



ONHYM

المكتب الوطني للهيدروكربونات والمعادن
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

Kingdom of
Morocco

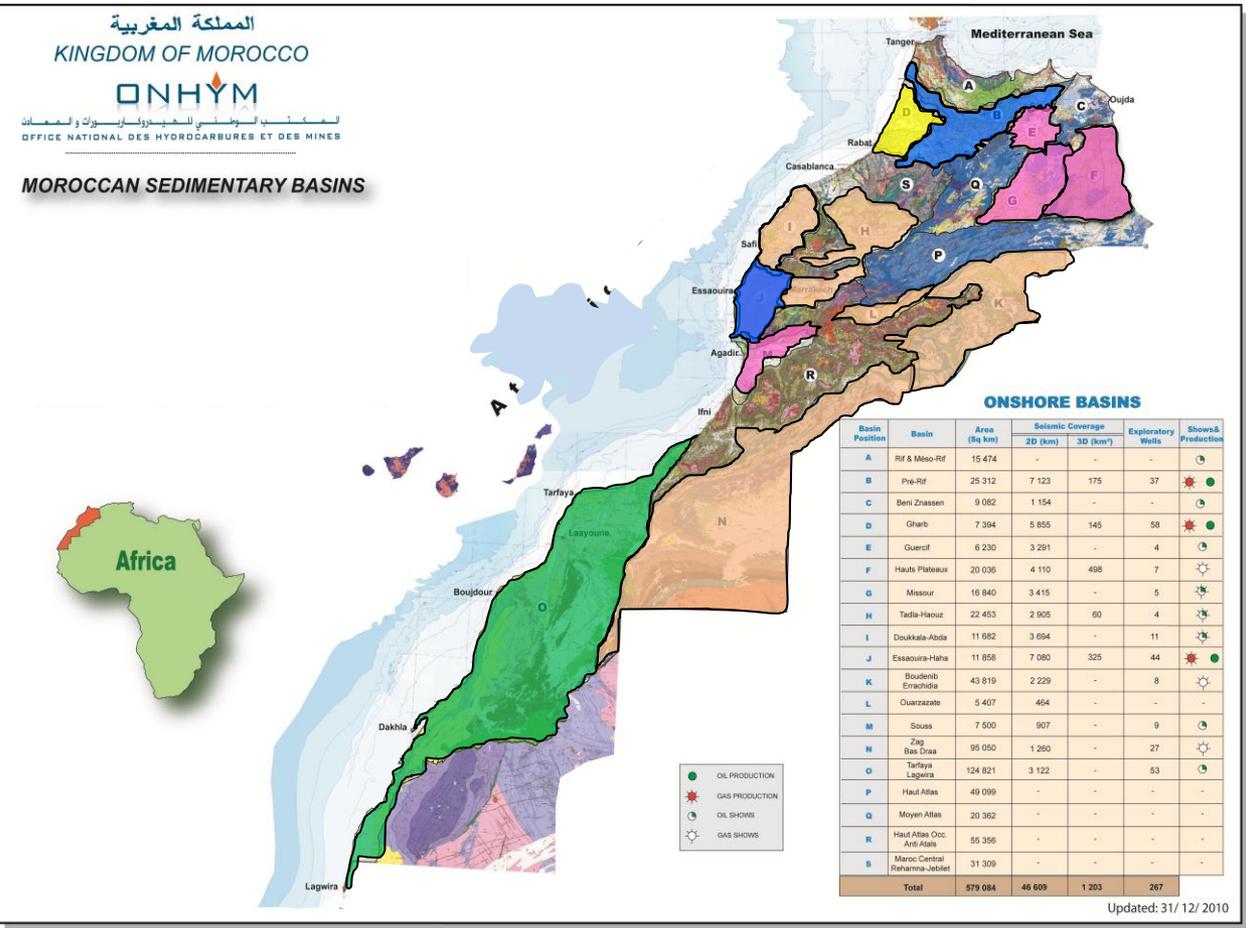
More Exploration Opportunities in Morocco

A. AIT SALEM
ONHYM

ONHYM Perspectives

- Opening of new frontier areas for exploration
(Fold and thrust belts, ultra deep water etc);
- Use of new technology tools in the exploration
(modern 2D and 3D seismic, geological and geochemical
modelling etc) ;
- 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
Missour (G)

Jurassic :



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

Cretaceous :



Tarfaya (O), Boujdour (O)

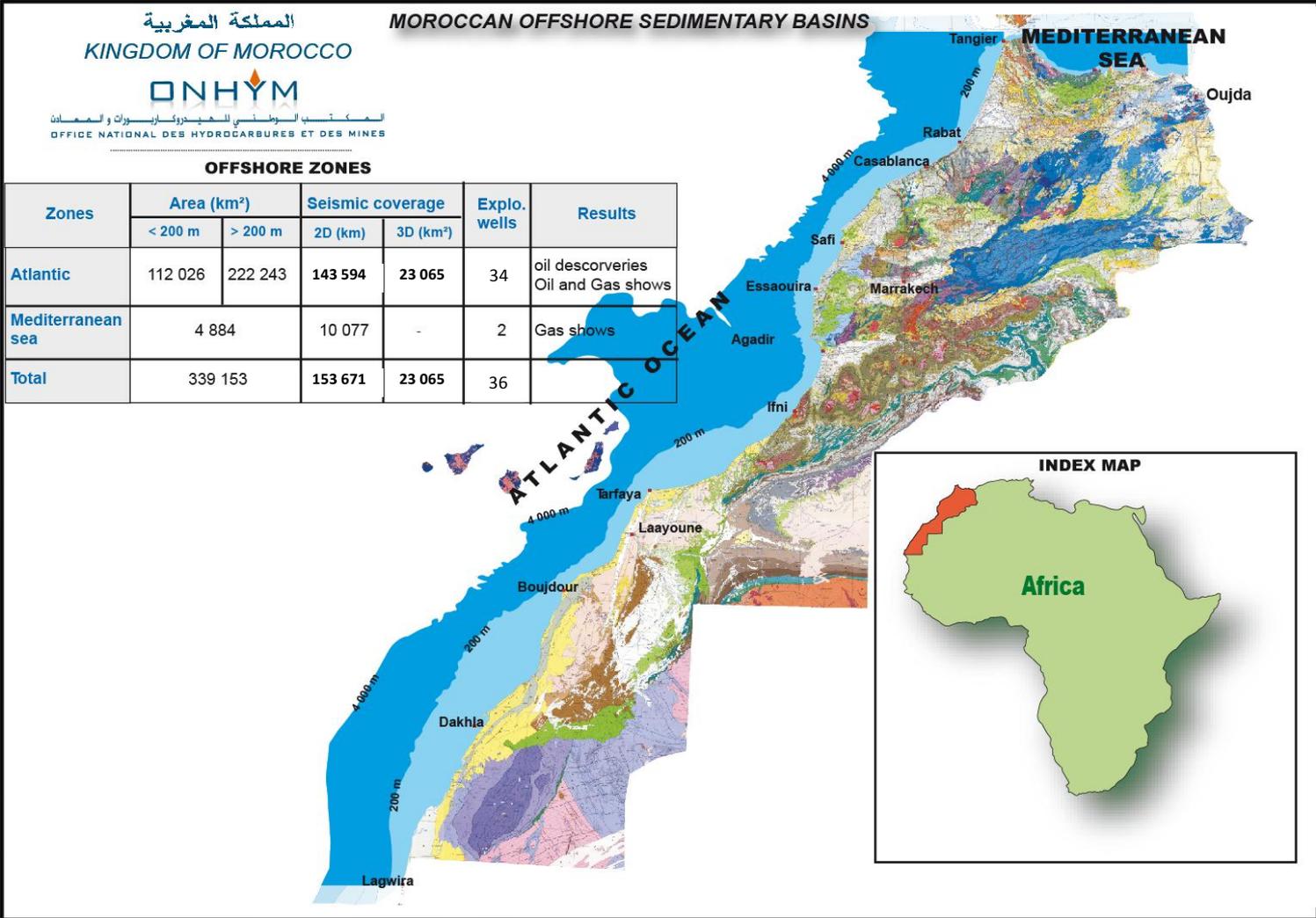
Tertiary:



Gharb (D)



