



ONHYM

المكتب الوطني للهيدروكربونات والمعادن  
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

Kingdom of  
Morocco

# Exploration Opportunities in Morocco

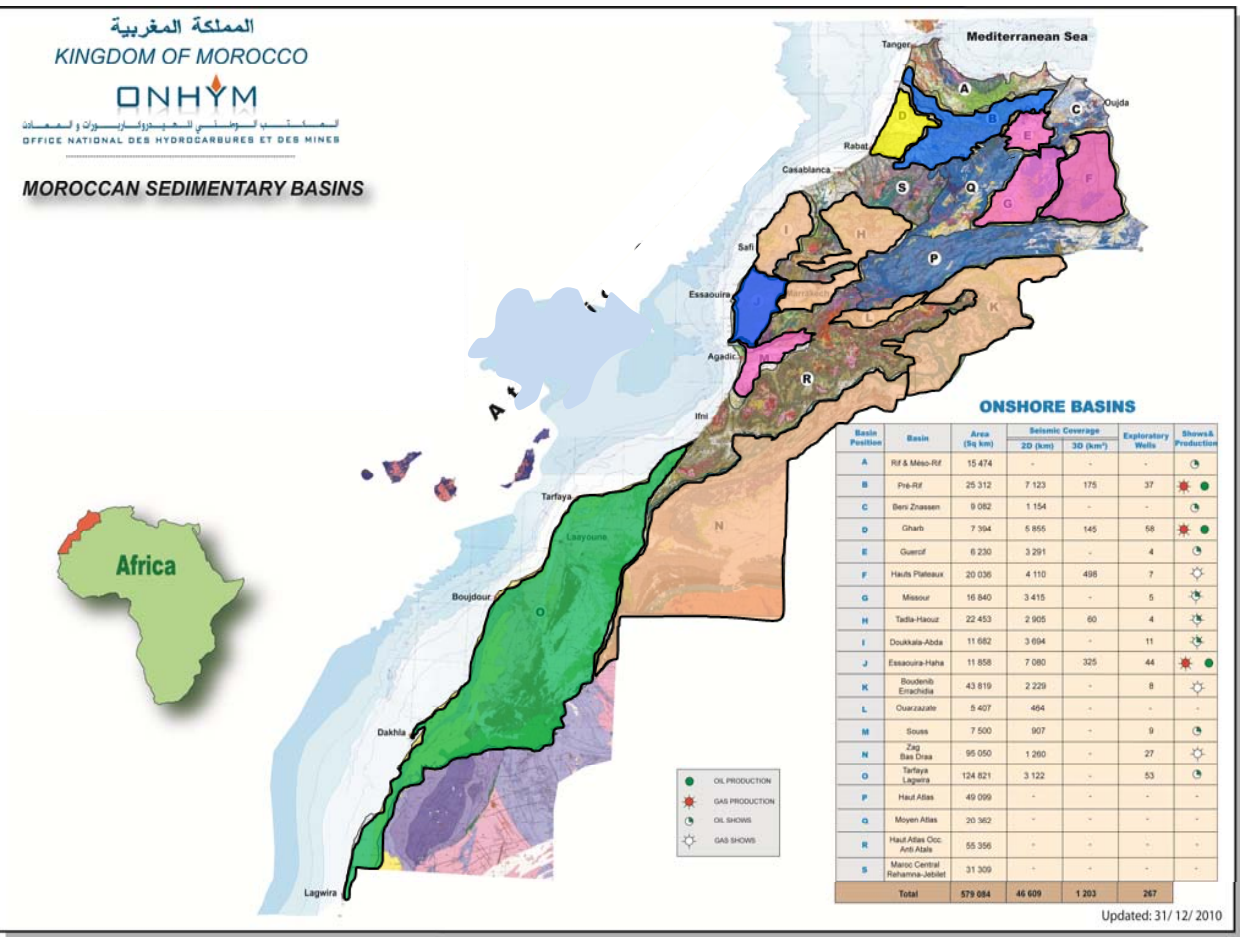
A. BENARCHID  
ONHYM

# ONHYM Perspectives

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- Opening of new frontier areas for exploration;
- Use of new technology tools in the exploration phase (onshore and offshore);
- Exploration and development of new resources (Oil Shale, Shale Gas & Shale Oil).

# Geological Snapshot : Onshore



**Paleozoic :**

Zag (N), Boudenib (K), Ouarzazate (L), and Tadla (H)

**Triassic :**

Essaouira (J), Souss (M), Guercif (E), High Plateaux (F) and Missouri (G)

**Jurassic :**

Laayoune (O), Tarfaya (O), Essaouira (J), Prerif (B)

**Cretaceous :**

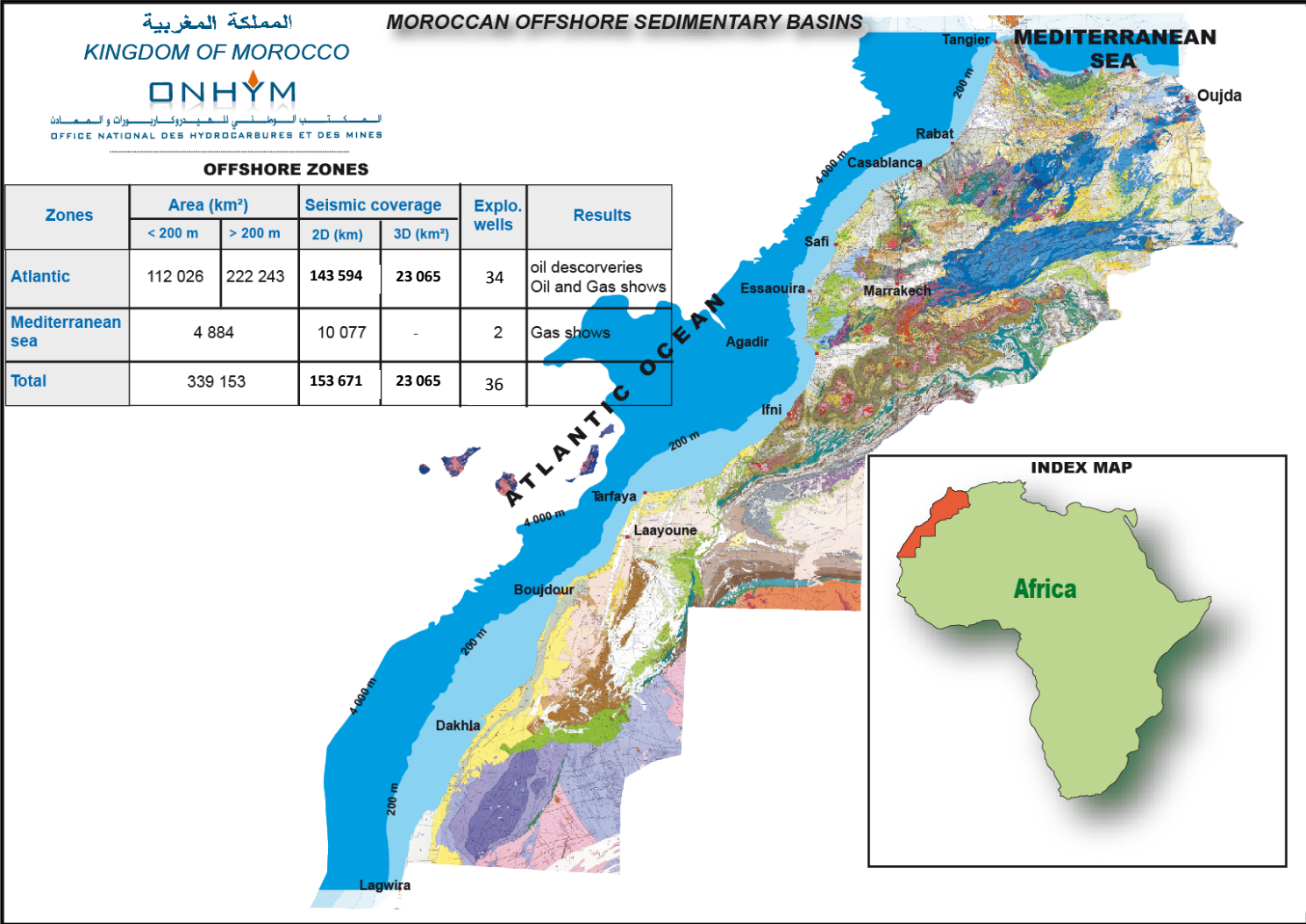
Tarfaya (O), Boujdour (O)

