



المكتب الوطني للهيدروكاربورات و المعادن
ΕΘΣΟ. Μ.Γ.Ε.Ο | ΗΦΣΛΟ.Κ.ΟΘ.Ο. + Λ Σ.Μ.Υ.Μ
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES



DEVELOPED PLAY CONCEPTS IN PROMISING MOROCCAN SEDIMENTARY BASINS

K. GUERNOUCHE



WHY TO EXPLORE IN MOROCCO?

- **Stable and attractive country** with market place that is rapidly deregulating and opening.
- **Promising Potential**
 - Most of the nation's territory is under explored
 - Wherever adequately explored, Moroccan sedimentary basins have produced Hydrocarbons.
- Opportunities that combine **low entry cost and suitable exit options.**
- **Fully shared vision with partners.**
- **One of the most attractive fiscal regime worldwide.**



The Moroccan Hydrocarbon Law : One of the most attractive in the world

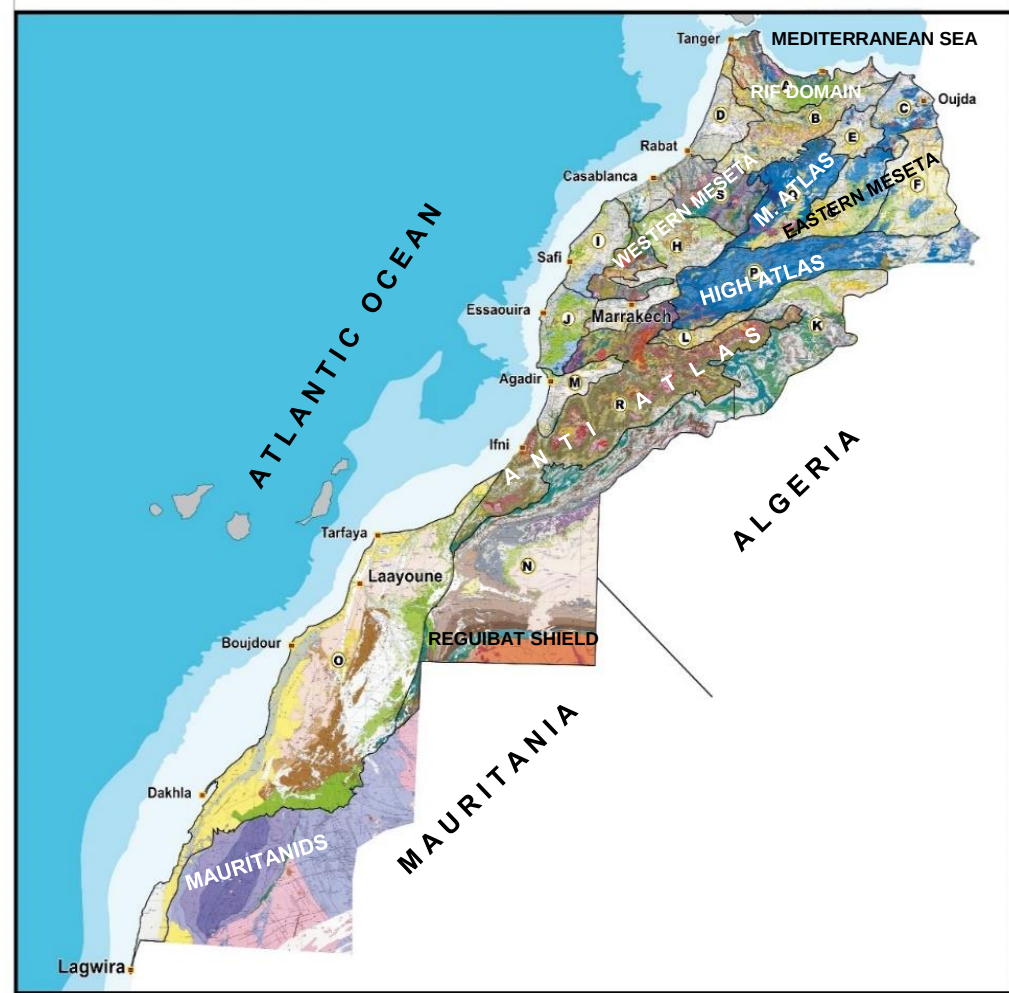
- Government interest share : 25% maximum
- Corporate tax : total exemption for ten-year period
- Surtax : None
- Tax exemption
 - With-holding tax on profits
 - Value added tax
 - Business activity tax
 - Urban tax
 - Tax on non-improved urban land