Exploration Snapshot : Offshore



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



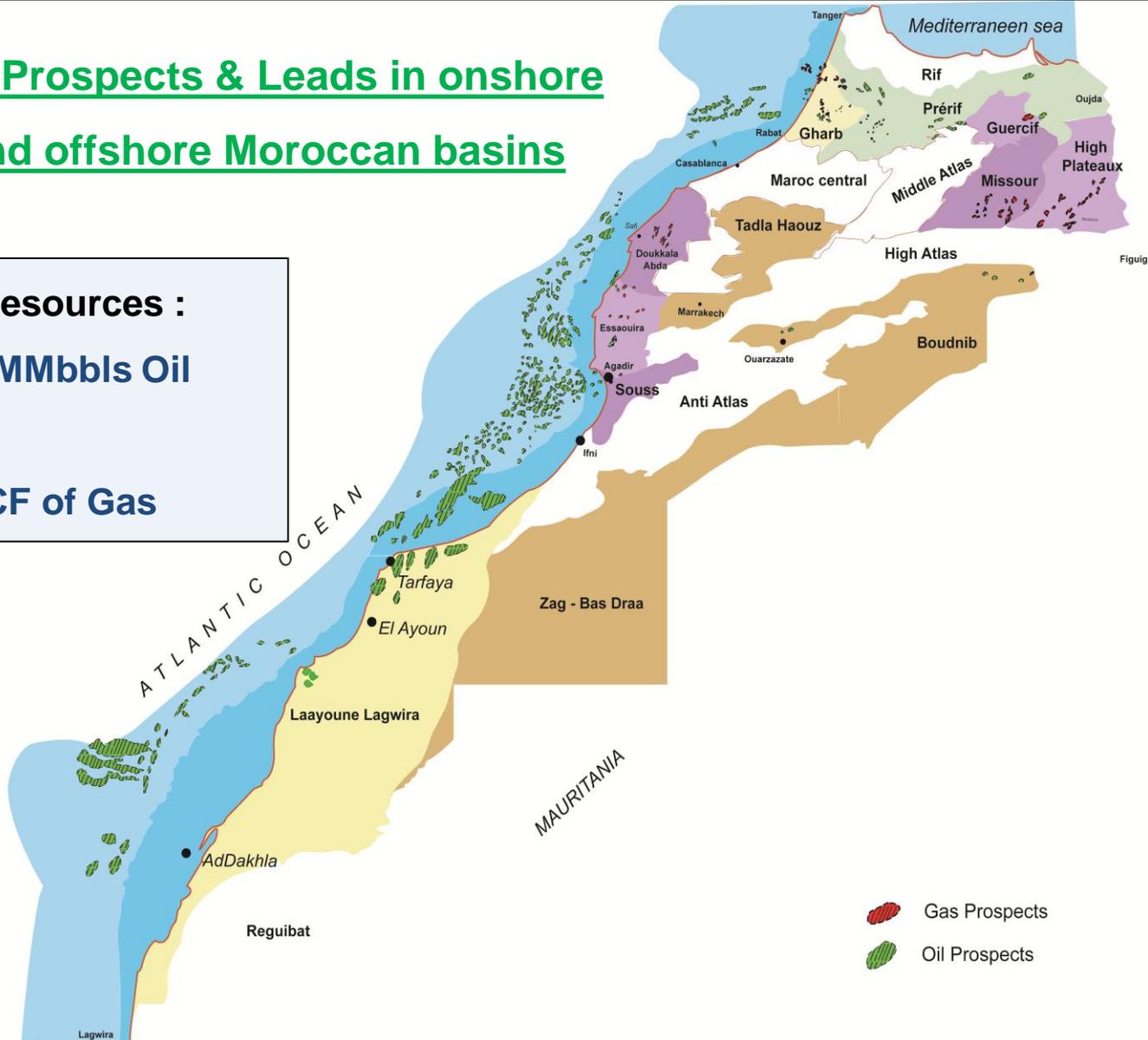
Petroleum System Summary

- The Essential elements to a working Hydrocarbon systems have been proven in the Onshore and Offshore Moroccan sedimentary basins;
- Evidence from hydrocarbon occurrences (discoveries, shows, surface oil seeps) and seismic indicators (HDIs, BSRs);
- Source rocks : Silurian-Devonian, Toarcian, Oxfordian, Aptian-Albian, Cenomanian-Turonian, Eocene-Miocene;
- Reservoir rocks: Devonian, Triassic, Jurassic, Lower Cretaceous, Coniacian, Miocene, Oligocene;
- Sealing Rocks: Triassic salt, Jurassic anhydrites, Cretaceous and Tertiary shale.

Exploration Results

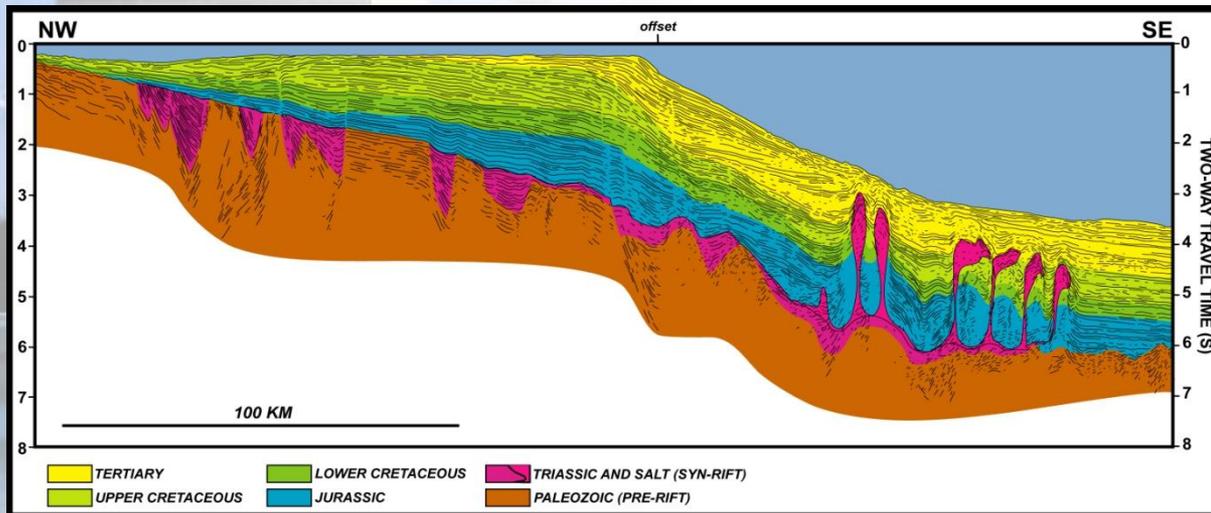
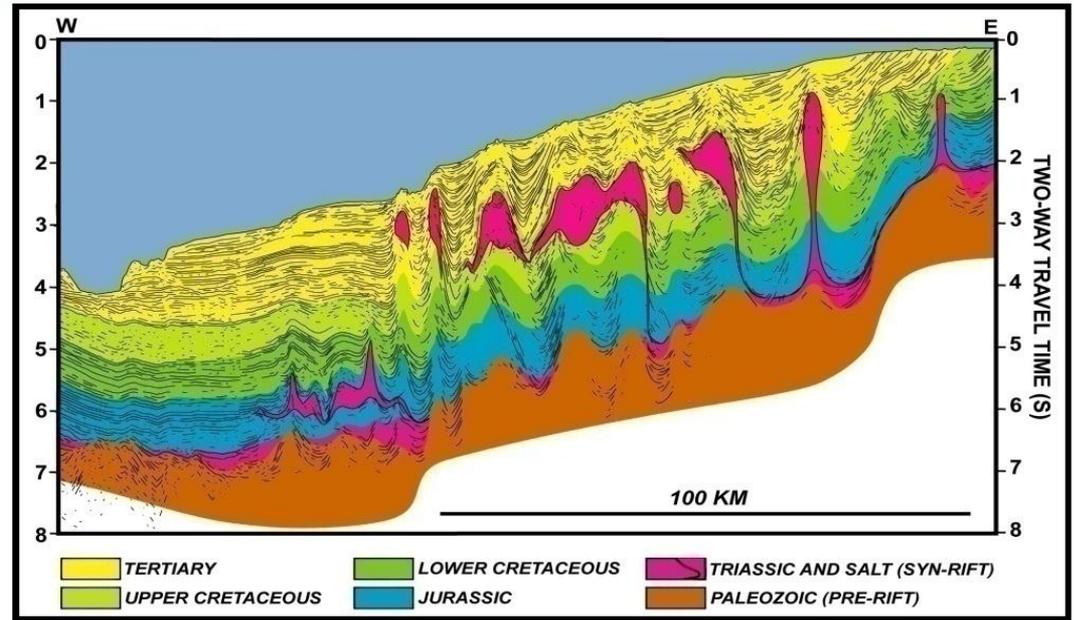
300 Prospects & Leads in onshore and offshore Moroccan basins