**Tertiary:**

Gharb (D)



# Geological Snapshot : Offshore

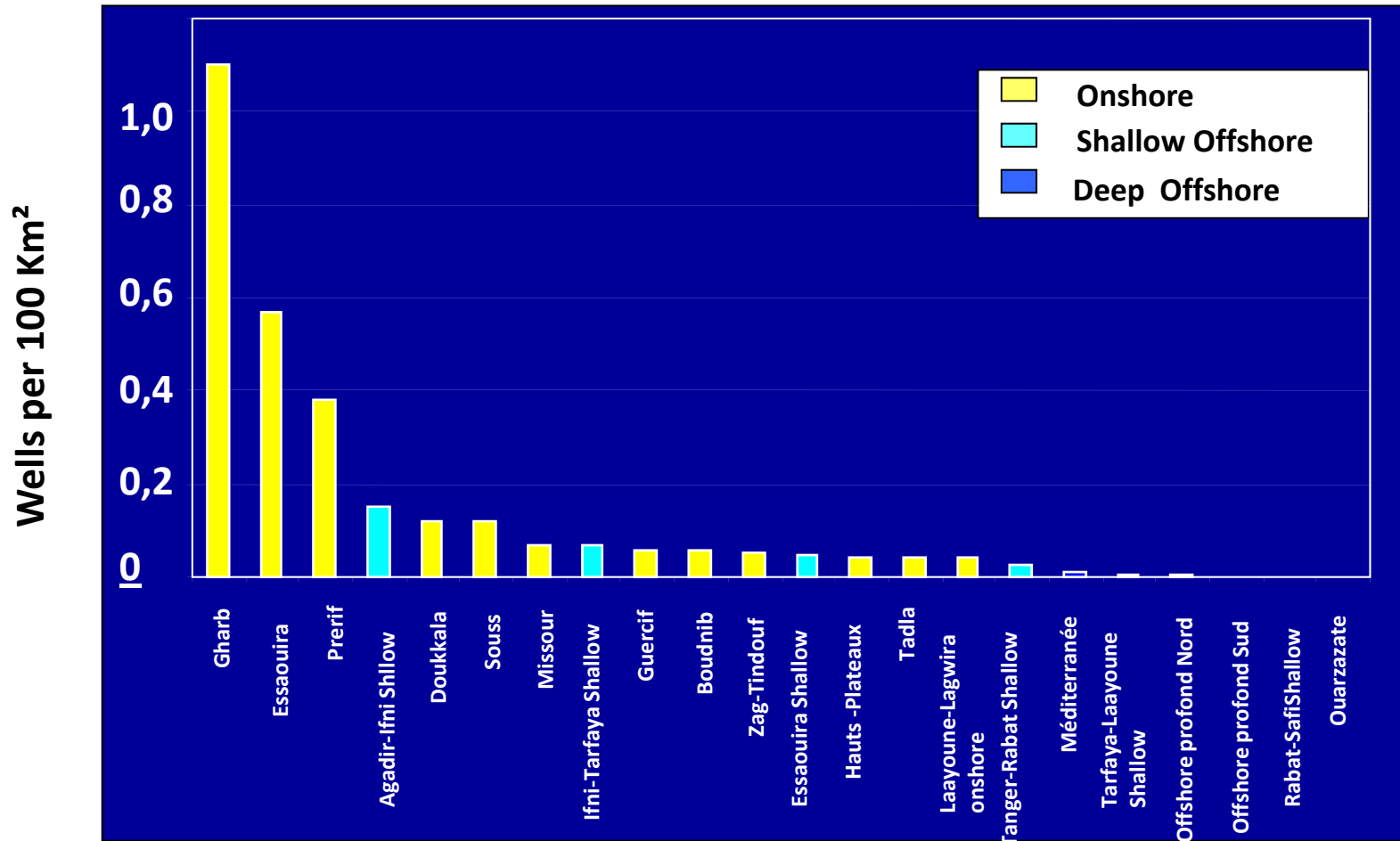


- Offshore Atlantic: Jurassic, Cretaceous and Tertiary basins
- Mediterranean: Tertiary basin



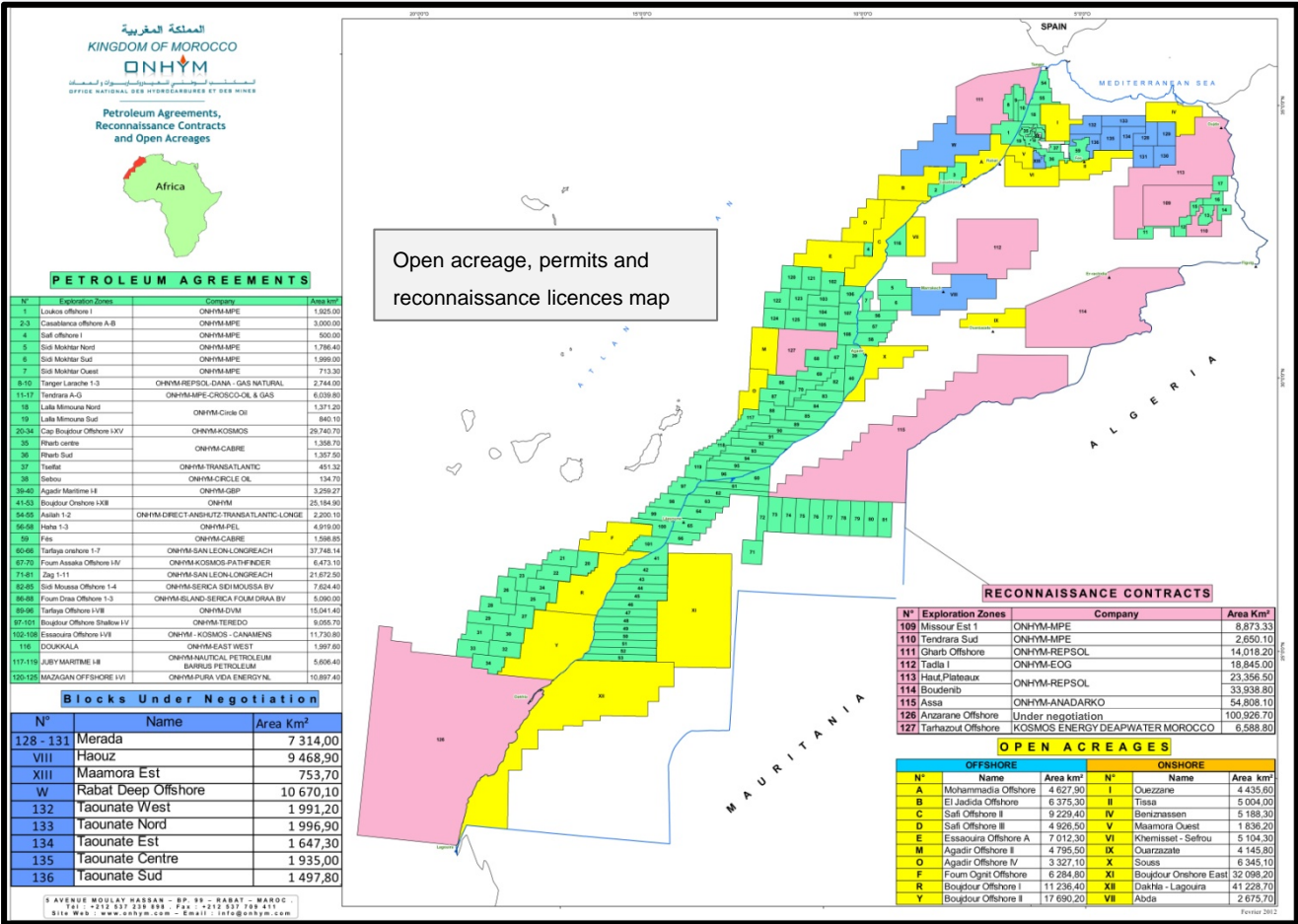
# Exploration History

## Exploration Drilling Density (well/ 100 Km<sup>2</sup>)



Moroccan Sedimentary Basins

# Licensing Status




**Open acreage**

- 10 blocs offshore
- 10 blocs onshore
- 09 blocs under negotiation

**PA & RL**

- 31 Petroleum Agreements offshore & onshore
- 09 Reconnaissance Licences (6 onshore and 3 offshore)



