, CATALAN-COASTAL & PYRENEES)



# BASIN MARGINS – SW BORDER

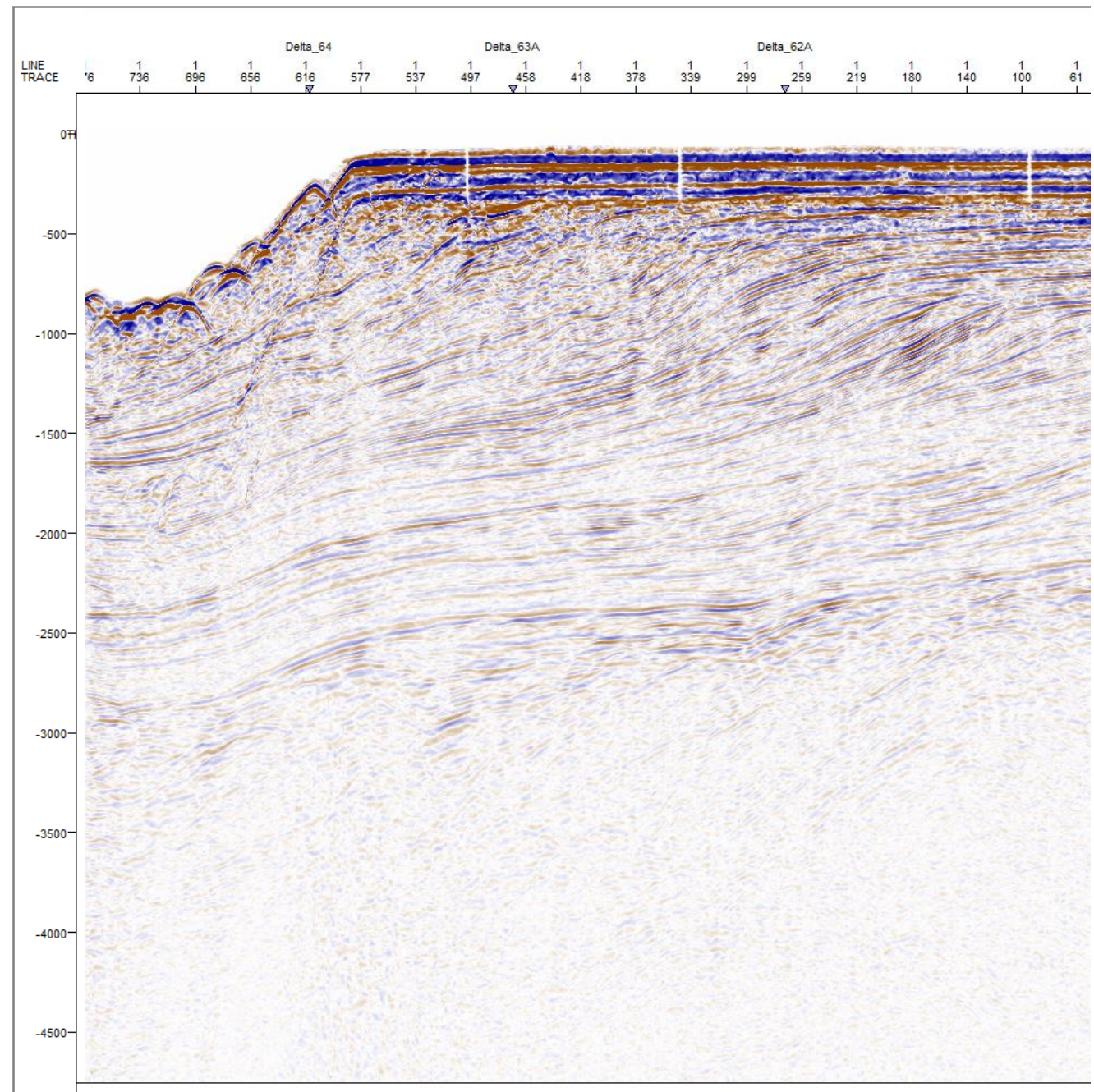
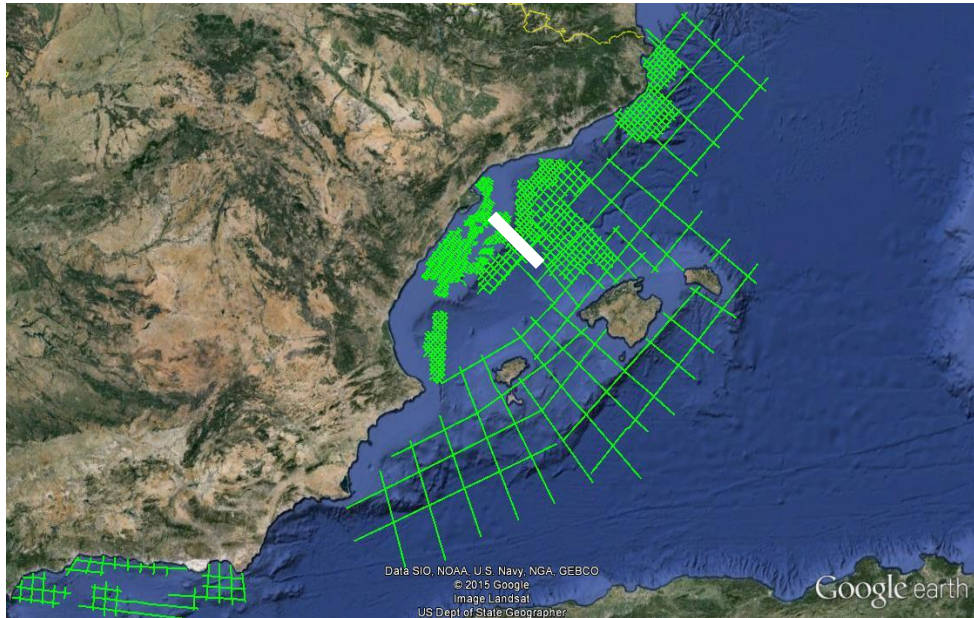
## STEEP SW MARGIN