Offshore Resources :
11 – 1 140 MMbbls Oil
and
up to 11 TCF of Gas



Plays Analogs

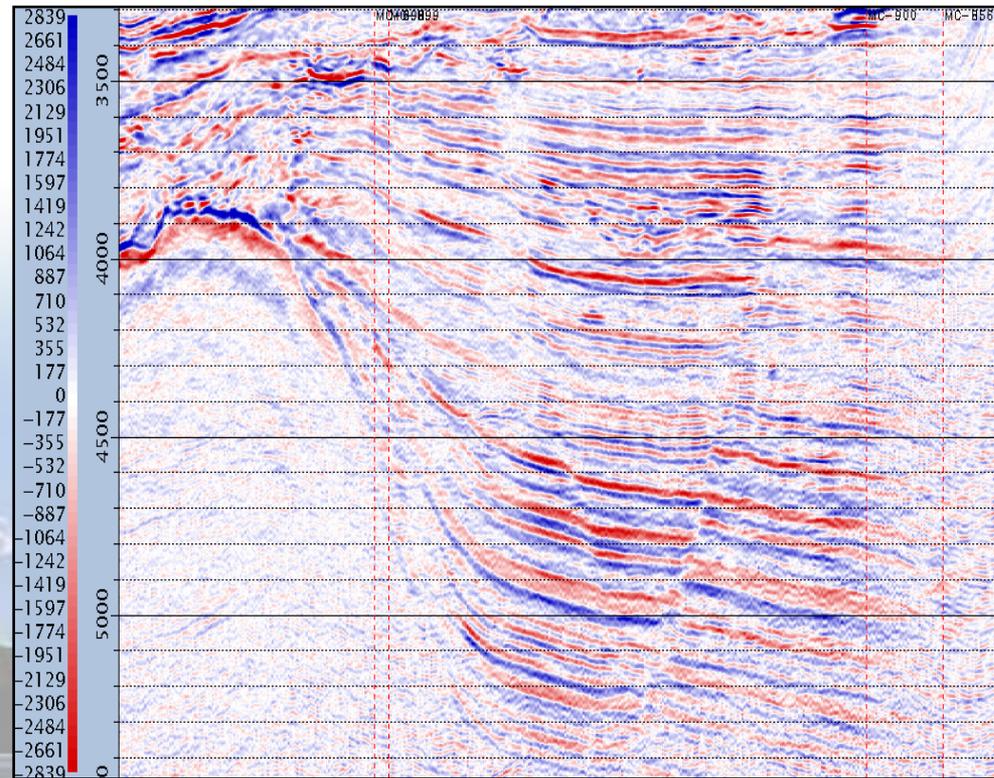
Tafelney Plateau, Morocco



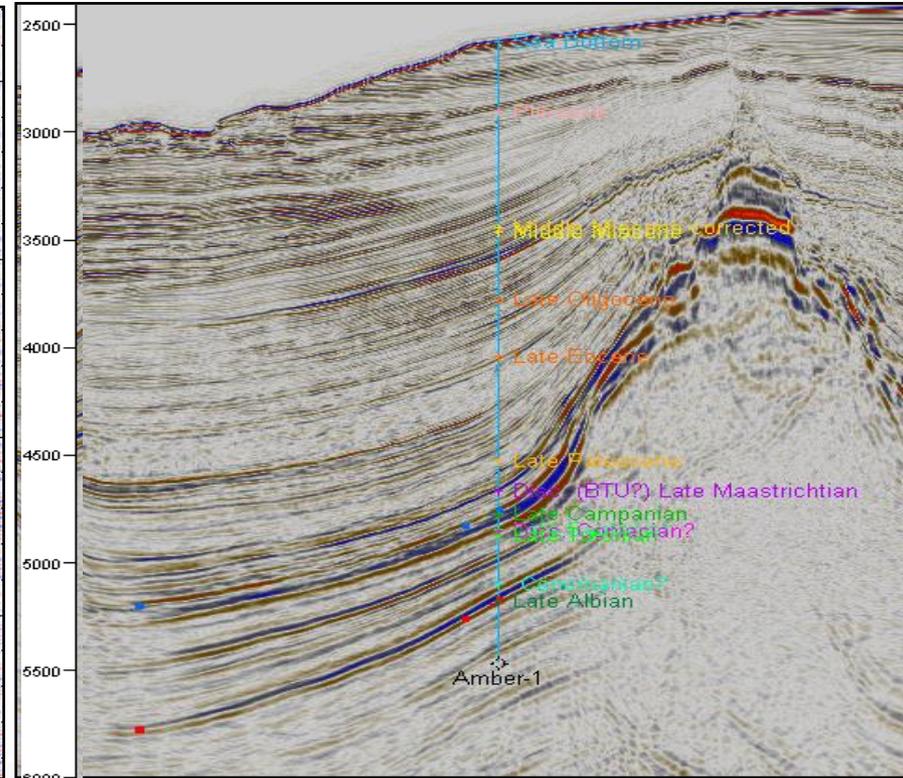
Lahavre Plateau, Nova Scotia

Plays Analogs

Salt induced play



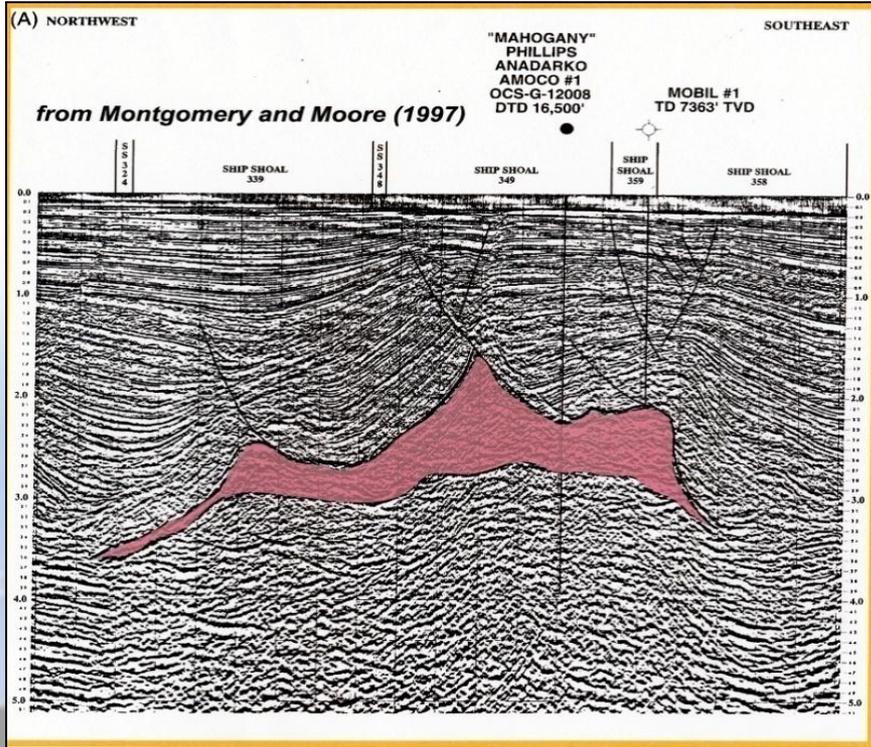
Ursa field Gulf of Mexico



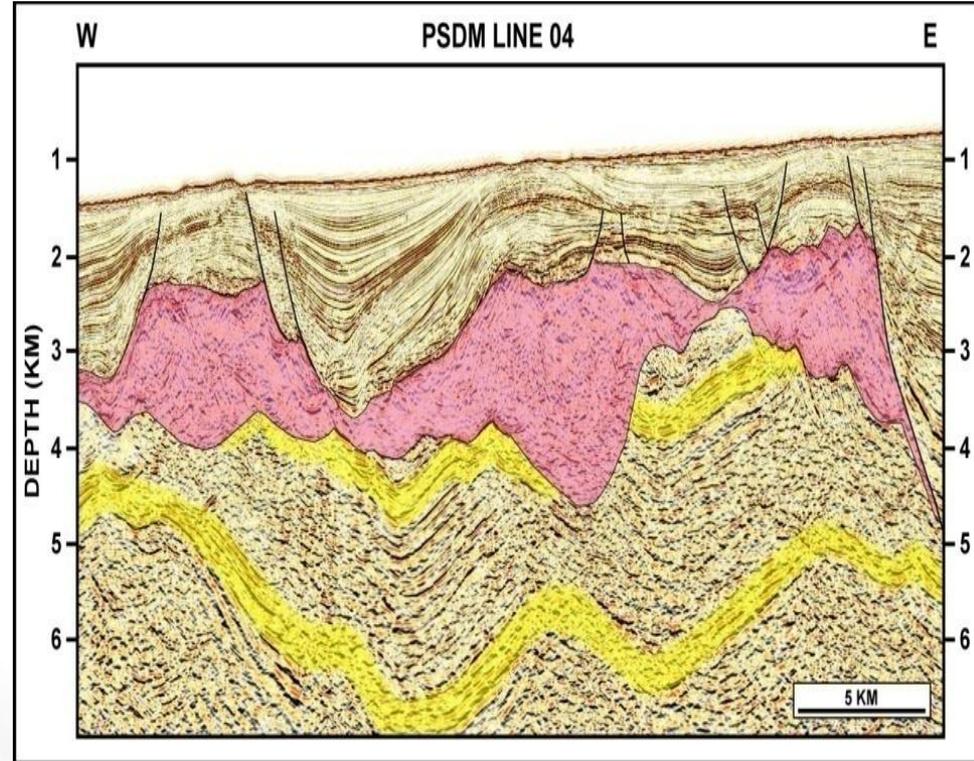
Moroccan Atlantic Offshore

Plays Analogs

Subsalt play

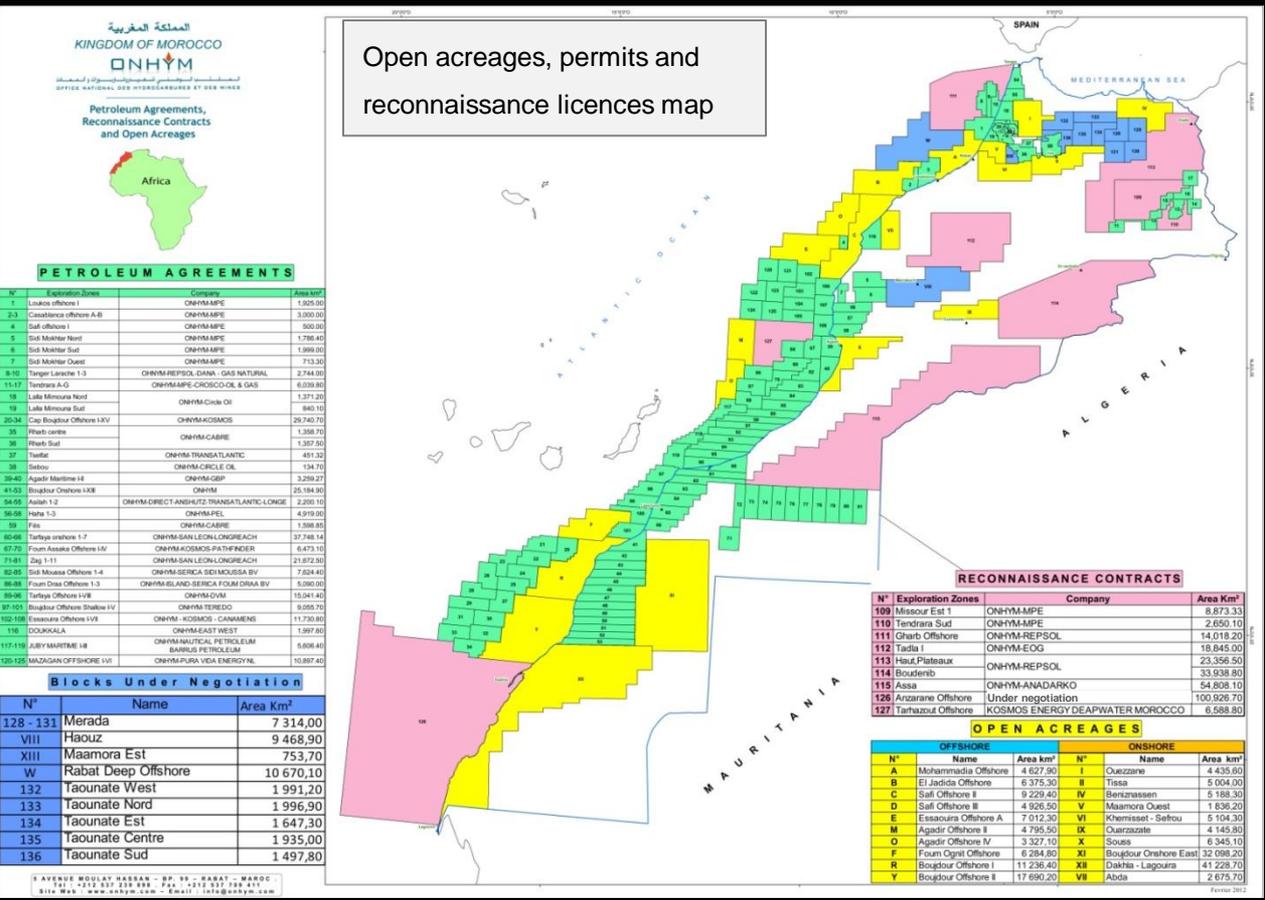


Mahogany Field
Gulf of Mexico (USA)



Moroccan Atlantic
Offshore

Licensing Status



Open acreages, permits and reconnaissance licences map

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

Data base

- 201 934 Km of 2D seismic (17 000 Km in offshore open areas and 5700 Km in onshore);
- 23 220 Km² of 3D seismic (2200 Km² in the offshore open acreage);
- Data from 300 Exploratory wells (Final well reports, logs, post mortem studies...);
- Regional and detailed geological and geochemical studies.

All the data available in the open blocs is shown and discussed with the companies in visit to ONHYM;

Very worm welcome and ONHYM's knowledge of the Moroccan petroleum geology.