# Exploration Status

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## Available Data base

- **201 934 Km of 2D seismic data (17 000 Km in offshore open areas and 5700 Km in onshore ones);**
- **23 220 Km<sup>2</sup> of 3D seismic data (2200 Km<sup>2</sup> in the offshore open acreage);**
- **300 of Exploratory wells (Final well reports, logs, post mortem studies...);**
- **Regional and detailed geological and geochemical studies.**

# Petroleum System Summary

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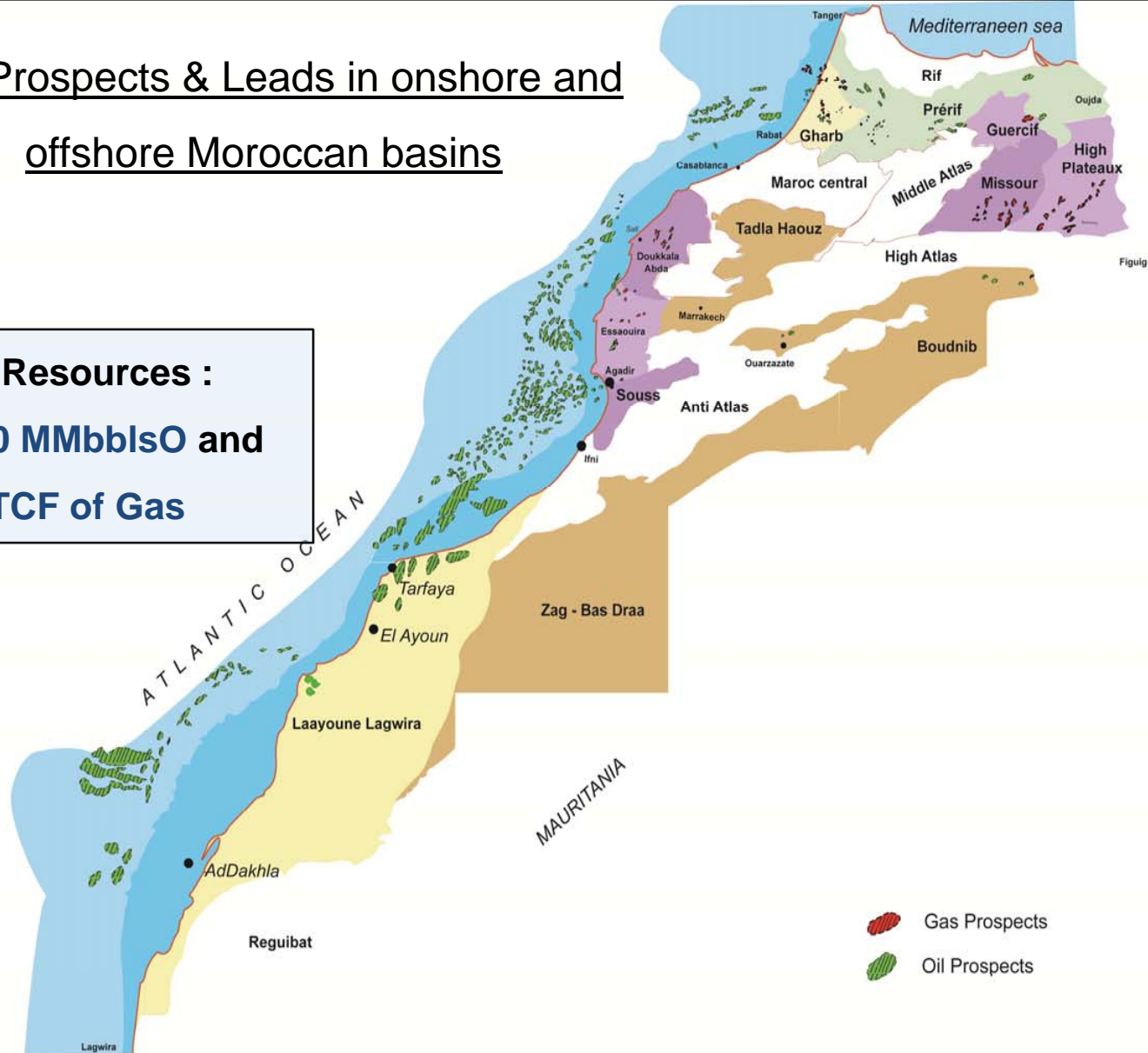
- **The Essential elements to a working Hydrocarbon systems are all present in most Moroccan sedimentary basins both Onshore and Offshore;**
- **Evidence from hydrocarbon occurrences (discoveries and shows), outcrops, and seismic indicators;**
- **Source rocks : Silurian, Toarcian, Oxfordian, Apto-Albian, Cenomano-Turonian, Eocene-Miocene;**
- **Reservoir rocks: Devonian, Triassic, Jurassic, Lower Cretaceous, Coniacian, Miocene, Oligocene;**
- **Sealing Rocks: Triassic salt, Jurassic anhydrites and Cretaceous and Tertiary shale;**



# Prospects & Leads

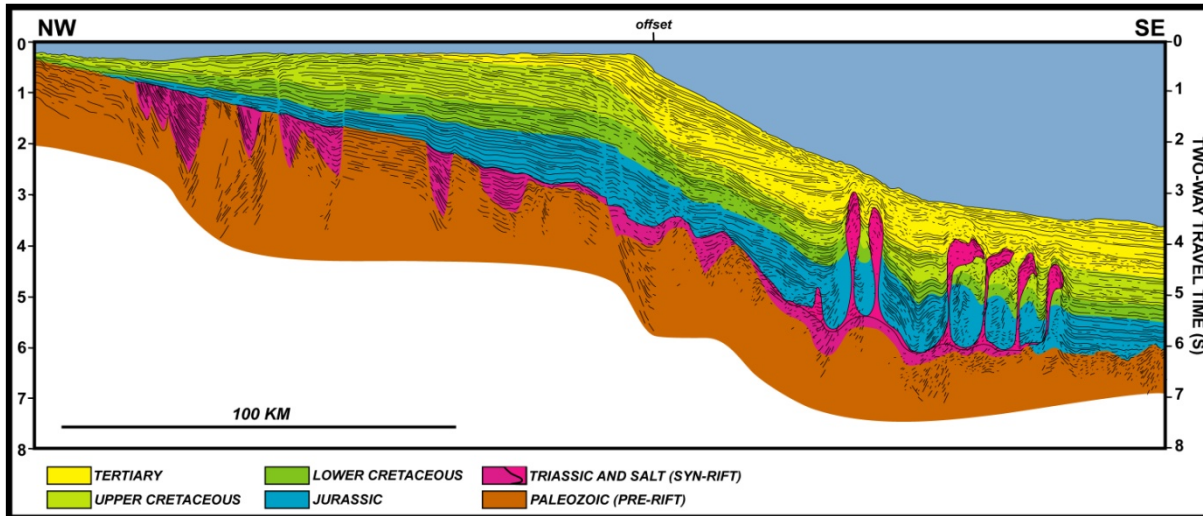
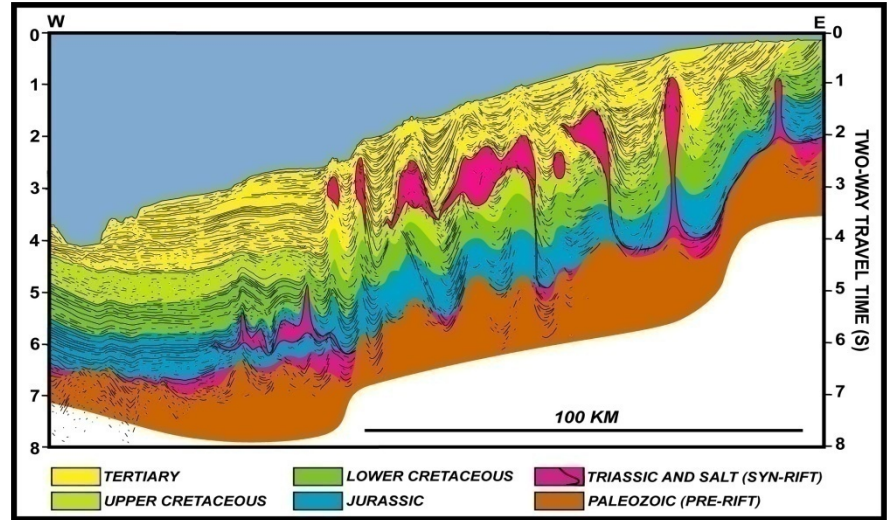
## 300 Prospects & Leads in onshore and offshore Moroccan basins