MOROCCAN SEDIMENTARY BASINS

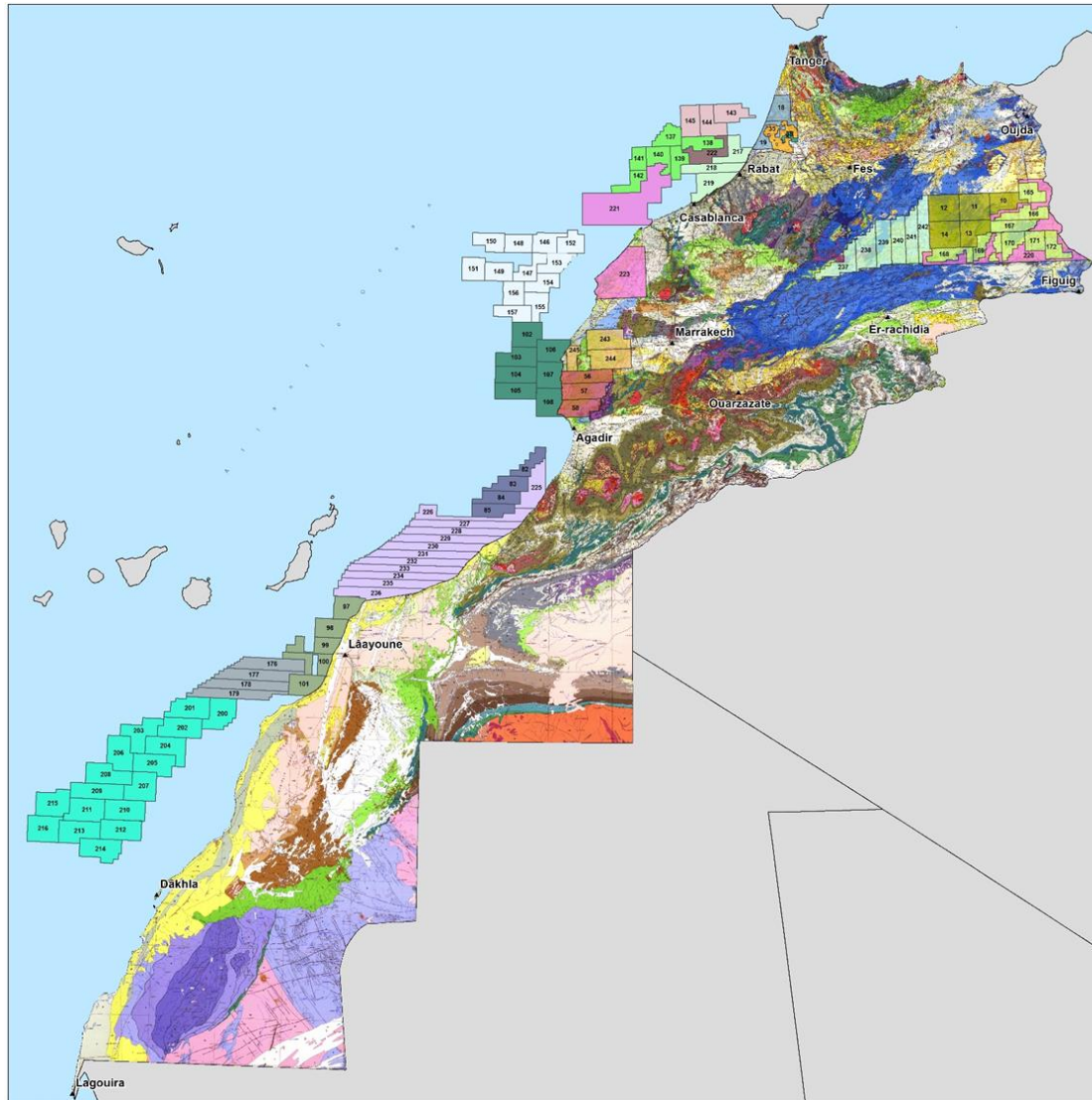
- **Large and diverse sedimentary basins**, of various geological ages and structural styles.
Total area : **918 237 Km²**.
- **A very extended offshore domain:**
3 000 km on the Atlantic and **500 km** on the Mediterranean sea coast lines.

Total area: **300 000 Km²** (to 4 000 m bathymetry), consisting of Mesozoic and Cenozoic sedimentary basins.
- **A various onshore sedimentary basins** (**620 000 Km²**): Objectives ranging from Paleozoic to Neogene in age.