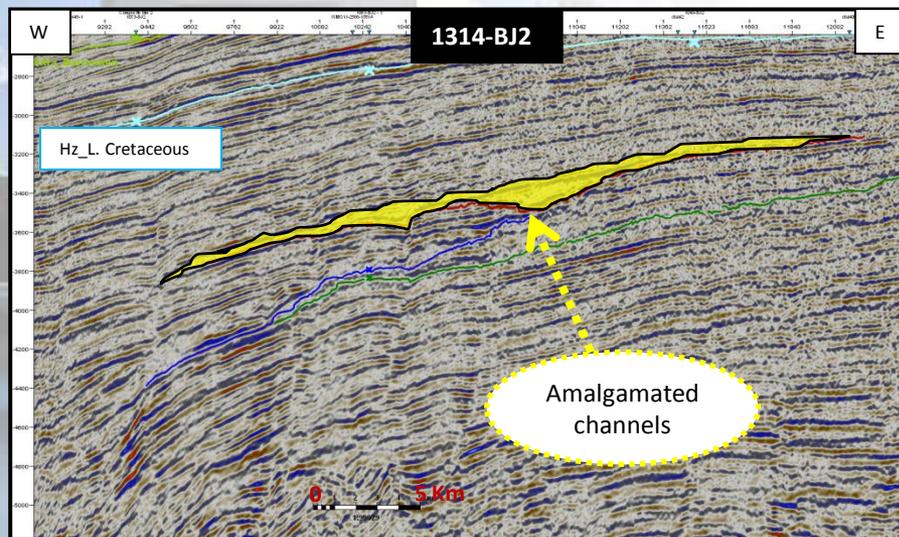
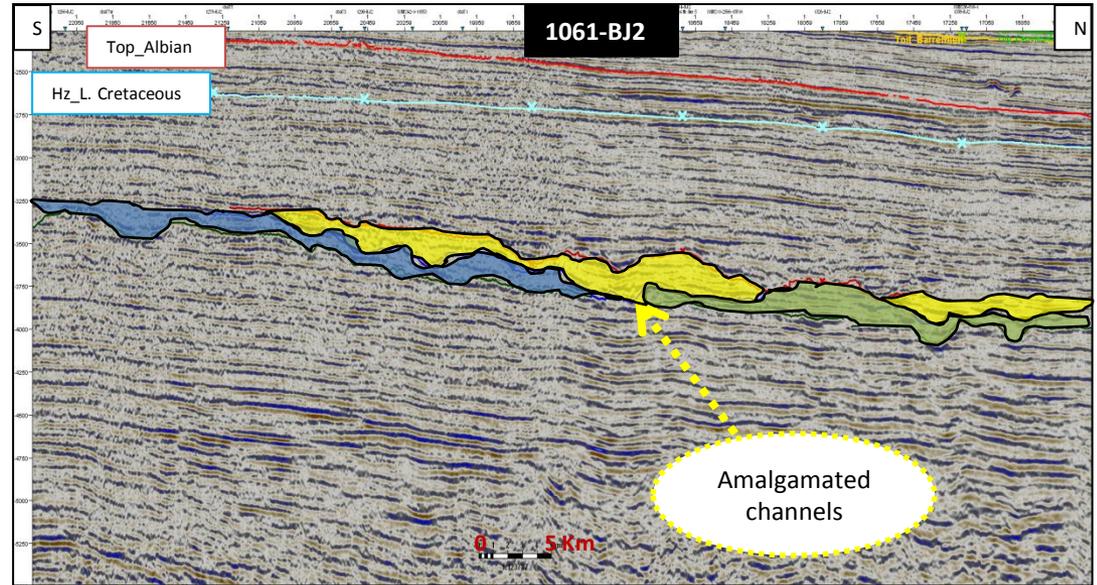
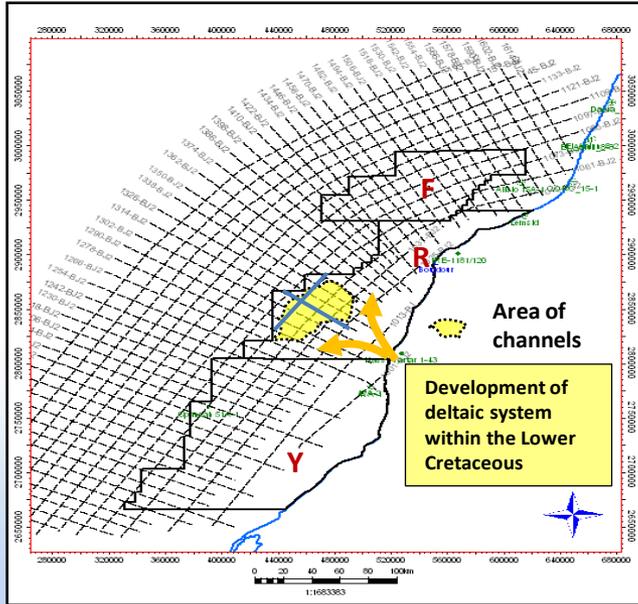


**Offshore Atlantic:
Example of play concepts
In open blocs**

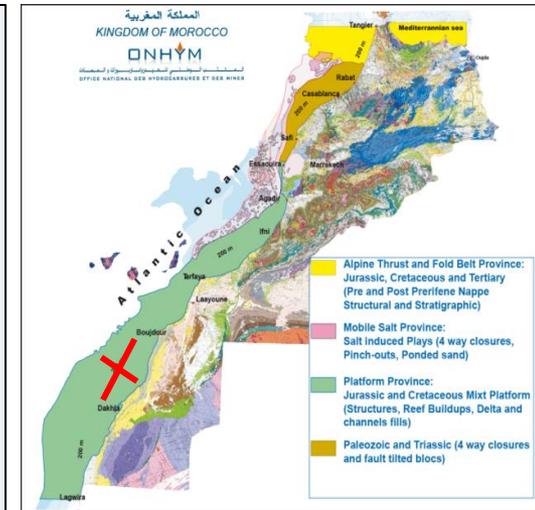


Boujdour Offshore

Lower Cretaceous Lead

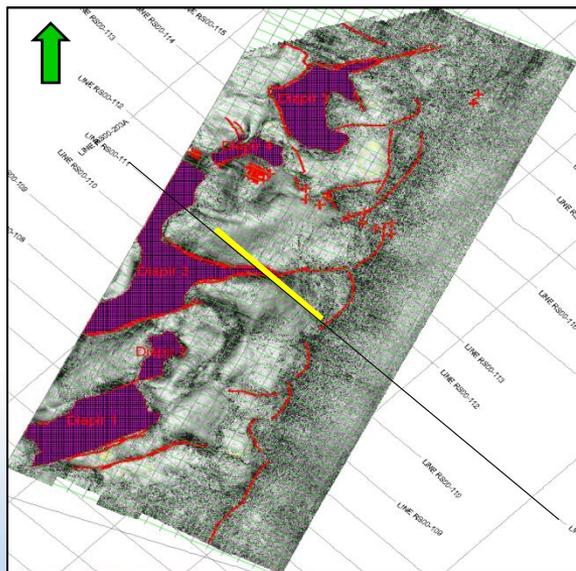


- **Traps :** Stratigraphic (Amalgamated feeder Channels)
- **Reservoirs:** Lower Cretaceous sandstones
- **Source rocks:** Aptian and Jurassic
- **Seals:** Tertiary & Upper Cretaceous marls and shales