**Offshore Resources :**  
**11 – 1 140 MMbblsO and**  
**up to 11 TCF of Gas**



# Analogs

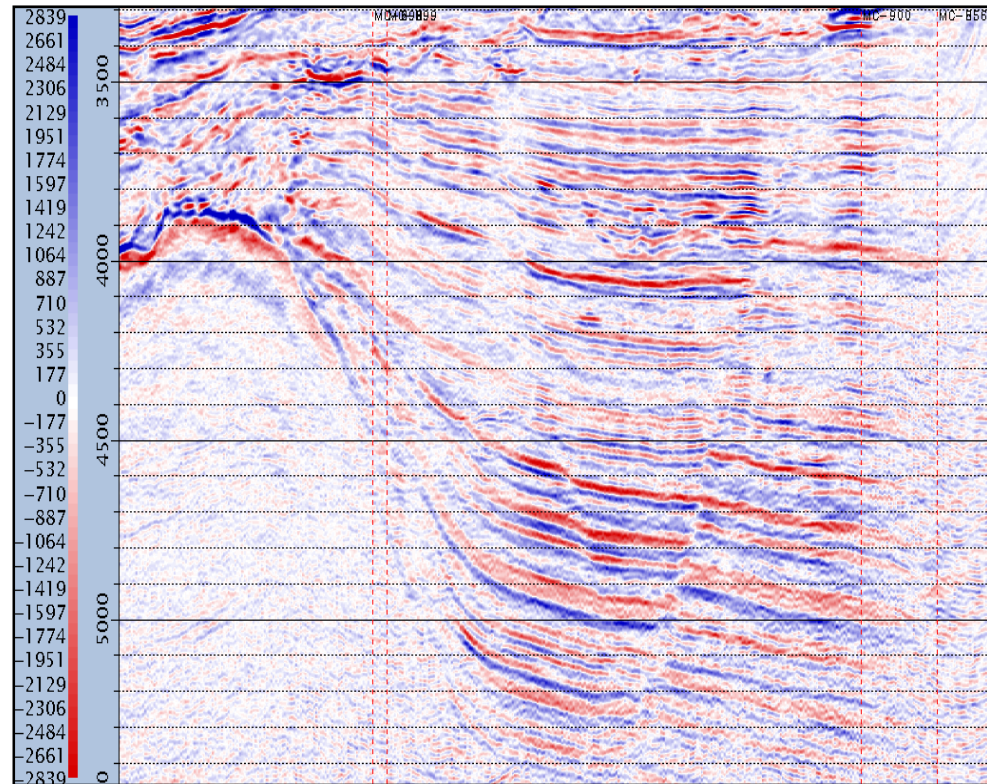
## Tafelney Plateau, Morocco



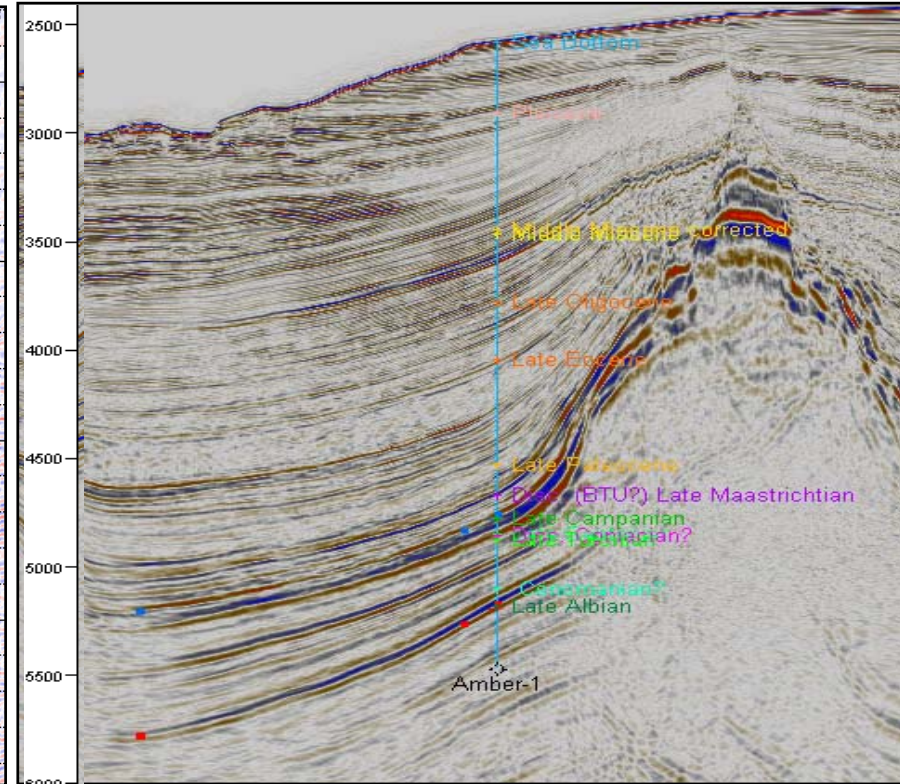
## Lahavre Plateau, Nova Scotia

# Analog

## Salt induced play



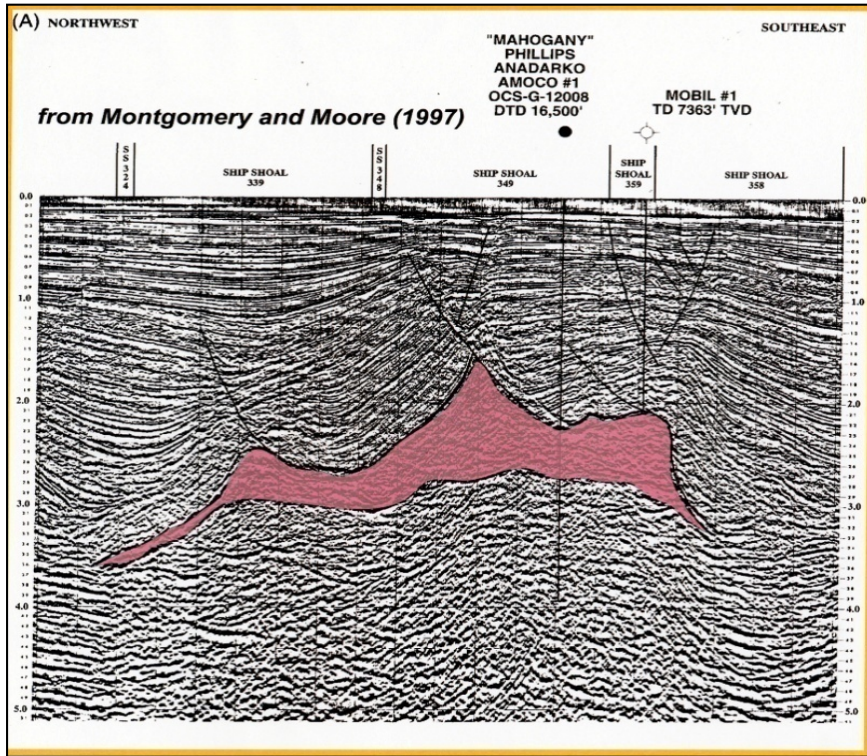
Ursa field Gulf of Mexico



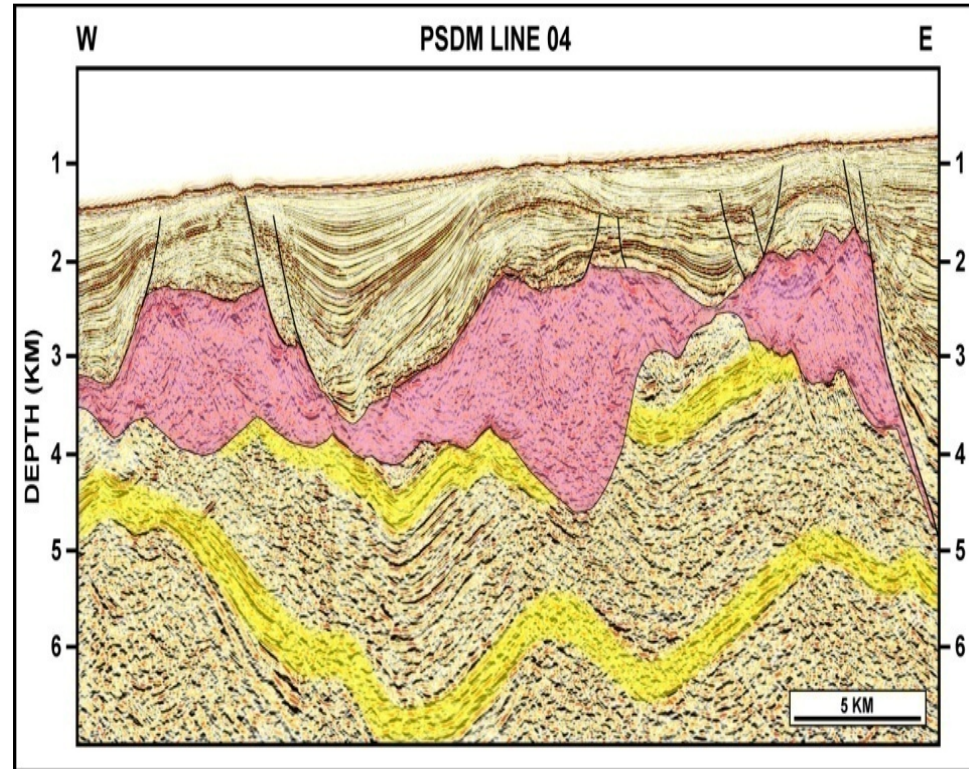
Moroccan Atlantic Offshore

# Analogs

## Subsalt play



Mahogany Field  
Gulf of Mexico (USA)