# BASIN MARGINS – NW BORDER

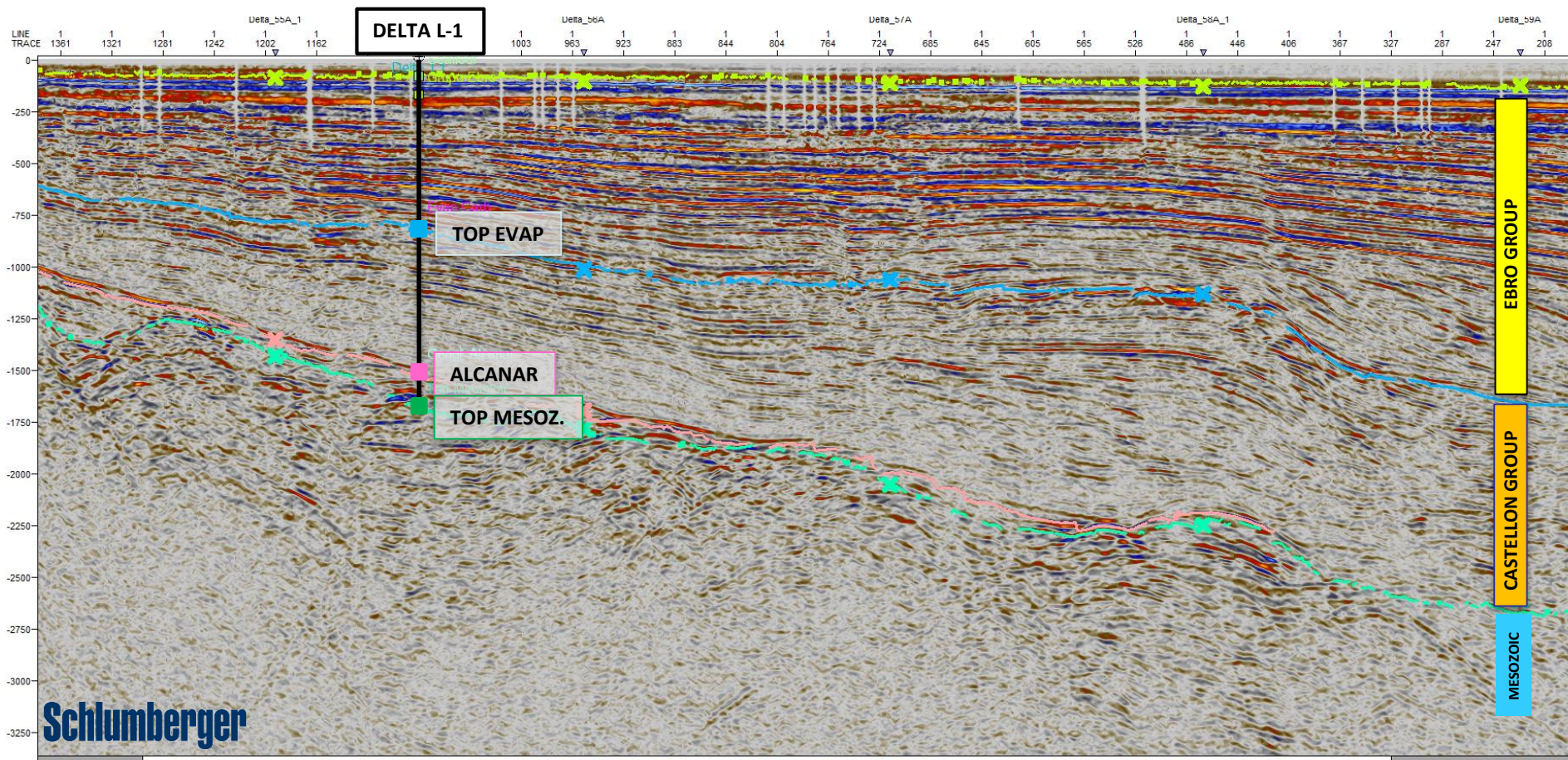
## THICK PROGRADING TERTIARY SEQUENCE





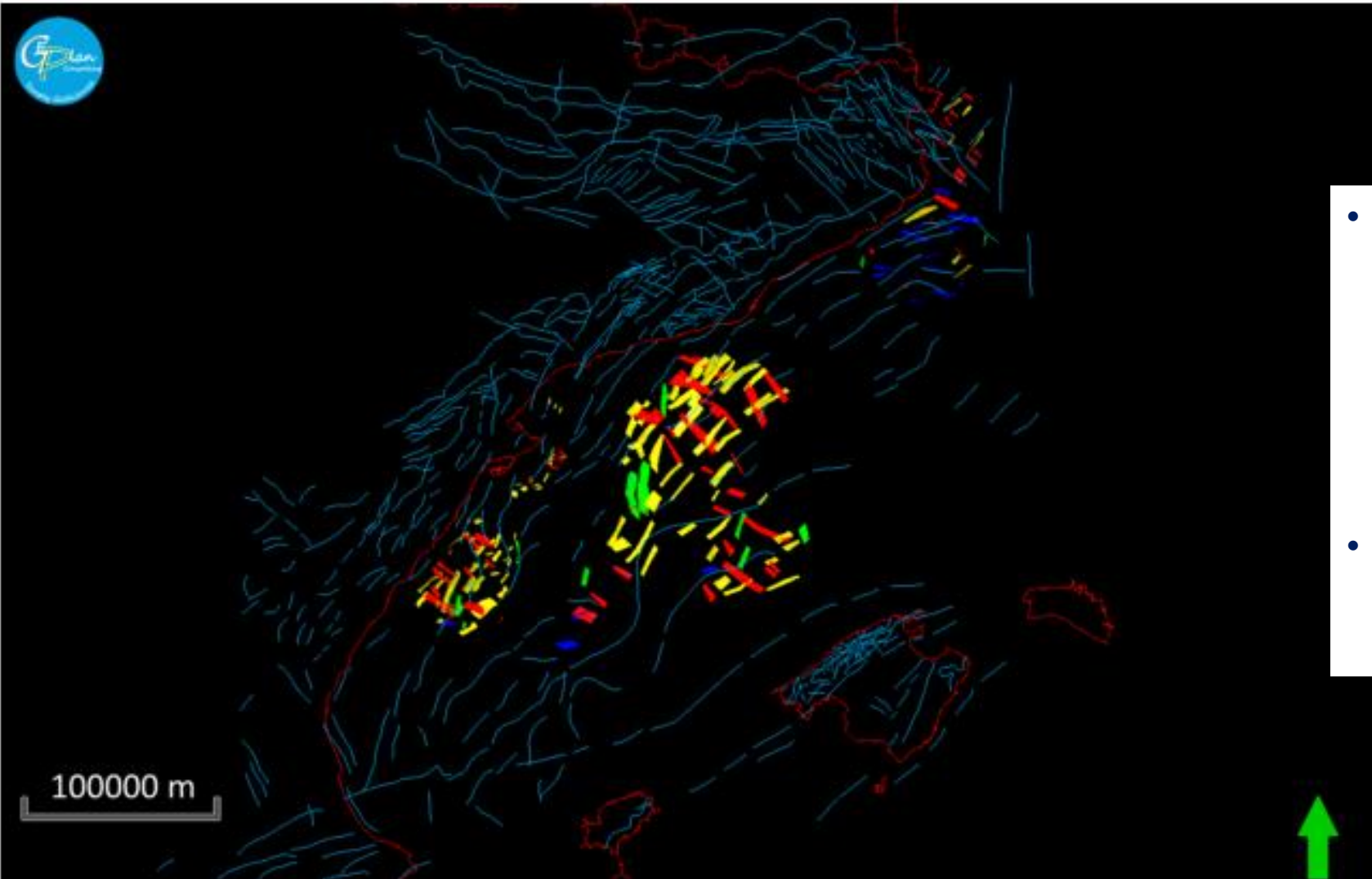
# STRATIGRAPHY

AGE		FORMATION	LITHOLOGY
NEOGENE	Q.	Ebro Group	Ebro sands
			Ebro clays
	MIOCENE	CASTELLON GROUP	evaporites
			calcarenes
			Castellon sands
			Castellon clays
		ALCANAR GROUP	Salou Fm.
			San Carlos Fm.
			Casablanca-Tarraco shales
			Alcanar Fm.
PALEOGENE	Upper	Cretaceous Carbonates	Utrillas/Escucha
			Urgonian marine carbonates
	Lower	Wealdian continental facies	Purbeckian facies
			marine limestones
	Upper	Mas D'Ascla Fm.	Middle Jurassic shallow water limestones
			limestones and marls
	Middle	Keuper facies	M3
			M2
	Lower	Buntsandstein facies	M1
			Alcotas
PERMIAN	Upper	Boniches	Tabarrena
			metamorphic rocks
	Lower	metamorphic rocks	





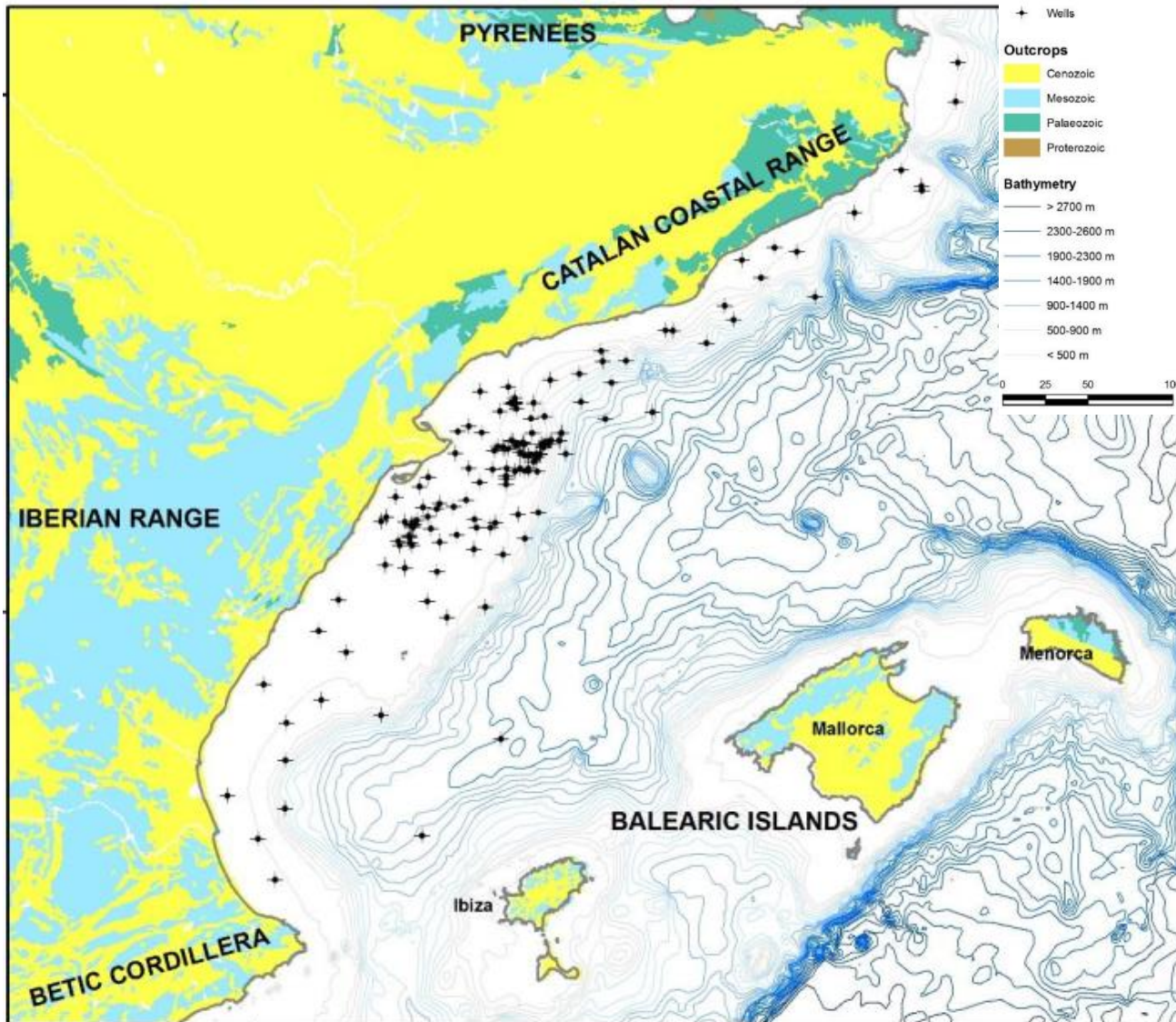
# STRUCTURAL FRAMEWORK



- **TWO MAIN FAULT FAMILIES:**
  - **NE-SW (RELATED TO THE RIFTING & TO THE BETIC-BALEARIC THRUST BELT SYSTEM)**
  - **NW-SE (MAINLY RELATED TO REGIONAL-SCALE TRANSFER ZONES)**
- **SAME FRACTURE TRENDS CAN BE OBSERVED ALSO ONSHORE (BALEARIC ISLANDS & IBERIA)**