HYDROCARBON EXPLORATION STATUS

PARTNERSHIP

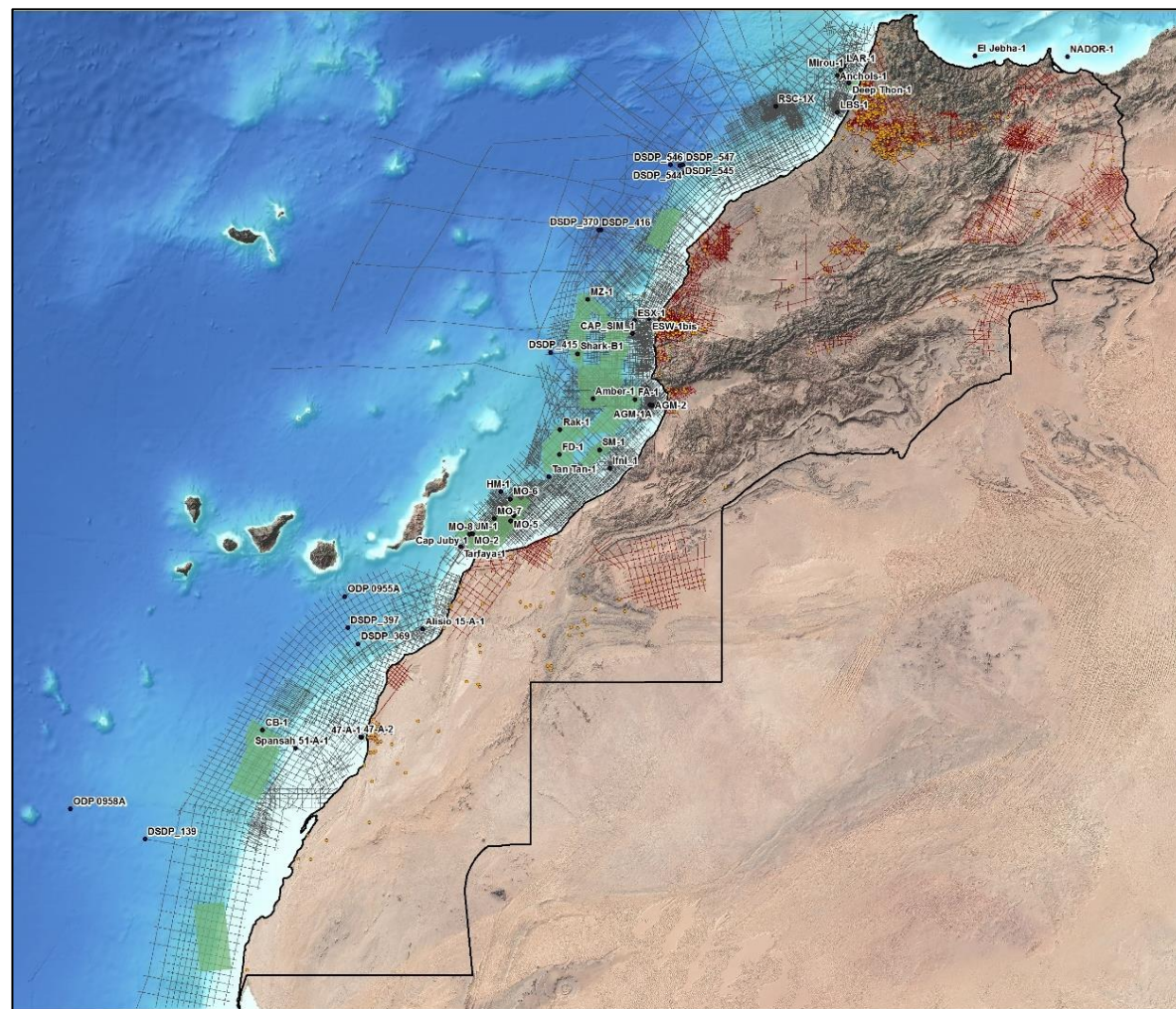


17 ONHYM Partners on:

- 106 Exploration Permits
- 3 Reconnaissance Licenses
- 9 Concessions
- Total : 181 070.12 km²



EXPLORATION SNAPSHOT : OFFSHORE & ONSHORE



SEISMIC & WELLS DATABASE

Seismic (Feb. 2018)