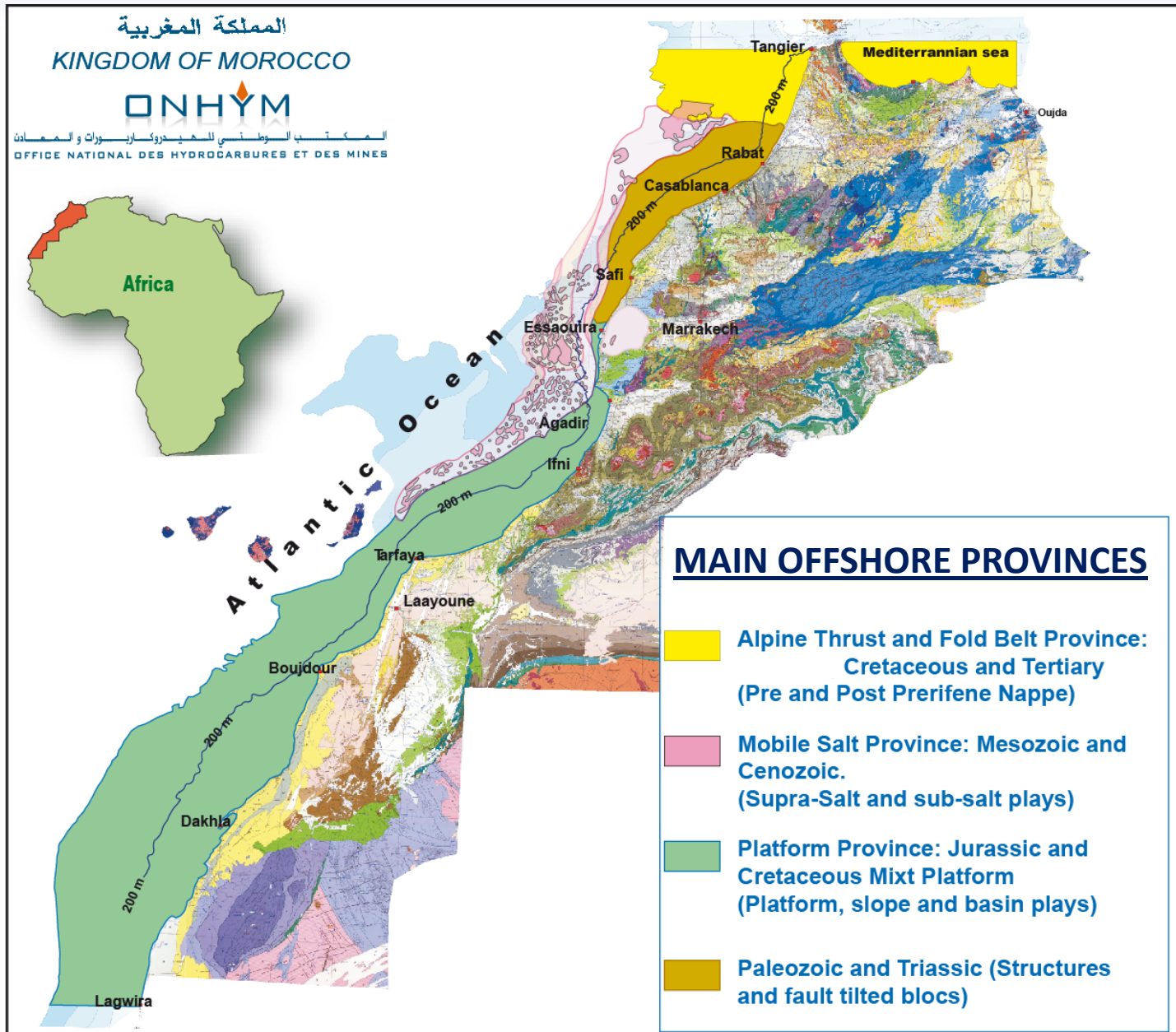


Moroccan Atlantic  
Offshore

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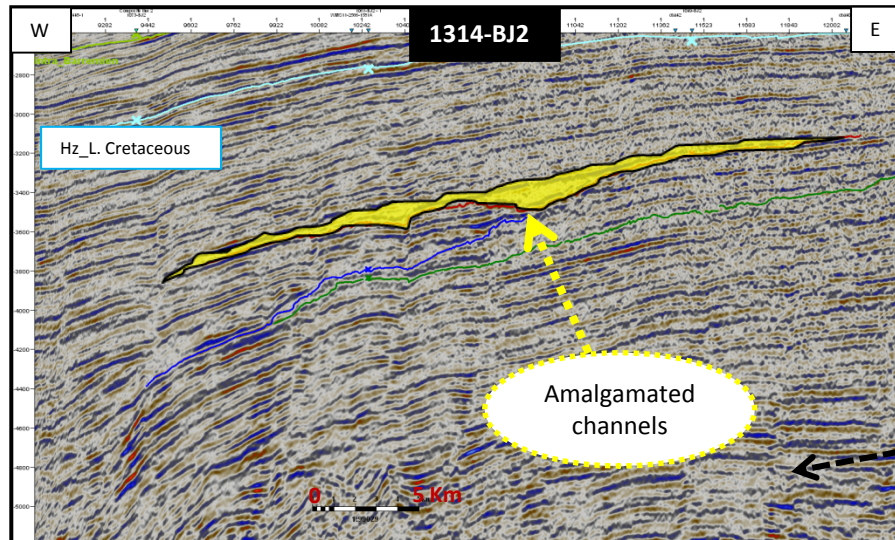
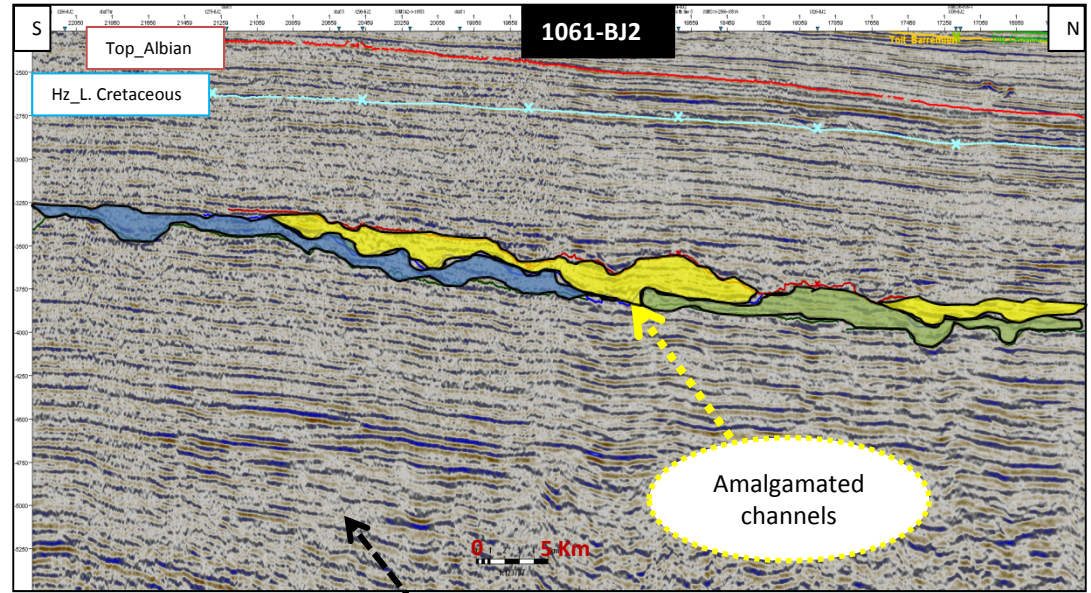
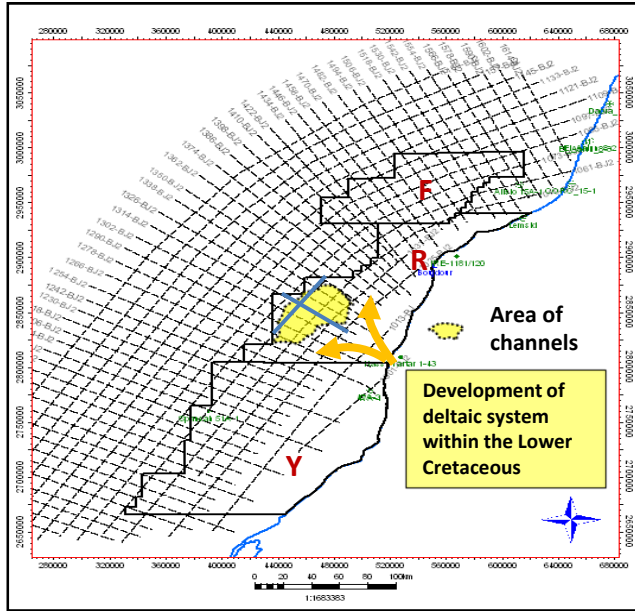
# Example of play concepts Offshore Atlantic

# Offshore Atlantic

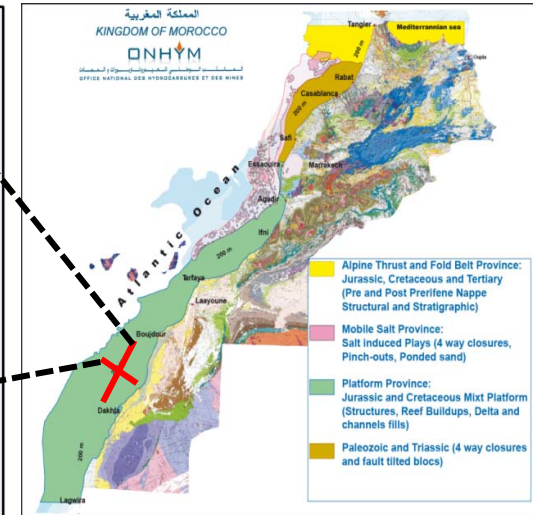


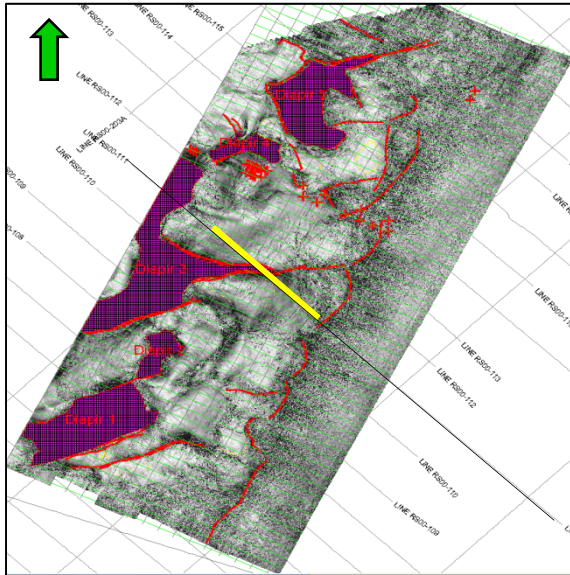