# PREVIOUS EXPLORATION ACTIVITY

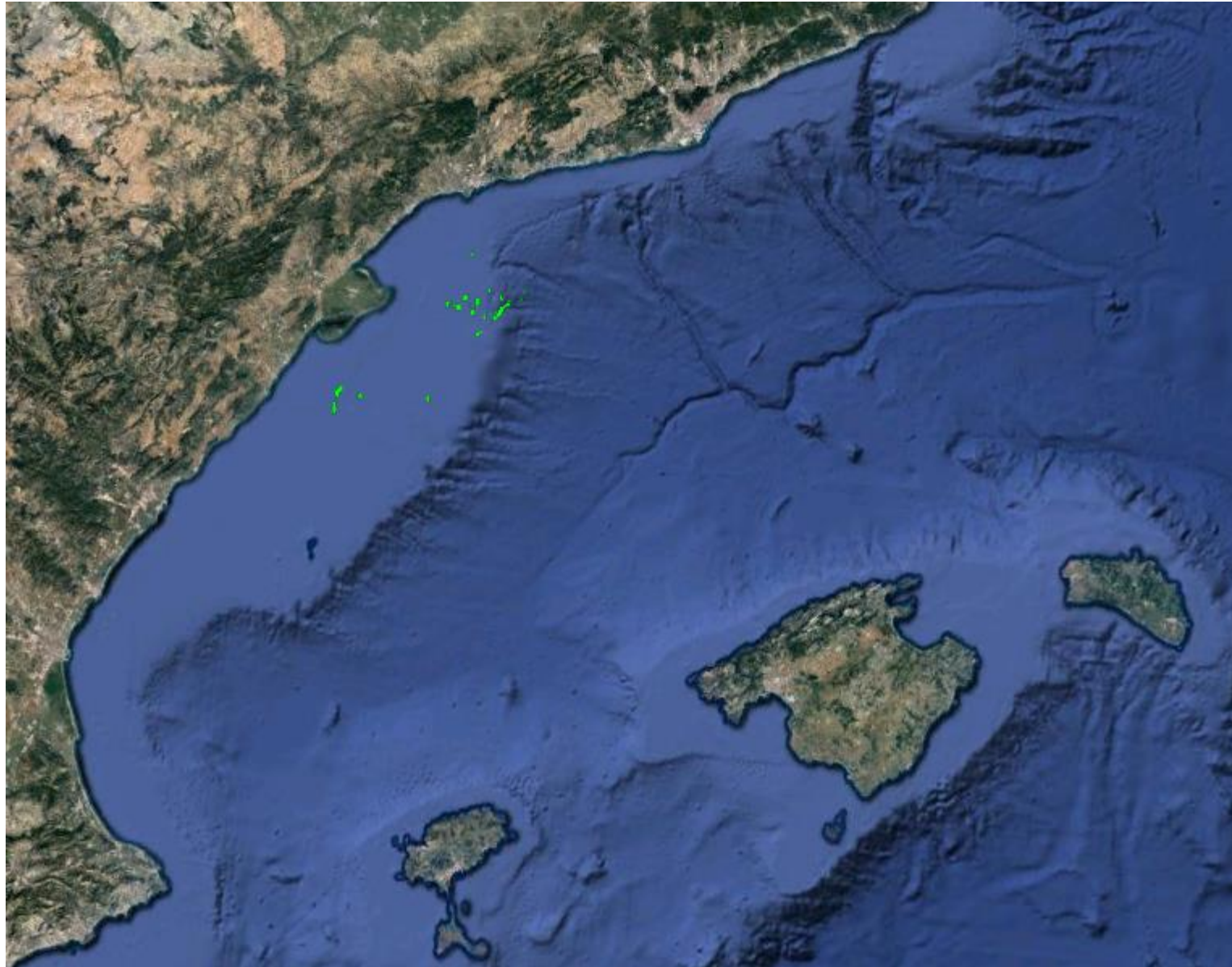


- EXPLORATION IN THE GULF OF VALENCIA STARTED IN 1968, WITH THE FIRST COMMERCIAL DISCOVERY.
- BY 1976, WITH JUST 22 EXPLORATION WELLS DRILLED, MOST OF THE HYDROCARBON HAD BEEN FOUND (AMPOSTA, DORADA, MONTANAZO AND TARRACO OIL FIELDS).
- SINCE 1994, 3D SEISMIC STARTED TO BE USED AS AN EXPLORATION TOOL AND, CONSEQUENTLY, A HIGH RATE OF SUCCESS HAS BEEN ACHIEVED AND NEW ACCUMULATIONS DISCOVERED; THEY, IN SPITE OF THEIR SMALL SIZES (3 TO 10 MILLION BARRELS OF OIL), HAVE BEEN IMMEDIATELY DEVELOPED.
- LESS THAN 200 WELLS DRILLED SINCE LATE 60'S
- ONLY 1 WELL IN THE DEEP-WATER PART OF THE BASIN
- BASIN AREAL EXTENT 63,000 SQ KM



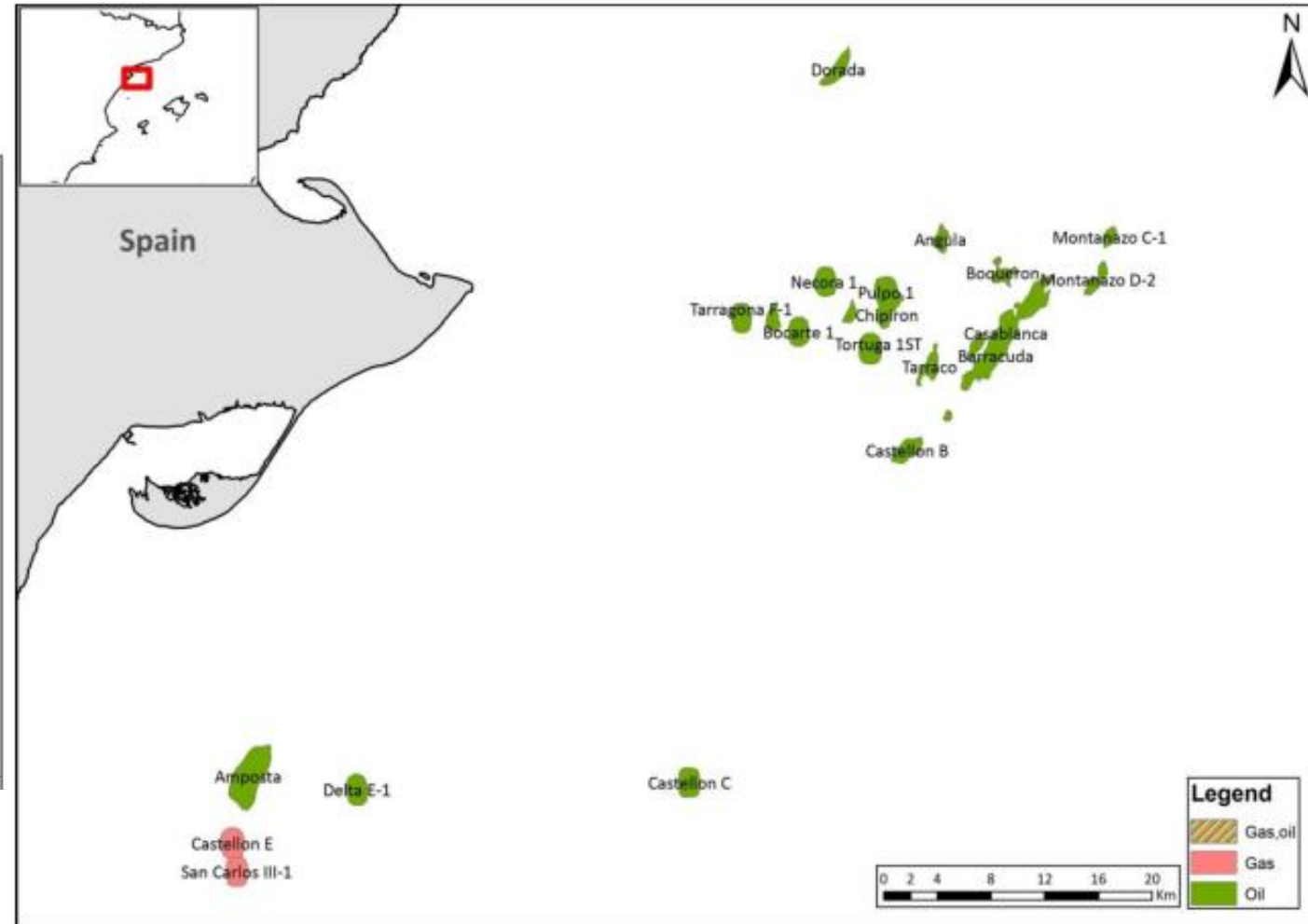
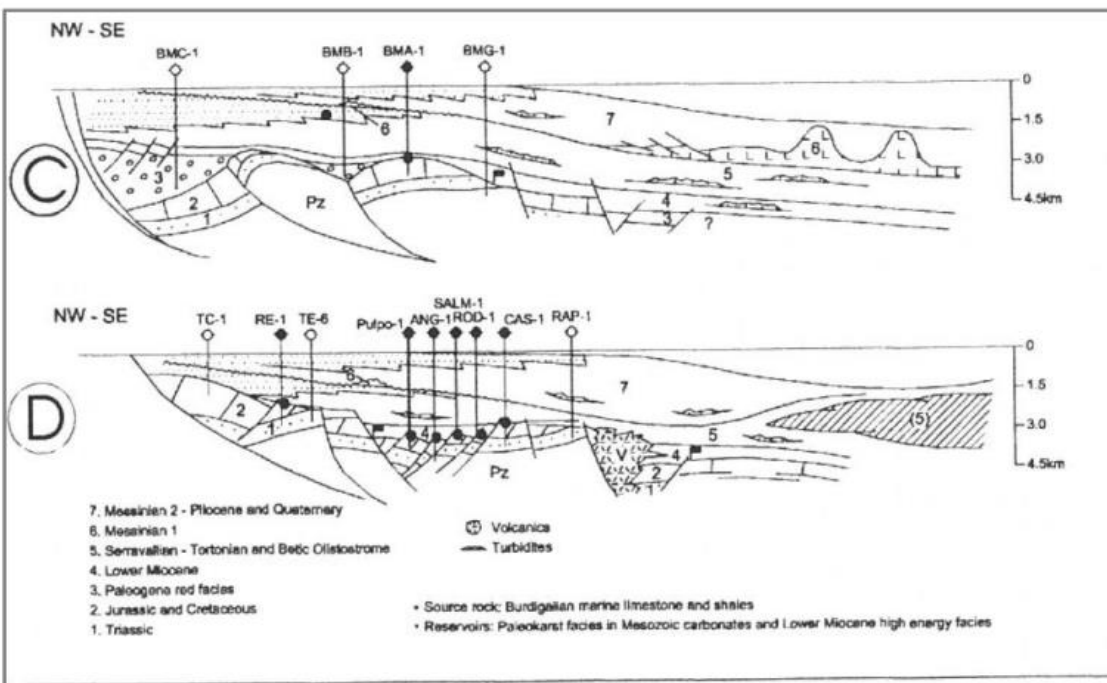
# HYDROCARBON DISCOVERIES