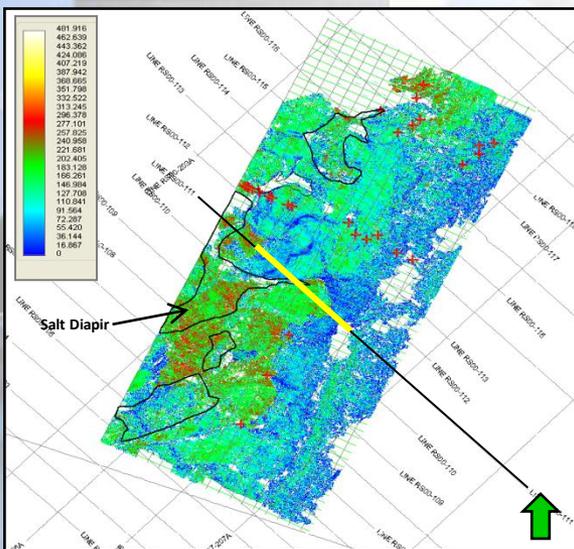


Safi Offshore

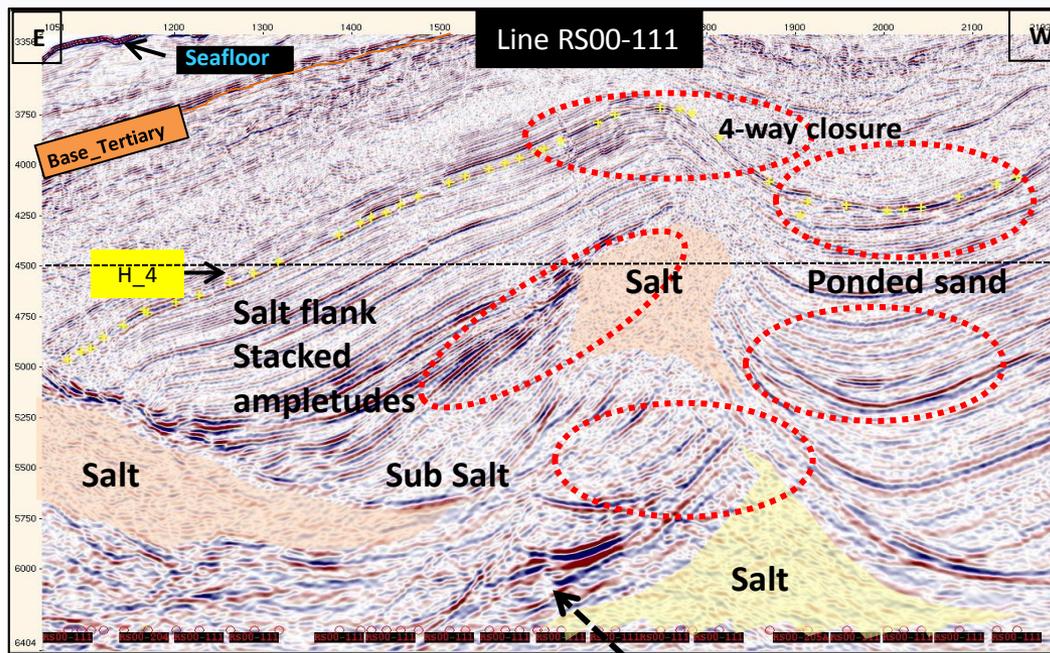
Lower Cretaceous Leads



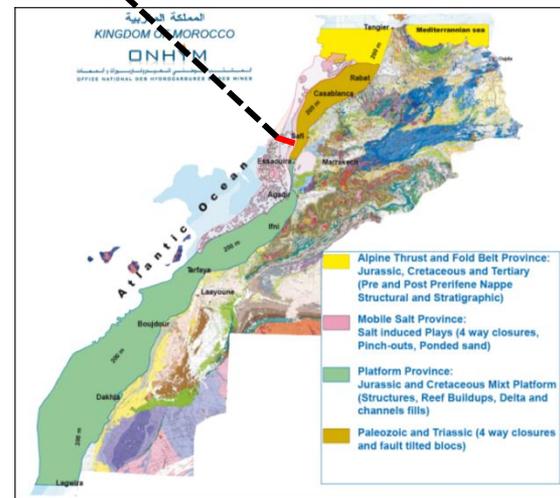
Time slice at 4500 ms of the « Dip of maximum similarity » attribute



«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

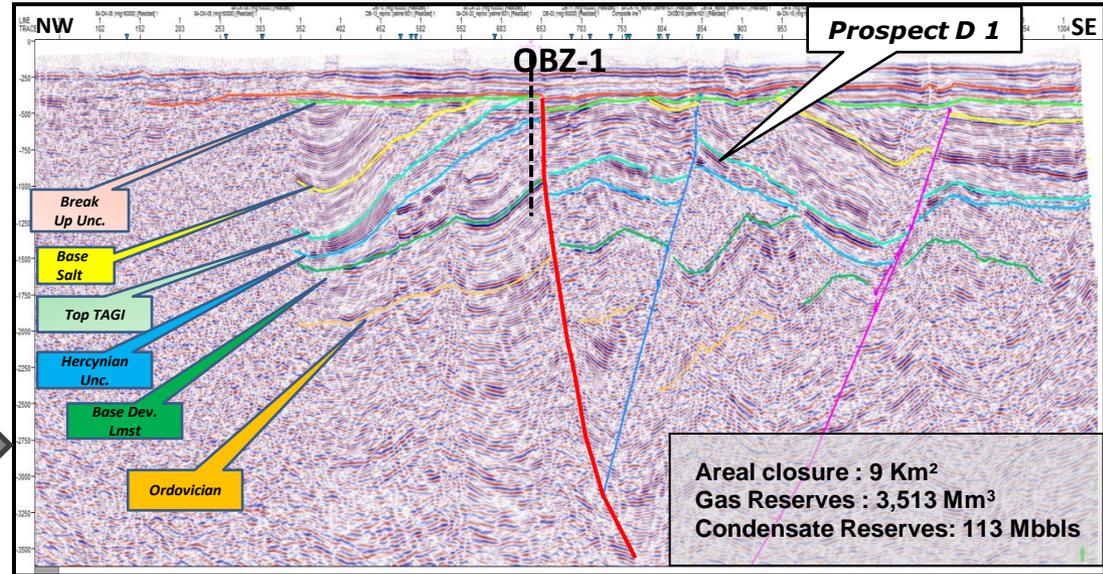
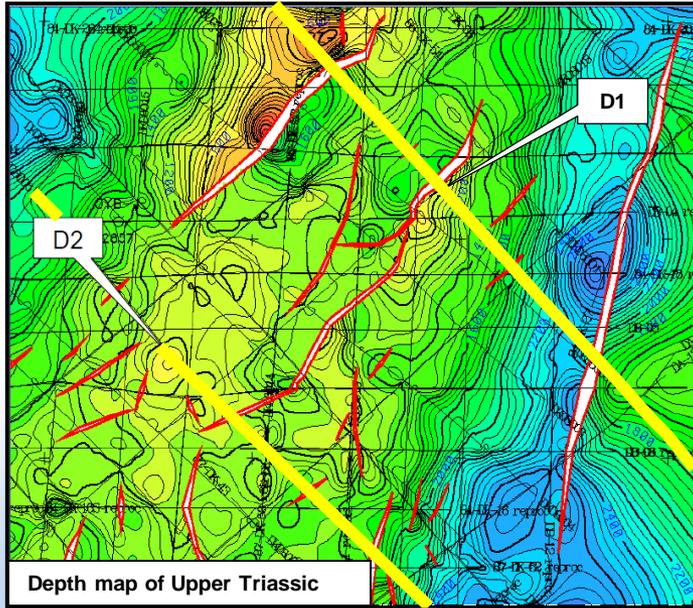


Example of play concepts Onshore

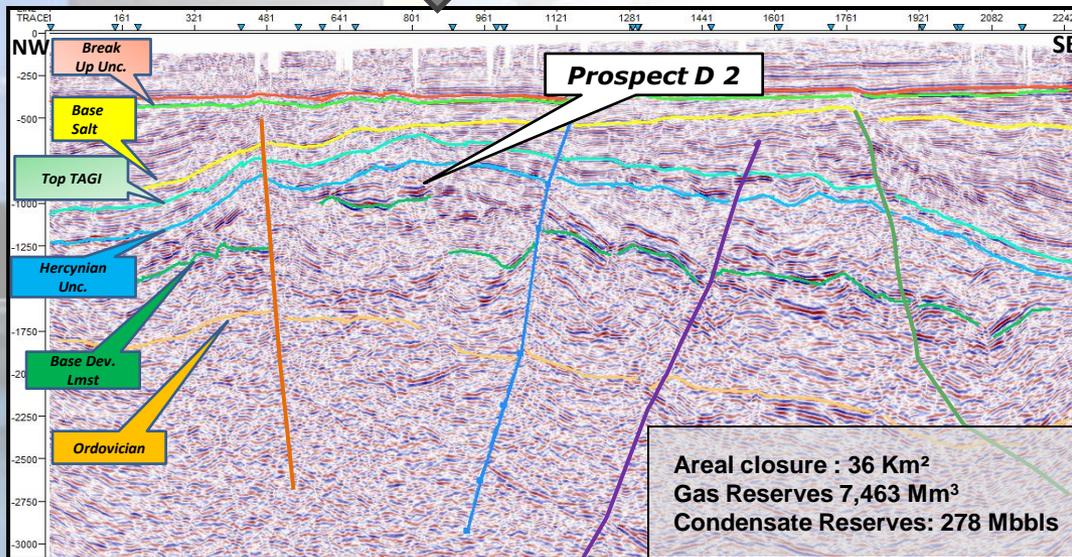


Abda-Doukkala basin

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 graptolic hot shales
 - Frasnian shales
- **Seals:** Triassic and Liassic interbedded shale & salt