# Boujdour Offshore

# Lower Cretaceous Lead

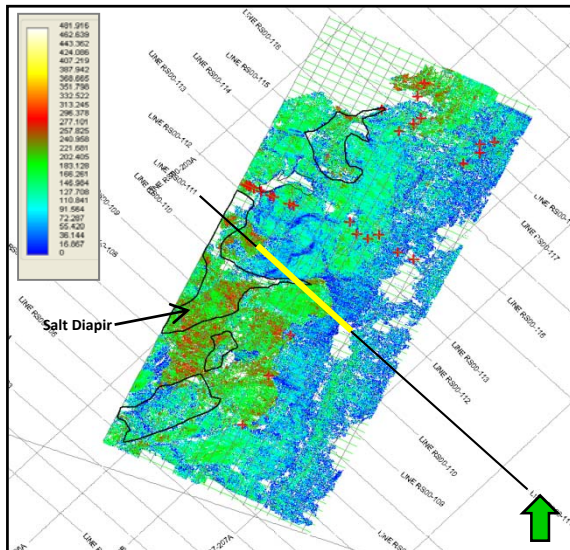


- **Traps :** Stratigraphic (Amalgamated Channels)
- **Reservoirs:** Lower Cretaceous sandstones
- **Source rocks:** Aptian and Jurassic
- **Seals:** Tertiary & Upper Cretaceous marls and shales

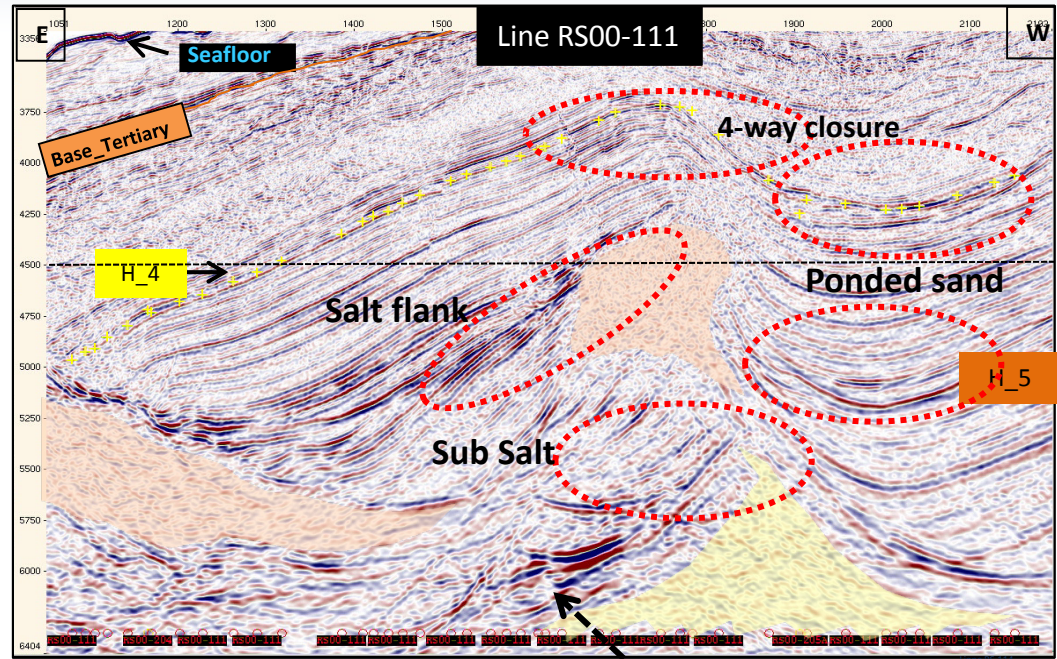




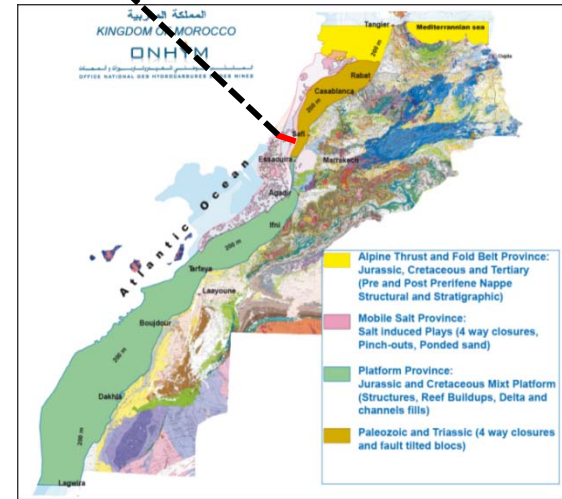
Time slice at 4500 ms of the « Dip of maximum similarity » attribute