YEAR	FIELD/DISCOVERY	HC	RESERVOIR AGE	SOURCE
1970	Amposta	Oil	Barremian	Burdigalian
1975	Dorada	Oil	Jurassic	Burdigalian
	Tarragona D	Heavy oil	Triassic	Burdigalian
	Casablanca	Oil	Jurassic	Burdigalian
	Tarraco	Oil	Jurassic	Burdigalian
1978	Montanazo C	Oil	Jurassic	Burdigalian
	Delta E1	Oil	Jurassic	Burdigalian
1980	Barcelona A	Heavy oil	Barremian	Burdigalian
1984	Salmonete	Oil	Jurassic	Burdigalian
1984	Angula	Oil	Jurassic	Burdigalian
1984	Rosas 2-1	Oil	?	?
1985	S.Carlos 3-3	Oil	Barremian	Burdigalian
1995	Rodaballo	Oil	Jurassic	Burdigalian
1996	Boquerón	Oil	Jurassic	Burdigalian
1999	Chipirón	Oil	L. Cret.	Burdigalian
2000	Barracuda	Oil	Jurassic	Burdigalian
2001	Necora 1	Oil	?	?
	Bocarte 1	Oil	?	?
2009*	Montanazo-Lubina	Oil	Jurassic	Burdigalian



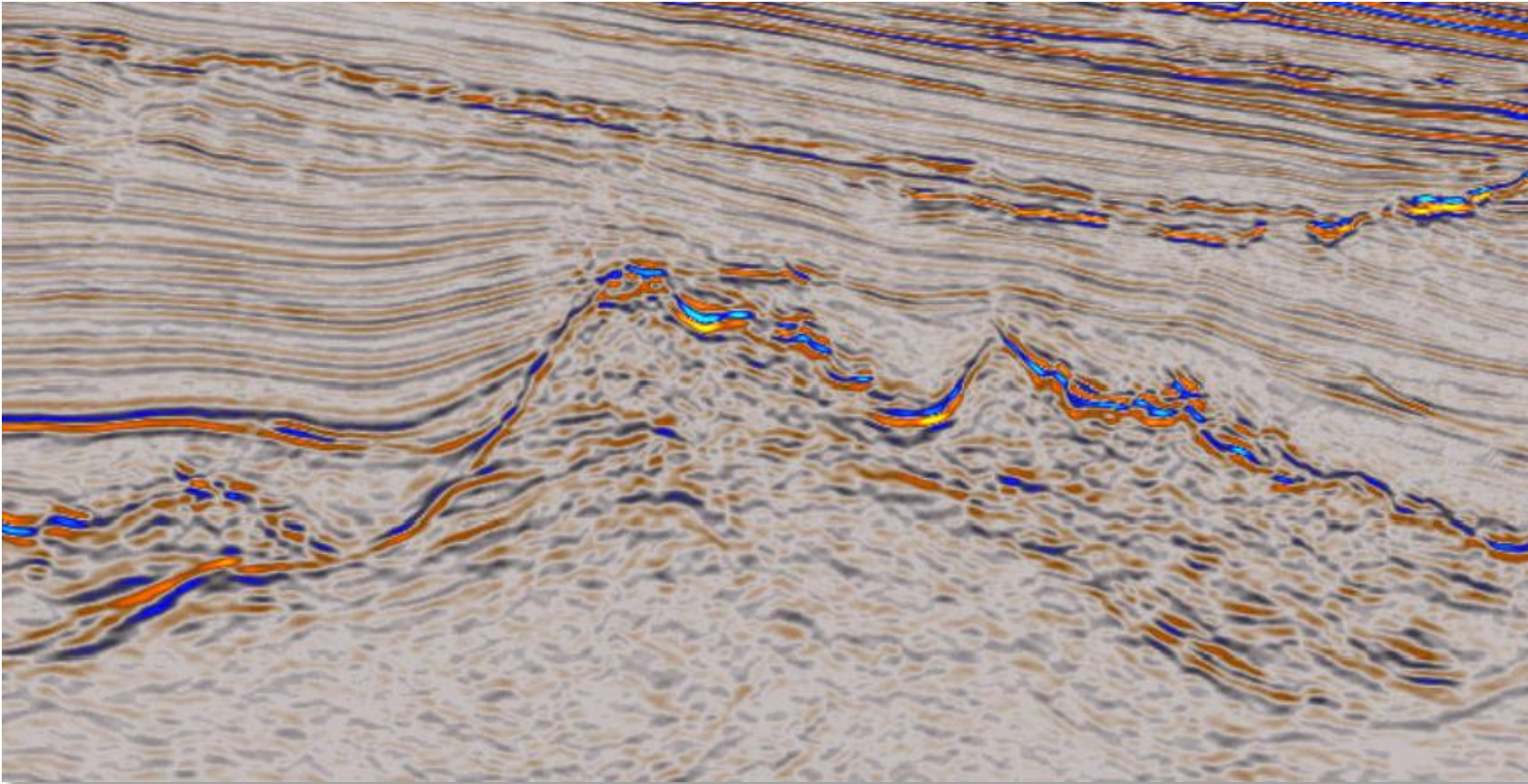


# HYDROCARBON DISCOVERIES

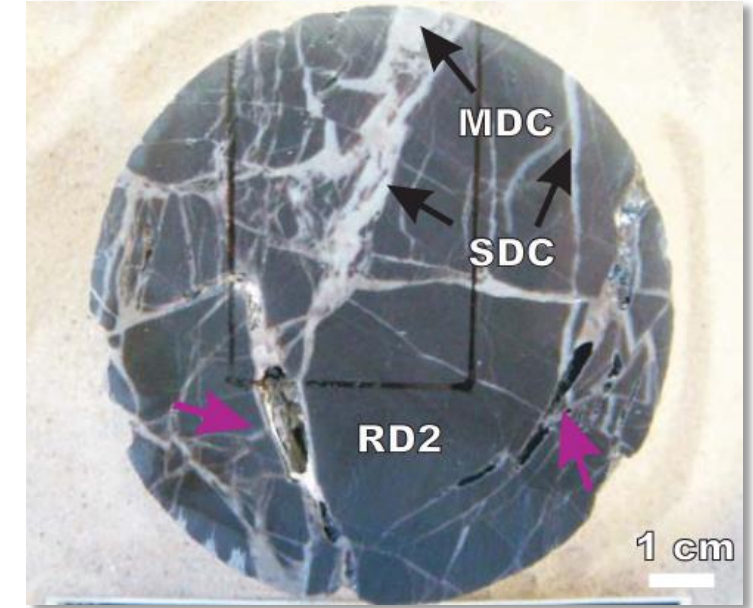




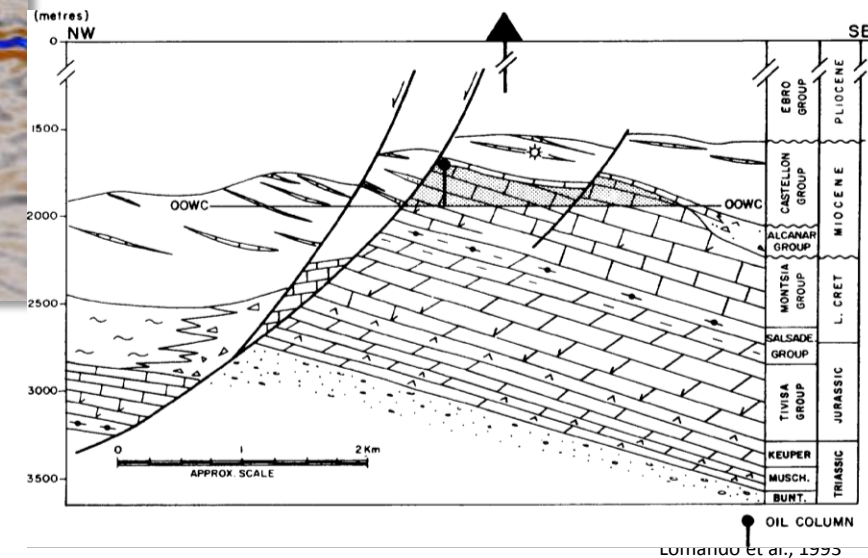
# CASABLANCA FIELD



- DISCOVERED IN 1975, STILL IN PRODUCTION
- RESERVOIRS ARE KARSTIFIED MESOZOIC CARBONATES
- LIGHT OIL (33.7° API)
- CUMULATIVE PRODUCTION (2015) – 149 MMbbl