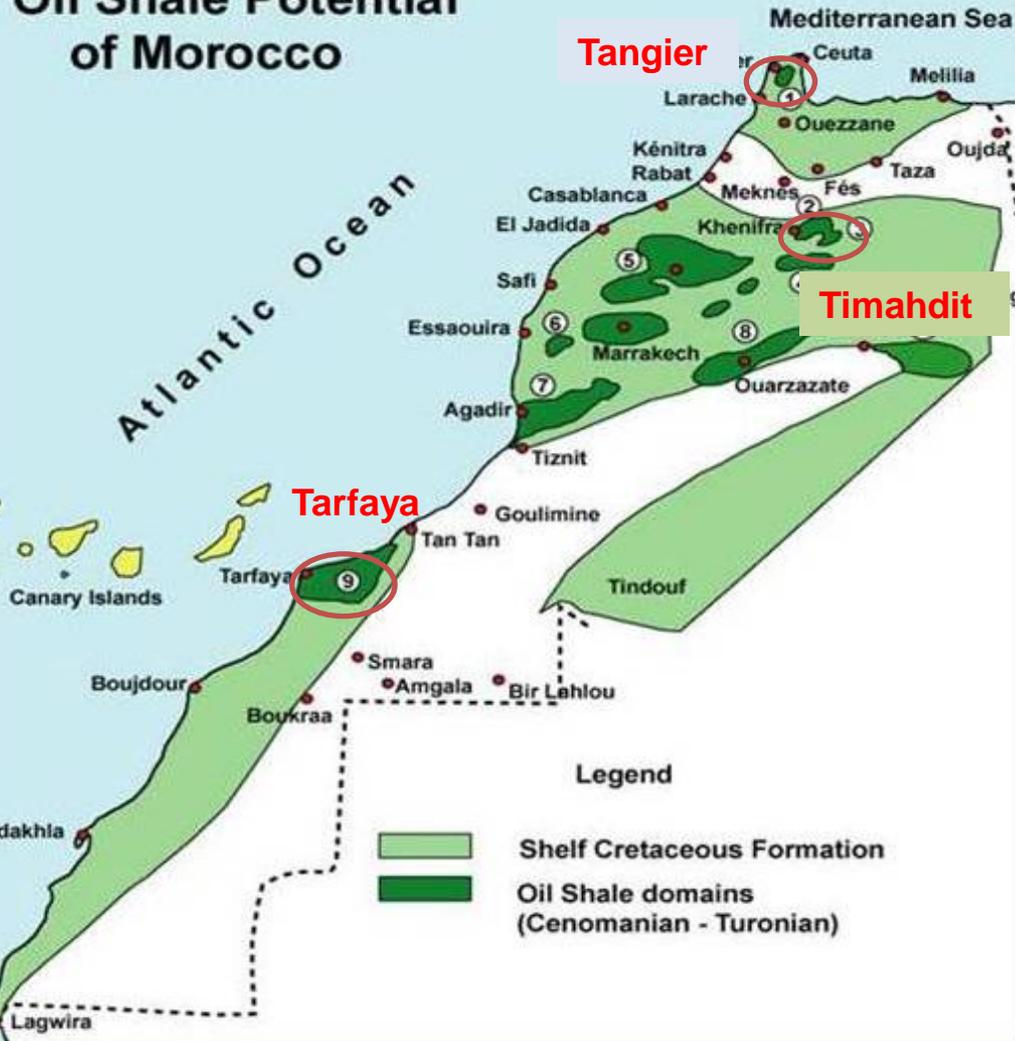


Unconventional hydrocarbons



Oil shale potential in Morocco

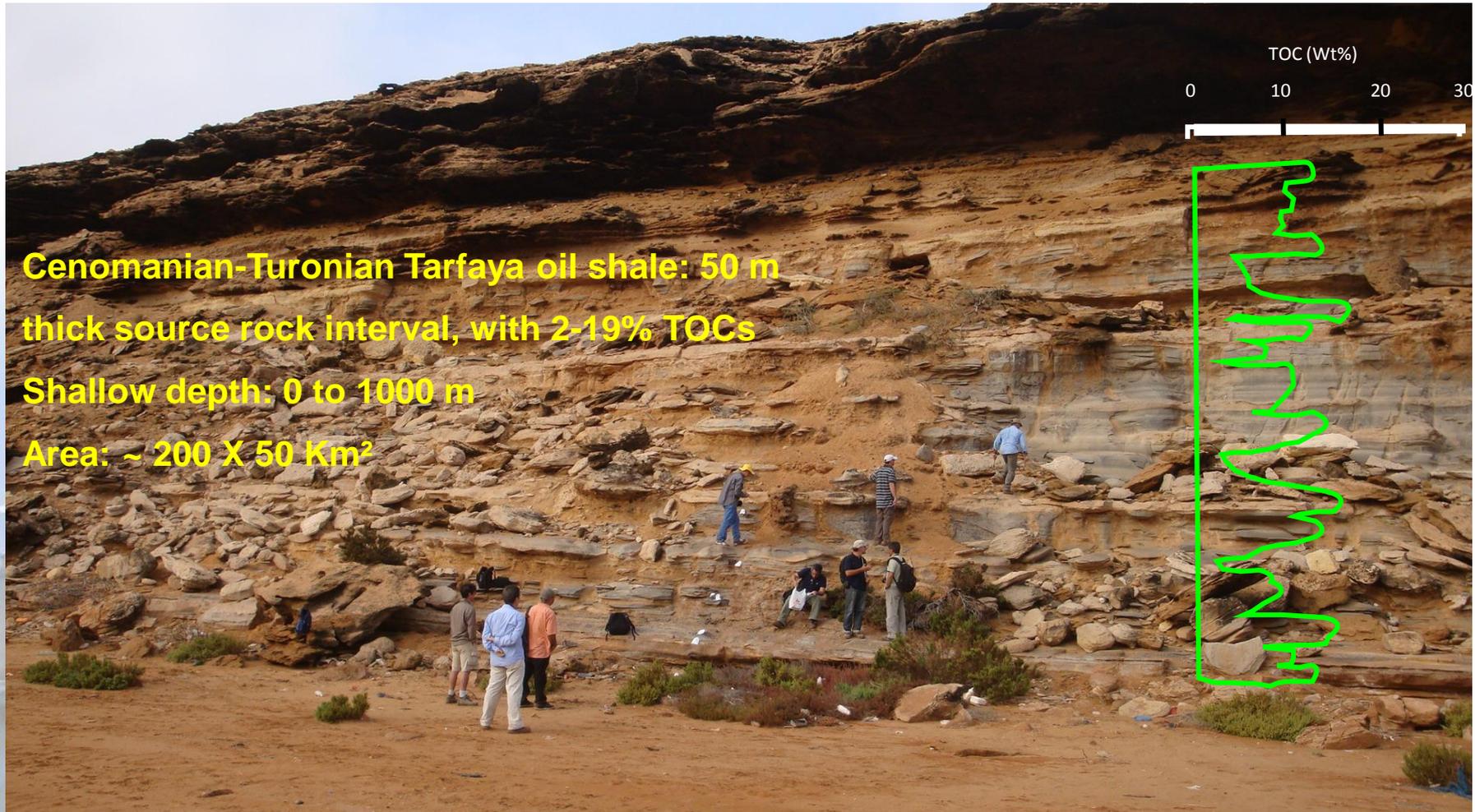
Oil Shale Potential of Morocco



- 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).