«Shale indicator» attribute map extracted at the Lower Cretaceous (H\_5)



- **Traps:**
  - Structures related to salt tectonics
  - Stratigraphic: ponded sand
- **Reservoirs:**
  - Lower Cretaceous sandstone turbidites
- **Source rocks:**
  - Aptian and Lower Jurassic (Toarcian)
- **Seals:**
  - Upper Cretaceous marls & shales



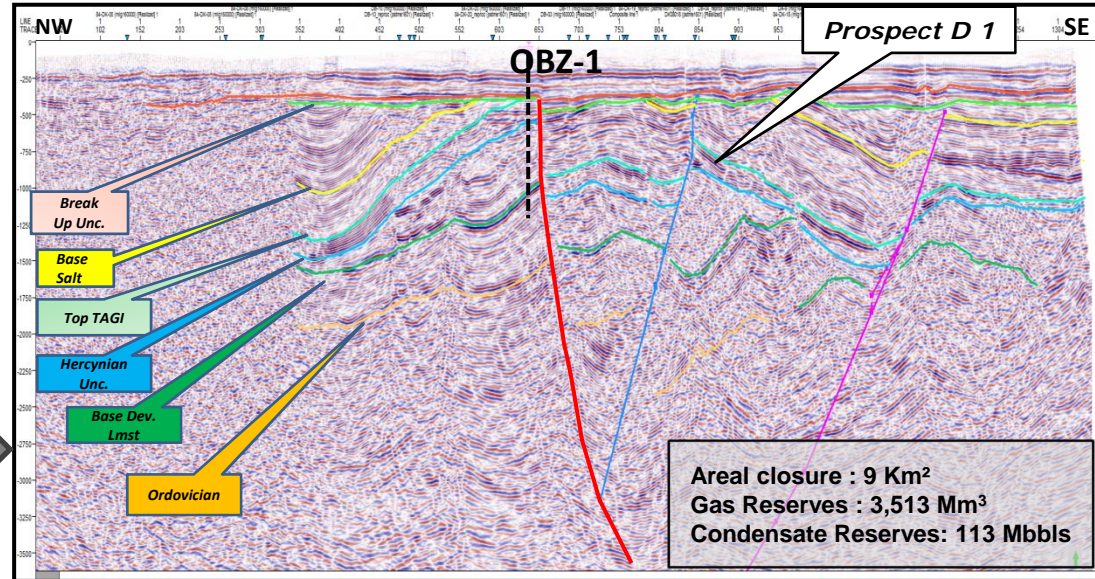
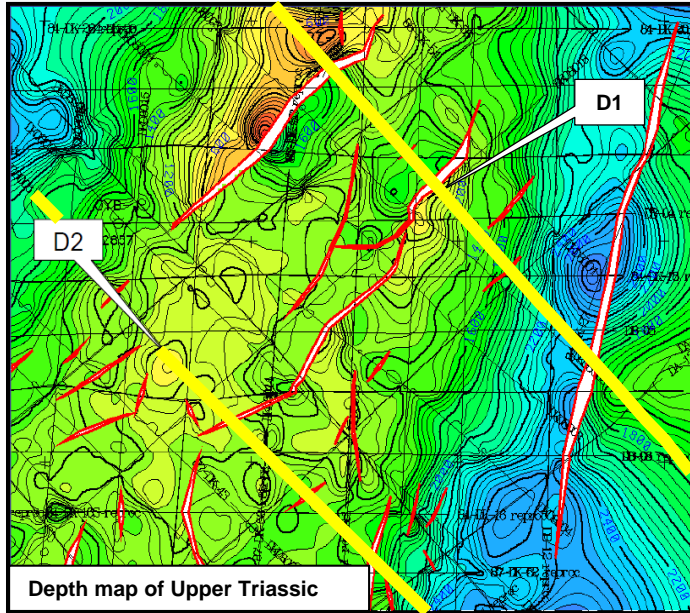


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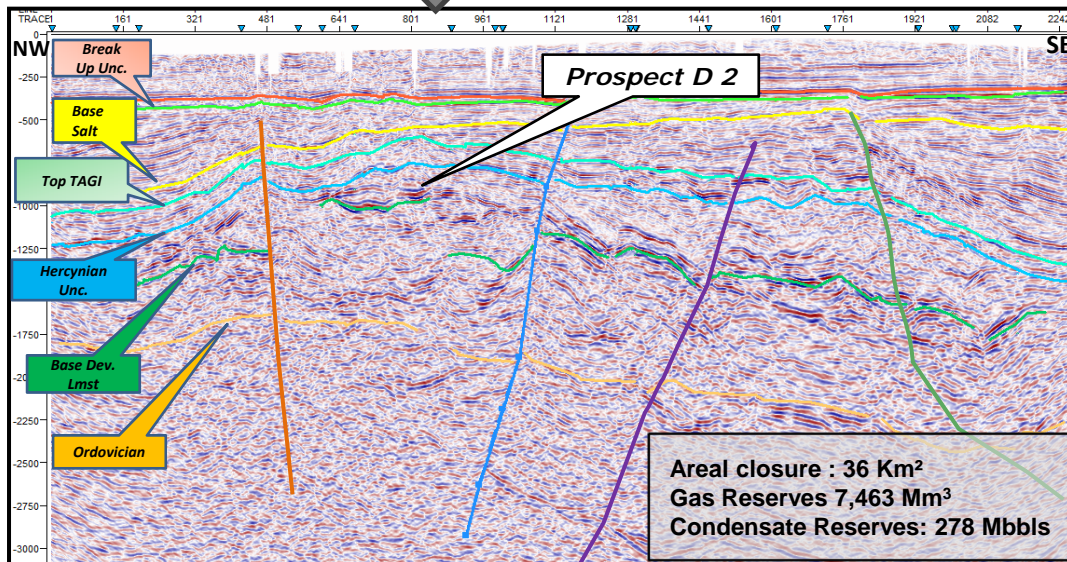
# Example of play concepts Onshore

# Abda-Doukkala basin

# Triassic Prospects



Line DA-05, through the OBZ-1 Well to the D1 Structure



Line DK080006, through the D2 prospect

- **Traps :** Faulted block and accommodation anticlines
- **Reservoirs:** Triassic sandstones (TAGI)
- **Source rocks:**
  - Silurian graptolite hot shales
  - Frasnian shales
- **Seals:** Triassic and Liassic interbedded shale & salt

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# Unconventional hydrocarbons