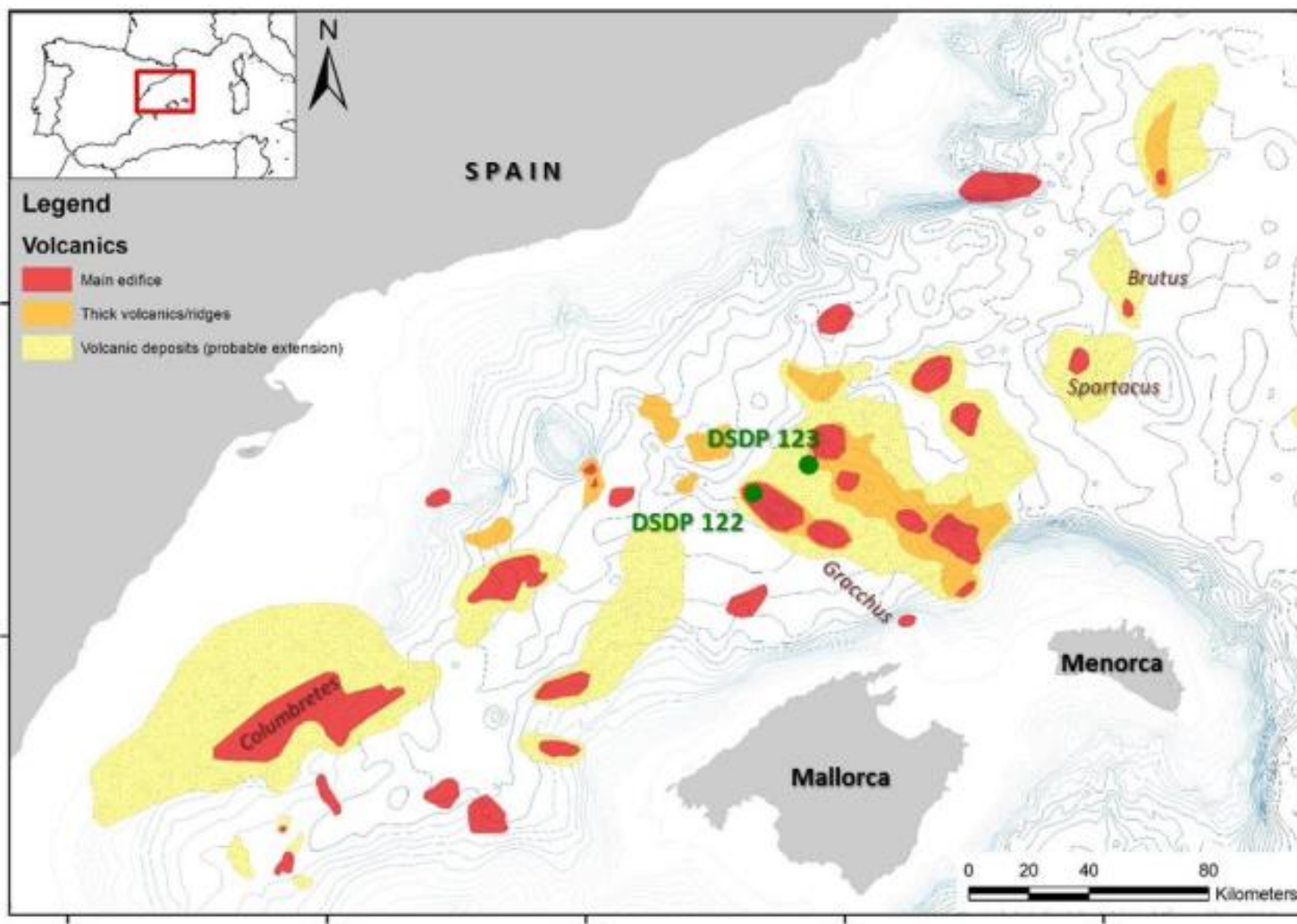
Rodríguez-Morillas et al., 2013



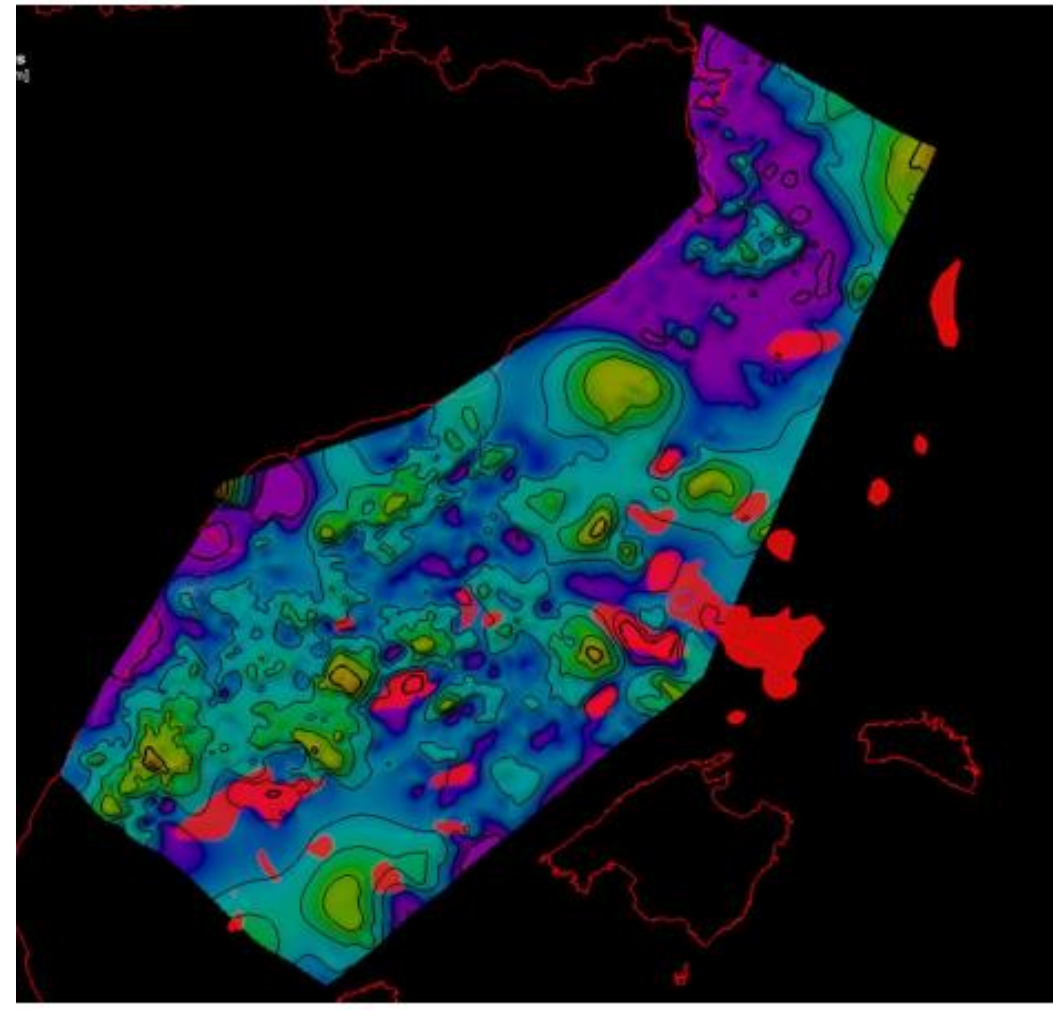
Lluch et al., 1995



# VOLCANISM



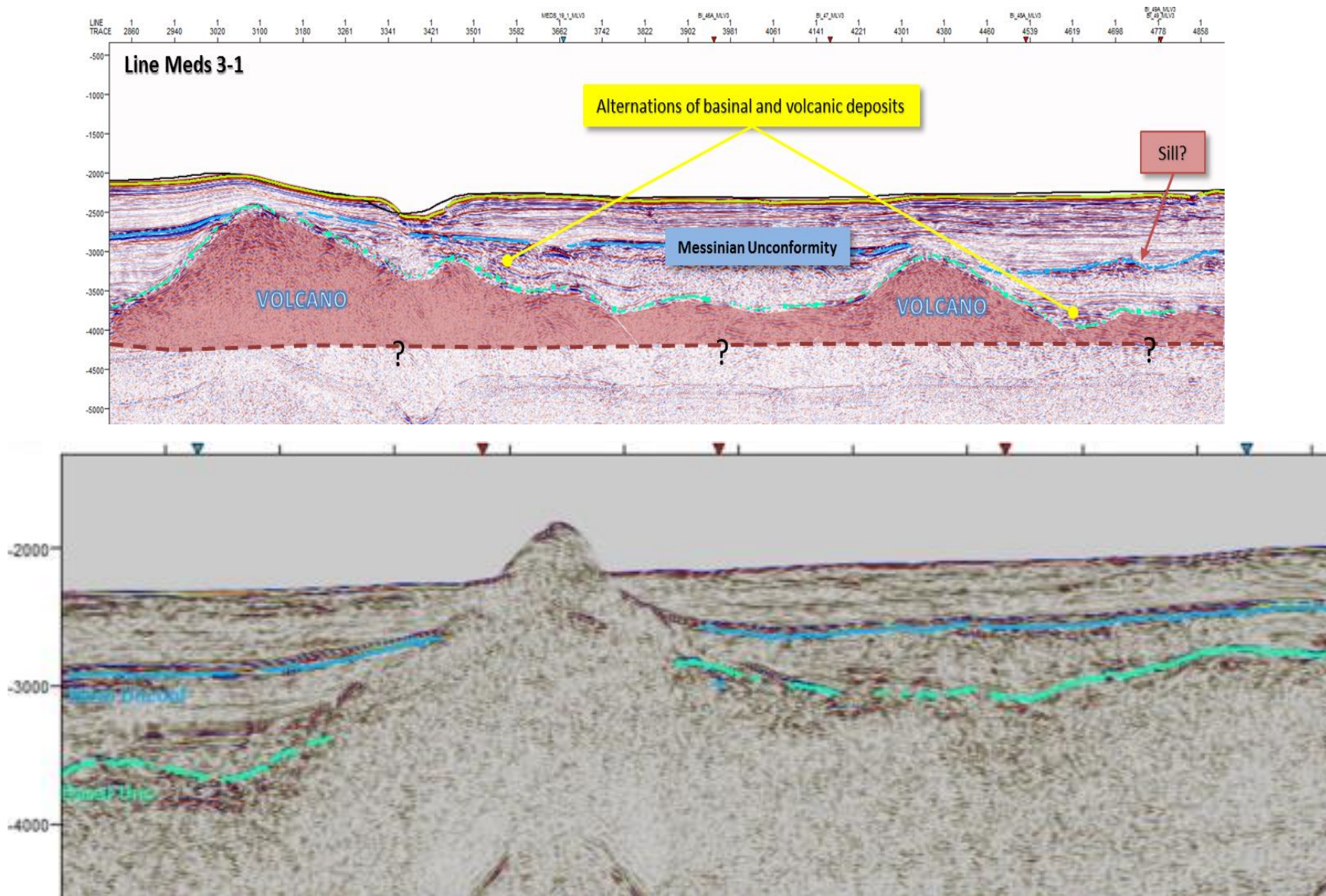
Messinian – Basal Unconformity isopach map