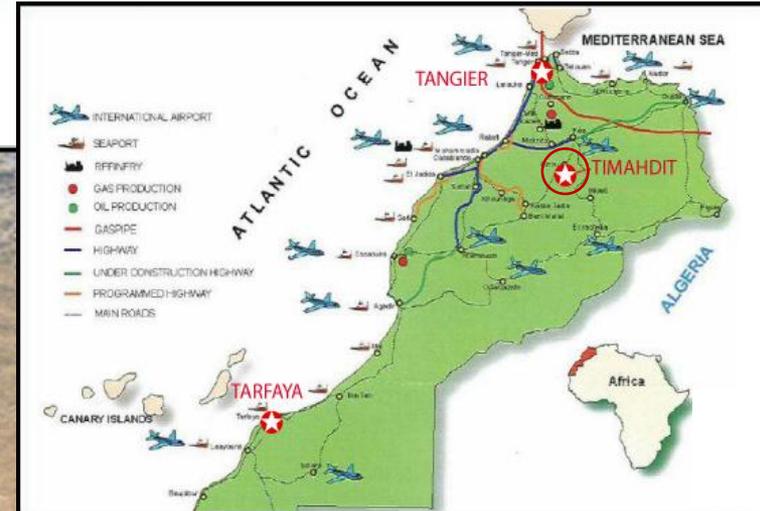
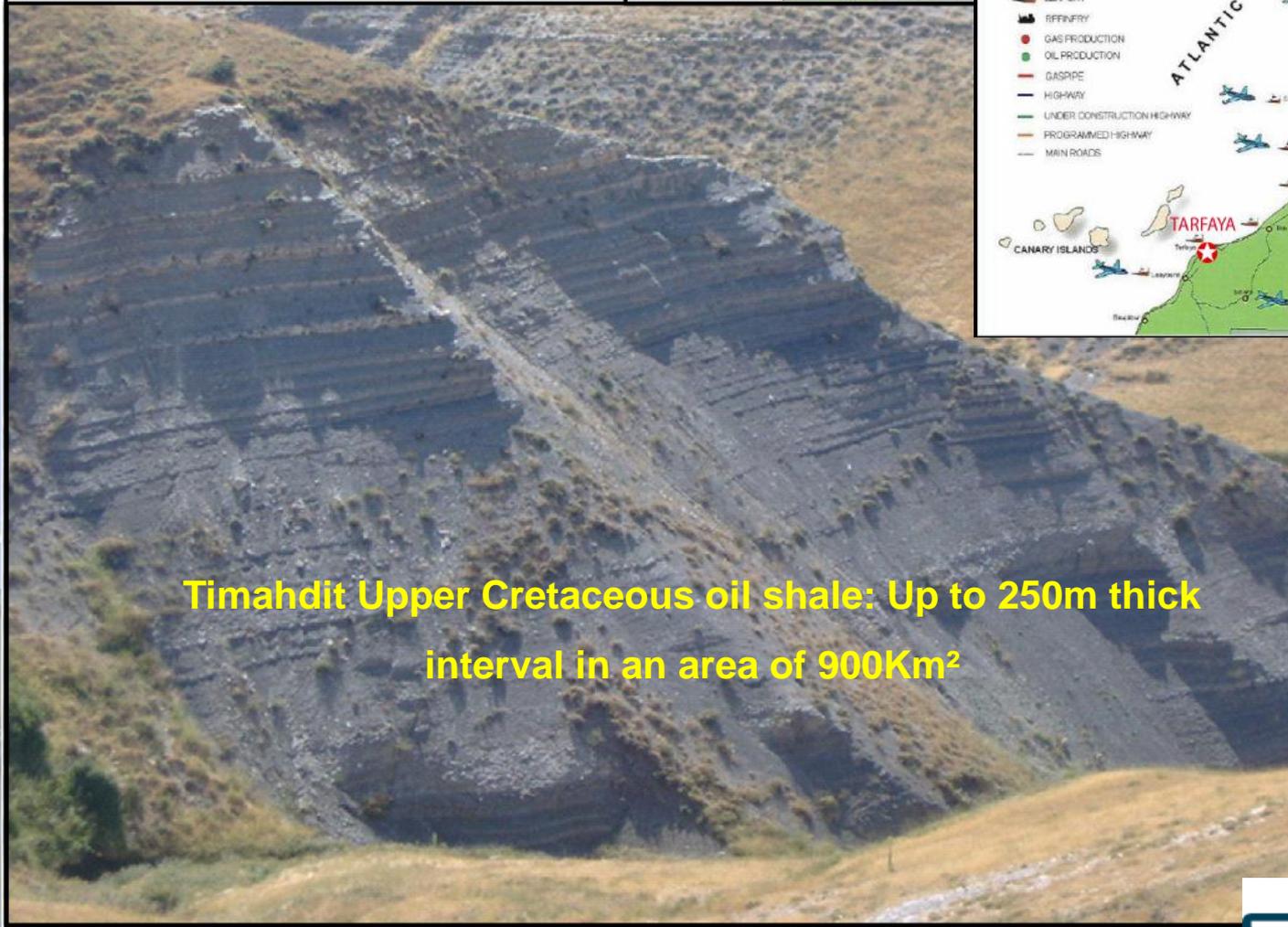
Oil shale potential in Morocco

Tarfaya onshore



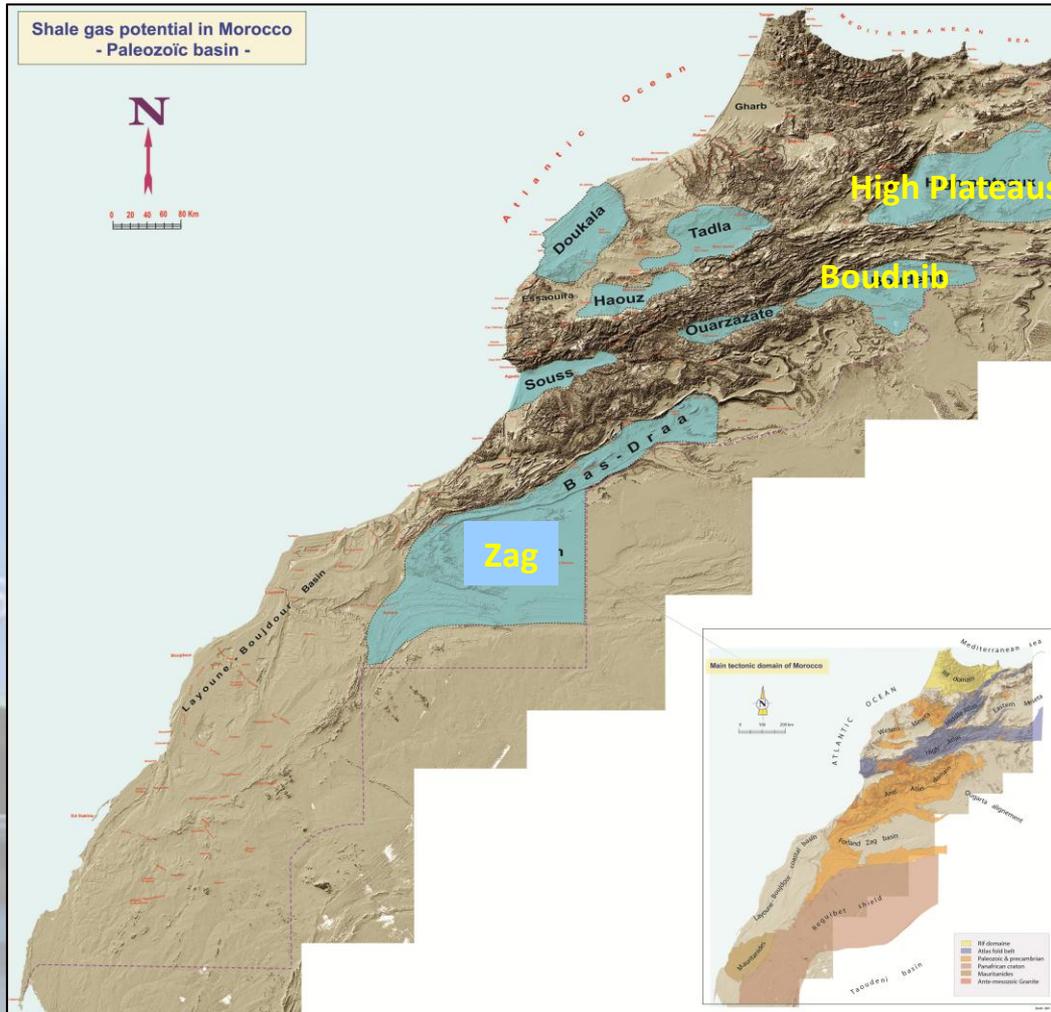
Oil shale potential in Morocco

Timahdit oil shale section



Shale gas potential in Morocco

Status to date



- First geological and geochemical appraisal of the Paleozoic depositional systems (in 3 basins) through bibliography, geological field work, review of existing well and seismic data;
- Other Paleozoic basins are under appraisal by ONHYM;
- The Mesozoic and Tertiary organic rich series have been proven to have a good potential and are strongly recommended for shale gas development projects.

Shale gas potential in Morocco

Eastern Anti-Atlas



Shale gas potential in Morocco

Paleozoic system

BASIN	AREA (Km ²)	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

Conclusions

- Moroccan sedimentary basins, both onshore and offshore, remain under-explored (< 2 exploratory wells / Km²);
- Exploration drilling activity, although limited, and outcrops have proven the presence of workable petroleum systems;
- New 3D seismic data have permitted upgrading of the leads and increased the rate of success some onshore areas;
- The play concepts are of different types rang in age from Paleozoic to Tertiary,
- In term of unconventional hydrocarbons, Moroccan basins are believed to have a great potential which deserves to be developed.

Conclusions

Next step

- 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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THANK YOU

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