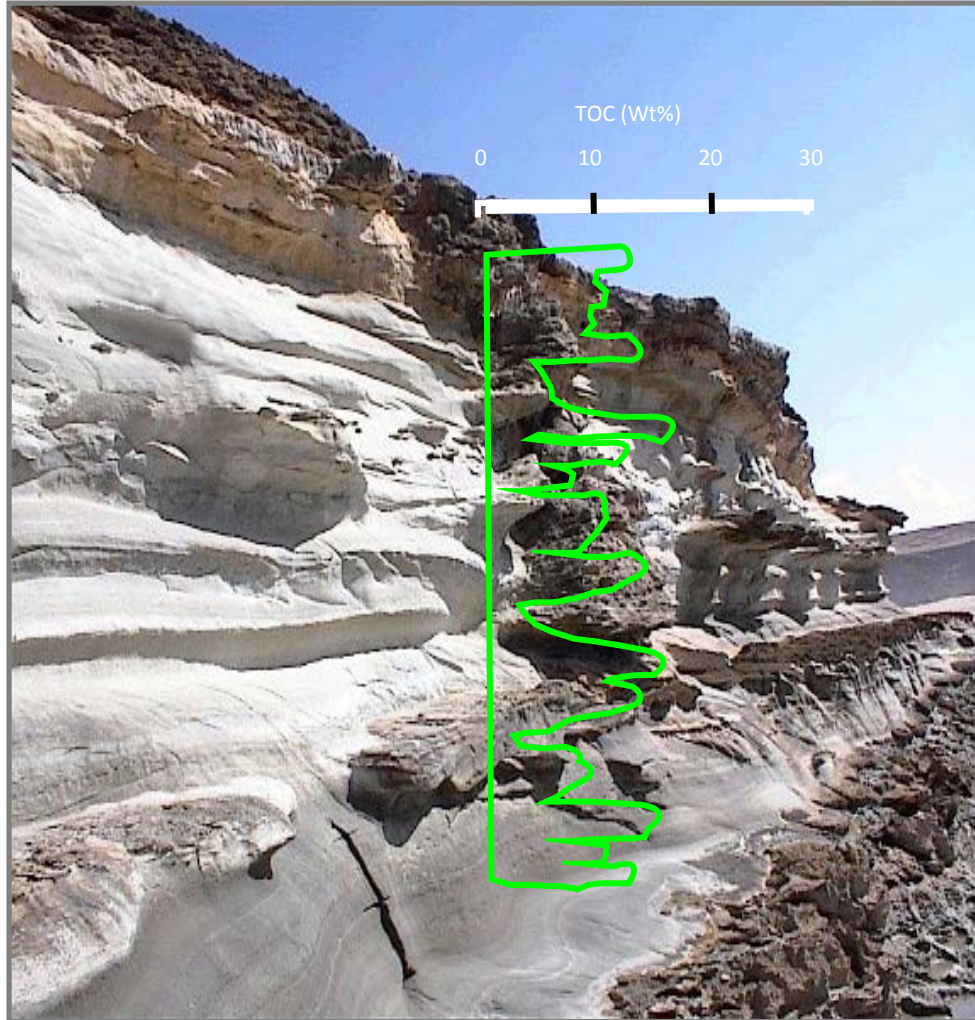
# Oil shale potential in Morocco



- The efforts of research started during the Eighties. They are resumed by national and foreign partners in concordance with the Moroccan global strategy.
- Morocco has important oil reserves contained in the oil shales (approximately 50 billion barrels, Timahdit &Tarfaya).

# Oil shale potential in Morocco

## Tarfaya onshore



**Cenomano-Turonian Tarfaya oil shale: 50 m thick source rock interval, with 2-19% TOCs**

# Oil shale potential in Morocco

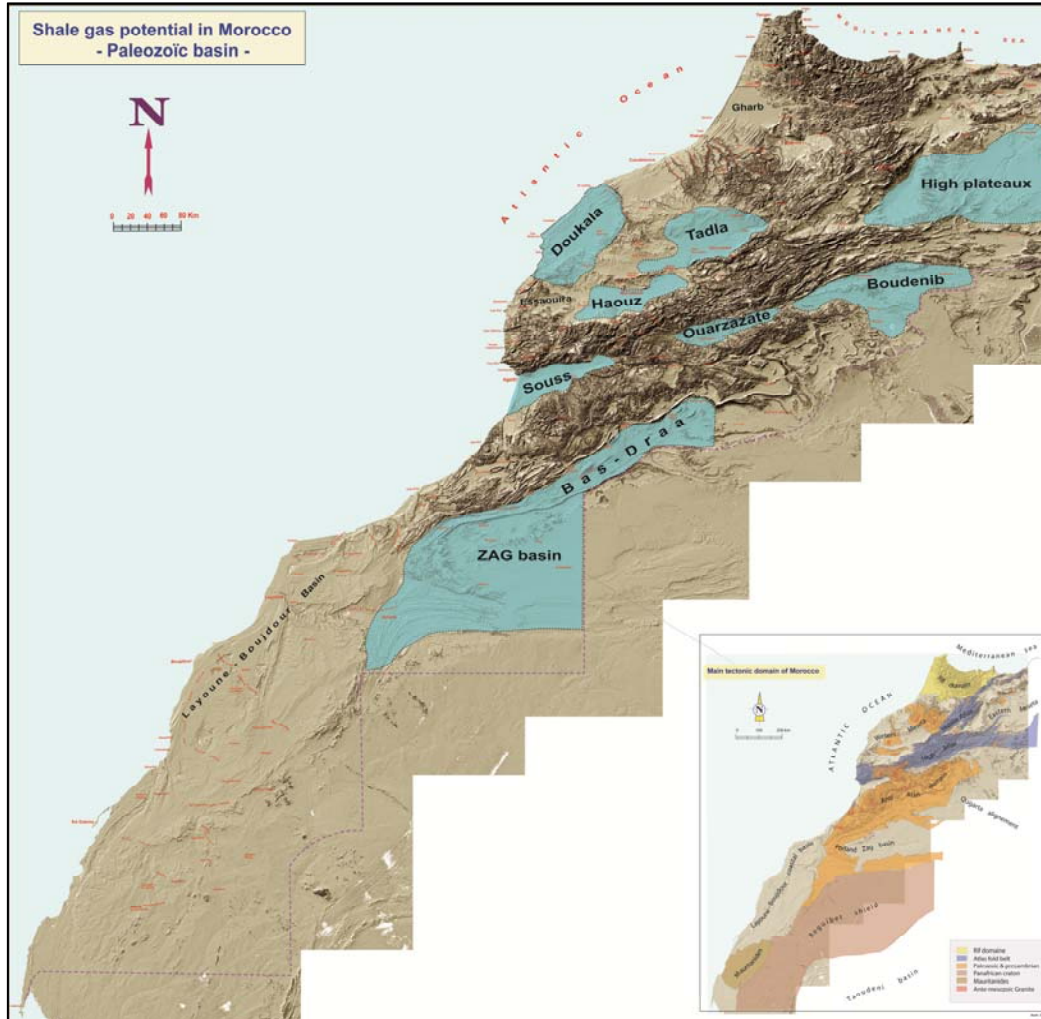
## Timahdit section



Upper Cretaceous Timahdit oil shale: 250m maximum thickness interval in an area of 900Km<sup>2</sup>

# Shale gas potential in Morocco

## Paleozoic system



- First geological appraisal of Paleozoic depositional system;
- Other basins worth a deep exploration work;
- The Mesozoic and Tertiary sediments have a good potential and should be considered for shale gas development plans.

# Shale gas potential in Morocco

## Paleozoic system

BASIN	AREA (Km <sup>2</sup> )	FORMATION	TOC (%)
Boudenib	34 000	Carboniferous	1 – 1.45
		Devonian	1 – 1.3
		Silurian	1 – 3
Tadla	10 000	Carboniferous	1 – 2
		Devonian	1 – 5.3
		Silurian	1 – 12
Doukkala	8 000	Carboniferous	1 – 2
		Devonian	1 – 2.48
		Silurian	1 – 2.1
Zag	65 000	Devonian	1 – 2
		Silurian	1 – 2
High Plateaux	23 437	Carboniferous	1 – 1.6



# Shale gas potential in Morocco

## Eastern Anti-Atlas



# Conclusions

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- Moroccan sedimentary basins, both onshore and offshore, remain under-explored ;
- Exploration drilling activity, although limited, and outcrops demonstrated the presence of viable petroleum systems;
- New 3D seismic data have permitted to increase the rate of success and to delineate new prospects;
- Developed play concepts are ranging in age from Paleozoic to Tertiary, and are of different types;
- In term of unconventional hydrocarbons, Moroccan basins have a good potential and worth a deep exploration work.

# Conclusions

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## What could be next?

- **Resumption of intensive exploration of the untested plays, both onshore and offshore, with new ideas;**
- **Reevaluation and upgrade of the previously indentified prospects and leads to go ahead for drilling;**
- **Acquisition of high quality seismic data and use of new reprocessing techniques and modelling to accurately assess and test the delineated plays and prospects;**
- **Intensive exploration programs to prove the unconventional hydrocarbon potential of the Moroccan basins.**



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