*Modified after Maillard et al., 2006*

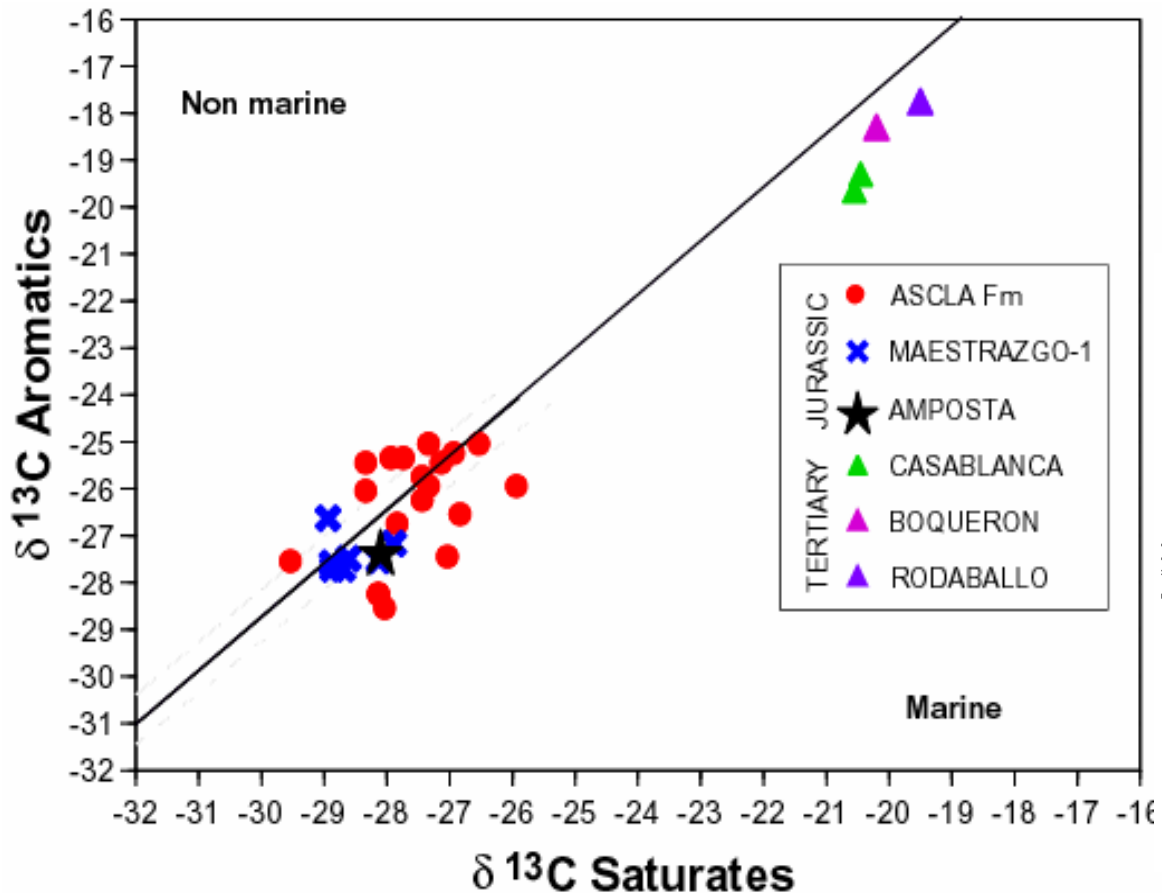


# VOLCANISM

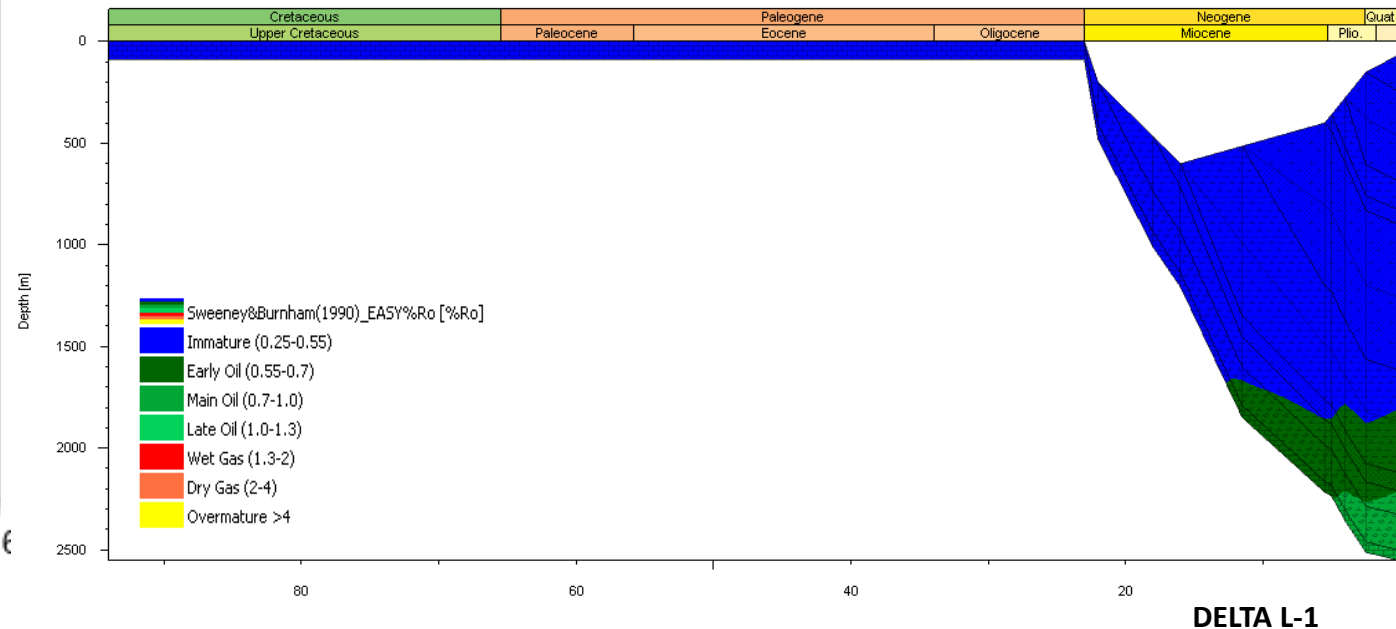




# SOURCE ROCKS AND OIL TYPES

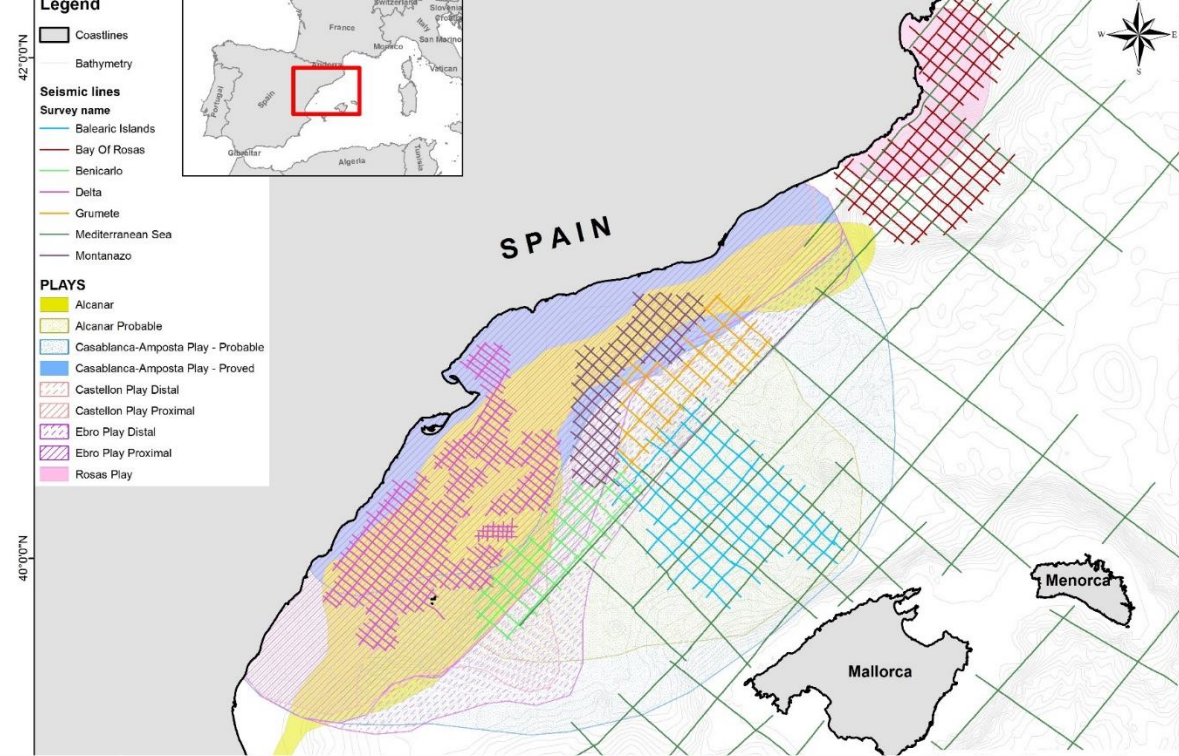
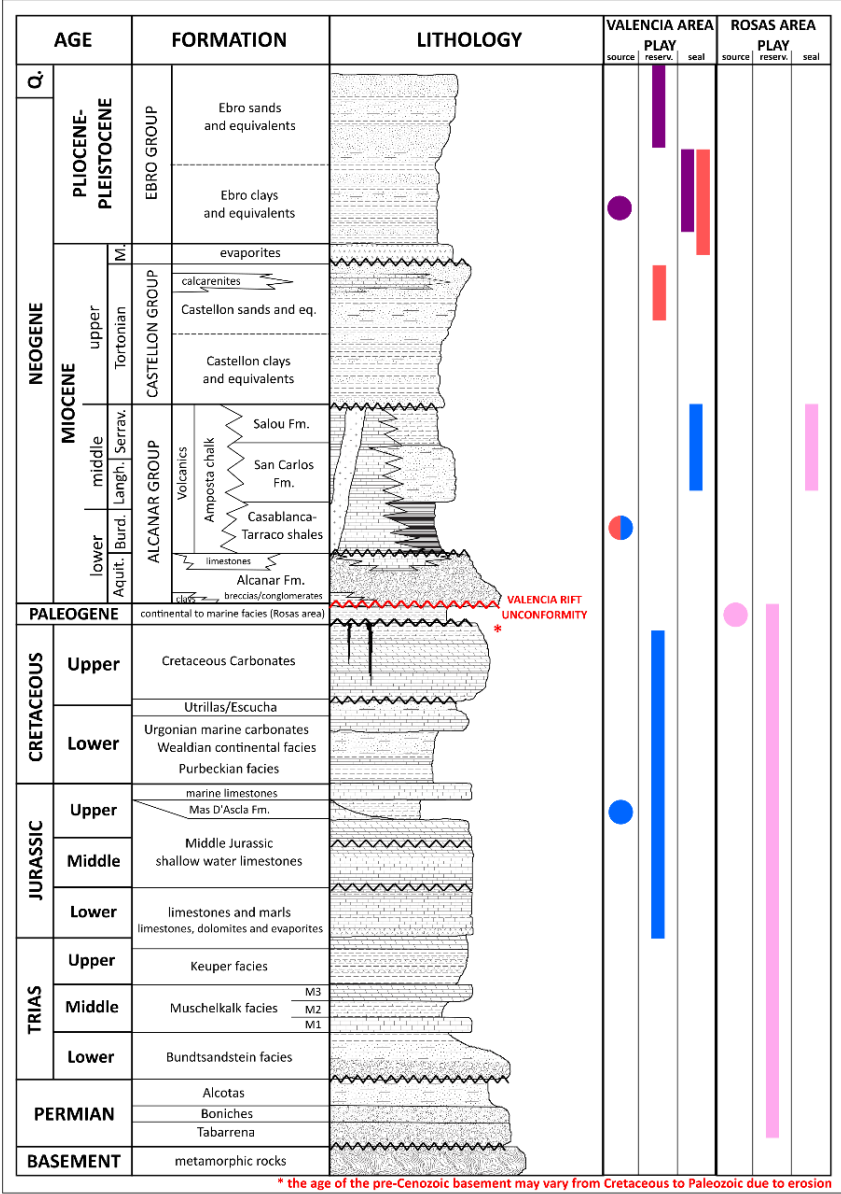


Mas D'Ascla Fm (U.Jurassic )	<ul style="list-style-type: none"> <li>Supposed to be the source in the Amposta Oil Field</li> <li>The highest TOC values (1.26%)</li> </ul>
Alcanar Group (Miocene)	<ul style="list-style-type: none"> <li>Casablanca oil field</li> <li>Low-quality, hydrogen-poor, type III kerogens, with TOC varying from 0.5 to 3%</li> </ul>





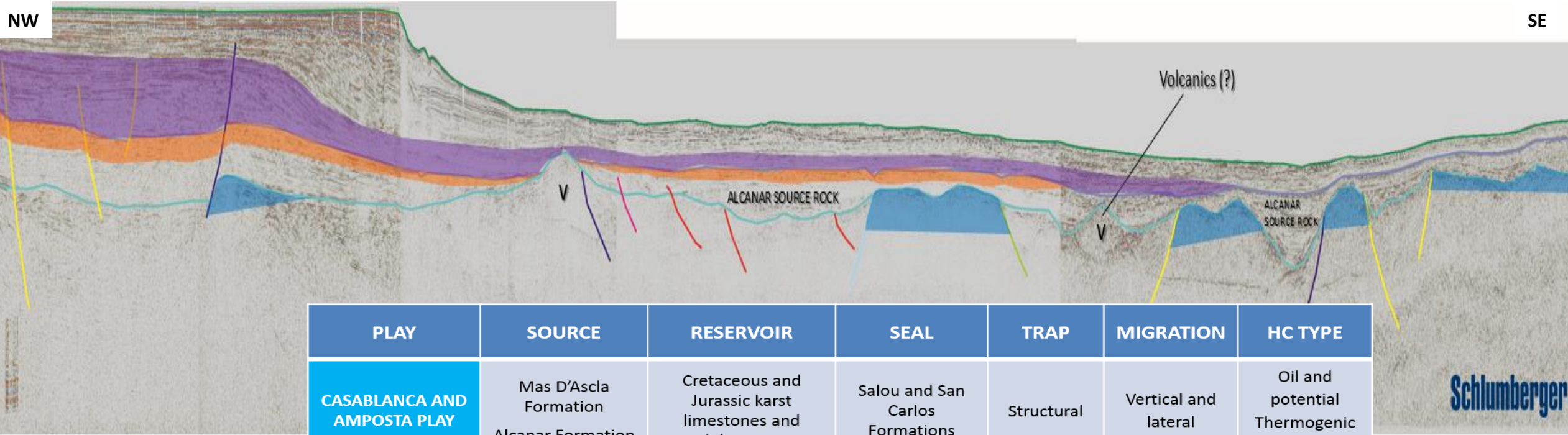
PLAY TYPES



PLAY	SOURCE	RESERVOIR	SEAL	TRAP	MIGRATION	HC TYPE
CASABLANCA AND AMPOSTA PLAY	Mas D'Ascla Formation Alcanar Formation	Cretaceous and Jurassic karst limestones and dolostones	Salou and San Carlos Formations	Structural	Vertical and lateral	Oil and potential Thermogenic gas
CASTELLON PLAY	Alcanar Formation	Castellon sands	Ebro Clays Messinian Evaporites	Stratigraphic	Vertical	Oil and Thermogenic gas
EBRO PLAY	Ebro clay	Ebro Sands	Ebro Clays	Stratigraphic	Lateral	Biogenic Gas
ROSAS PLAY	Paleogene marine faces	Cretaceous to Permo-Triassic carbonates and dolostone Paleogene?	Salou and San Carlos Formations equivalent	Stratigraphic	Lateral	Oil?



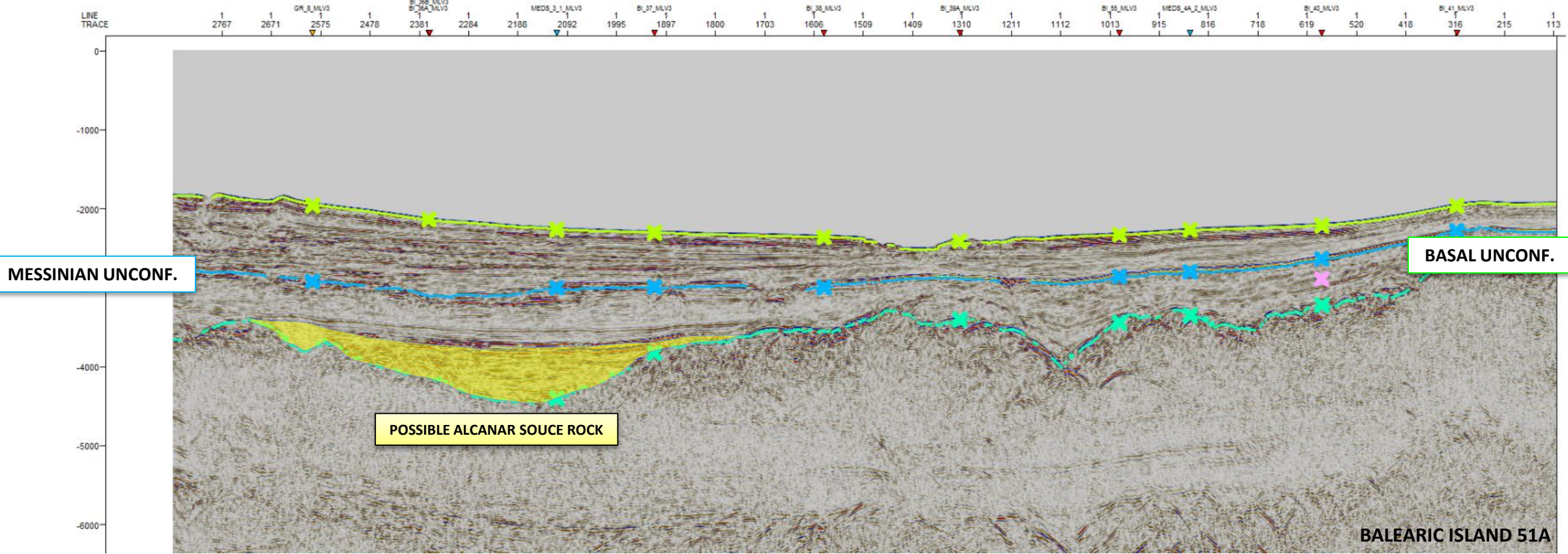
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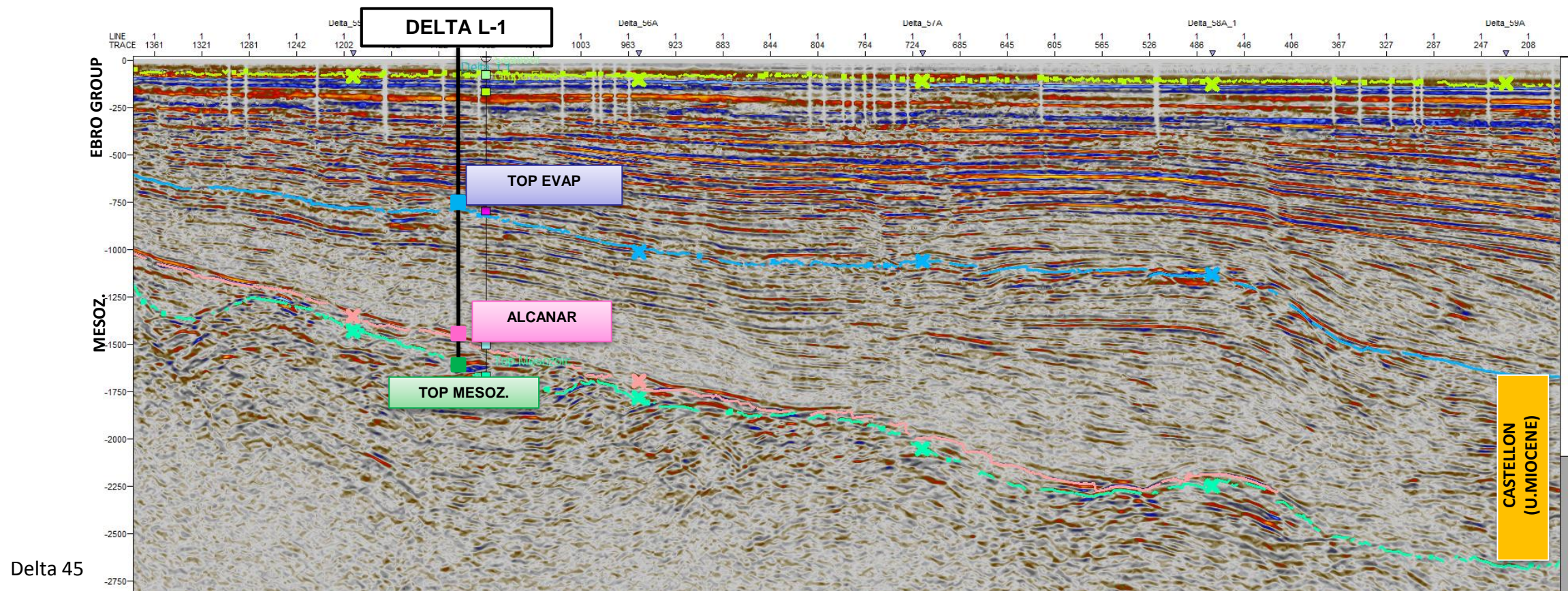
# CASABLANCA PLAY



PLAY	SOURCE	RESERVOIR	SEAL	TRAP	MIGRATION	HC TYPE
CASABLANCA AND AMPOSTA PLAY	Mas D'Ascla Formation Alcanar Formation	Cretaceous and Jurassic karst limestones and dolostones	Salou and San Carlos Formations	Structural	Vertical and lateral	Oil and potential Thermogenic gas



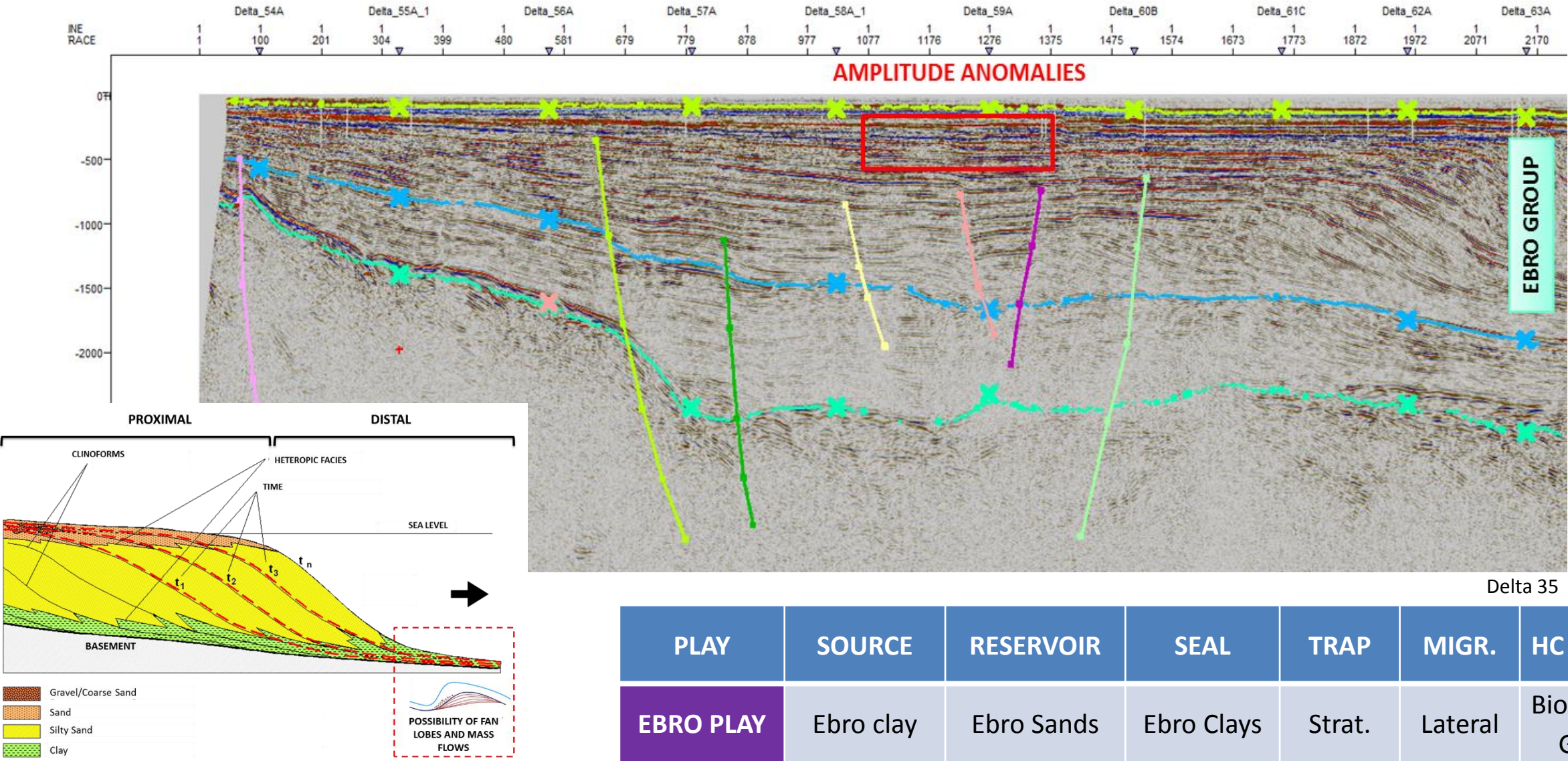
# CASTELLON PLAY (DISTAL & PROXIMAL)



PLAY	SOURCE	RESERVOIR	SEAL	TRAP	MIGRATION	HC TYPE
CASTELLON PLAY	Alcanar Formation	Castellon sands	Ebro Clays Messinian Evaporites	Stratigraphic	Vertical	Oil and Thermogenic gas

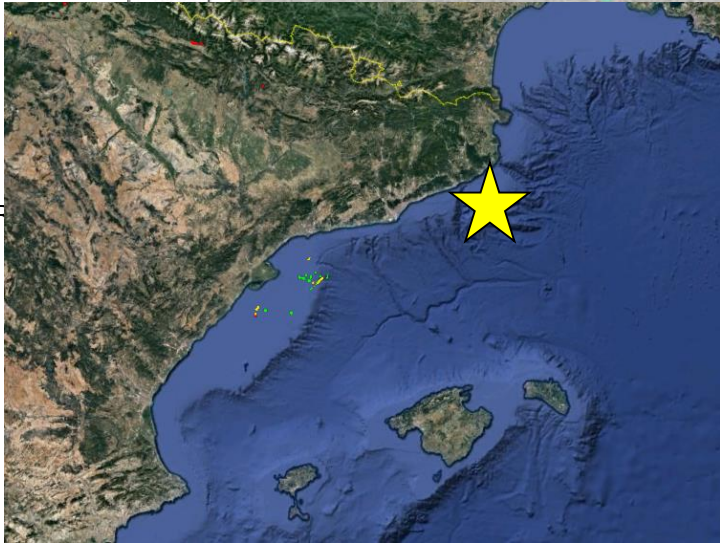
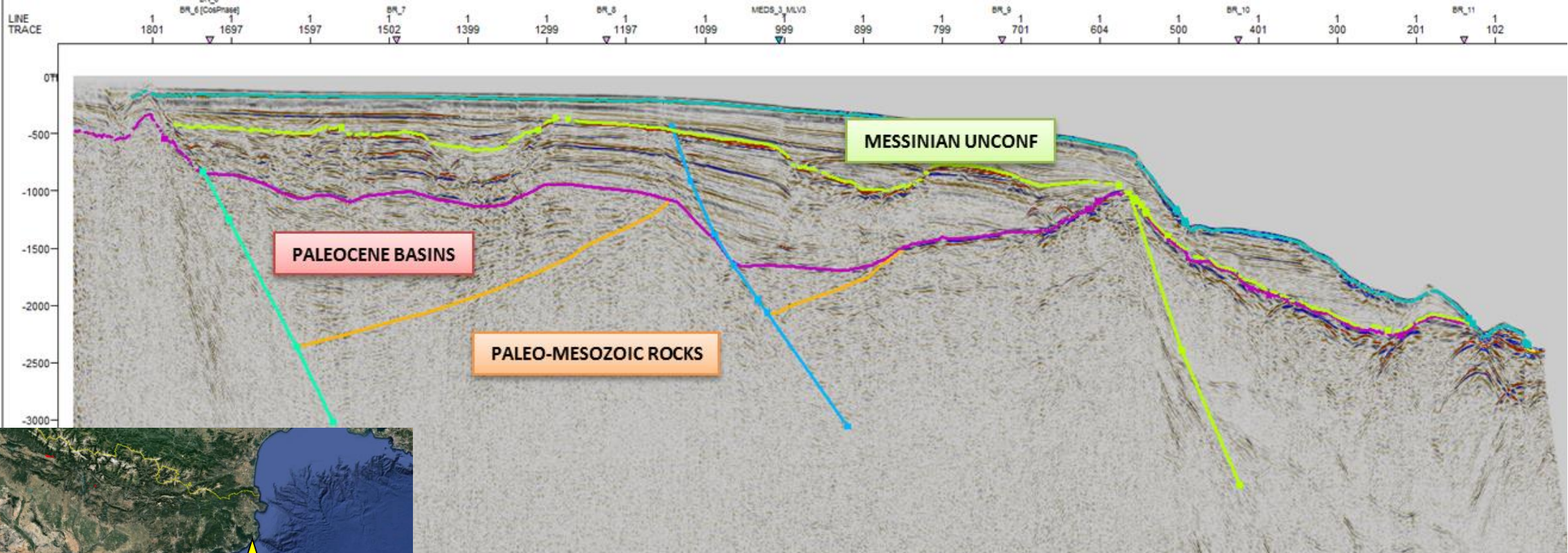


# EBRO PLAY (PROXIMAL & DISTAL)





# ROSAS PLAY



PLAY	SOURCE	RESERVOIR	SEAL	TRAP	MIGRATION	HC TYPE
ROSAS PLAY	Paleogene marine facies	Cretaceous to Permo-Triassic carbonates and dolostone Paleogene?	Salou and San Carlos Formations equivalent	Stratigraphic	Lateral	Oil?



# CONCLUSIONS

- **WIDE FRONTIER EXPLORATION AREA (UNDEREXPLORED, DEEP WATER, COMPLEX GEOLOGICAL EVOLUTION)**
- **EVIDENCES OF TWO WORKING PETROLEUM SYSTEMS USING INTEGRATED DATA**
- **2 MAJOR SOURCE ROCKS:**
  - **MAS D'ASCLA (U.JURASSIC)**
  - **ALCANAR (MIOCENE)**
- **RESERVOIRS ARE:**
  - **KARSTIFIED LIMESTONES AND DOLOSTONES (CASABLANCA AND AMPOSTA PLAY)**
  - **VERTICALLY PROGRADING SILICICLASTIC TURBIDITES TO DELTAIC SYSTEM (CASTELLON PLAY)**
  - **PROGRADATIONAL AND SHELF-MARGIN DELTAS TO SLOPE TRANSITION (EBRO PLAY)**
  - **PERMO-TRIASSIC TO CRETACEOUS LIMESTONE AND DOLOSTONES AND PALEOGENE DEPOSITS (ROSAS PLAY)**
- **HEAT FLOW AND PRESENCE OF VOLCANIC EDIFICES ARE CRITICAL FACTOR FOR SOURCE-ROCK MATURITY**

**THANK YOU !**