- 2D Seismic: 228147 Km
- 3D Seismic: 59589 Km²
- Additional 2D & 3D seismic to be acquired in 2018

Exploratory Wells (Feb. 2018)

- 43 wells offshore (41 in the Atlantic & 2 in the Mediterranean)
- 302 wells Onshore

HYDROCARBON EXPLORATION : DRILLING ACTIVITY SUMMARY

Drilling Activity between 2013/2017

OFFSHORE:

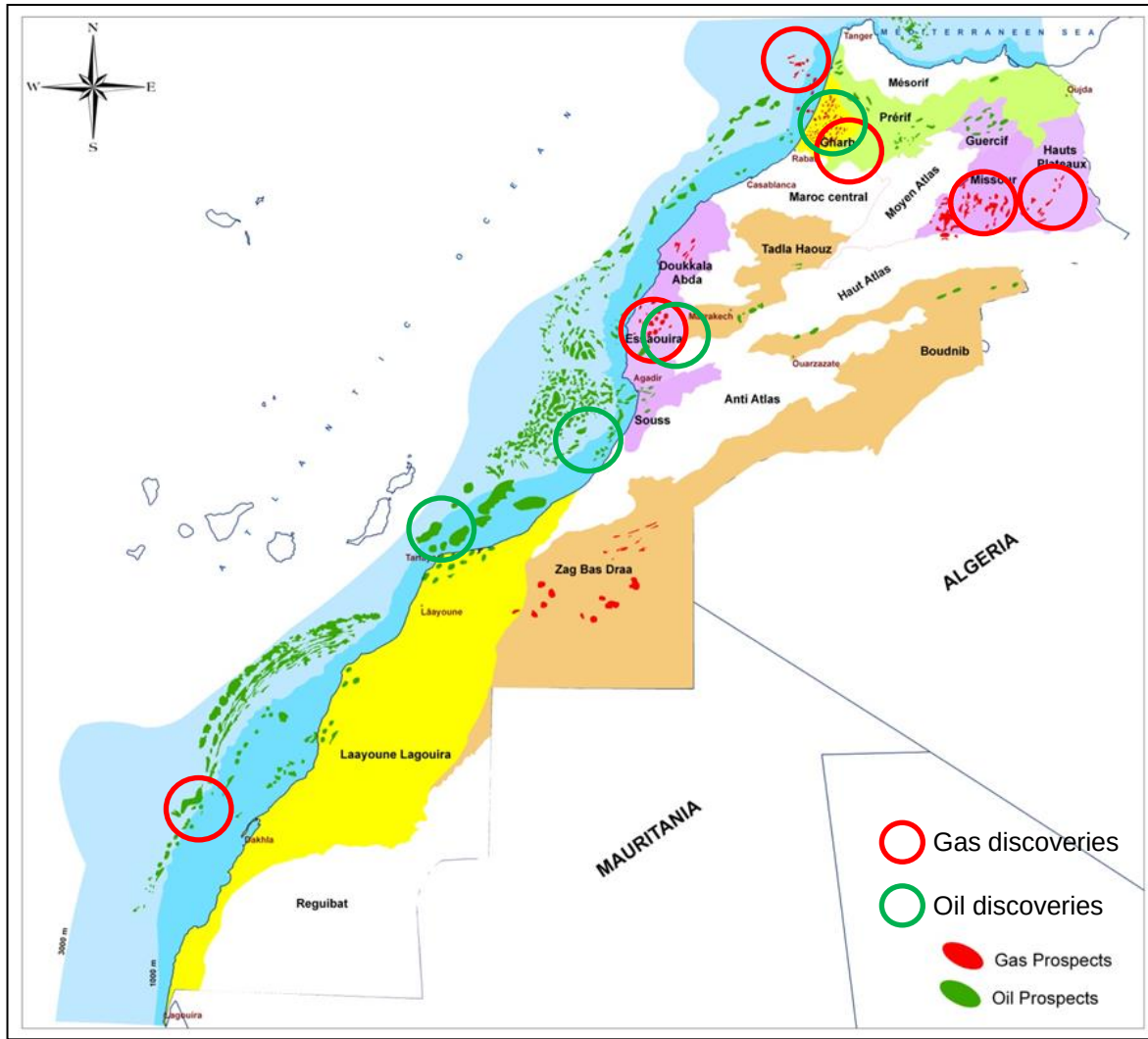
- 5/7 wells drilled offshore encountered either oil or gas shows or heavy oil and 1 well hit a non commercial gas and condensate accumulation.

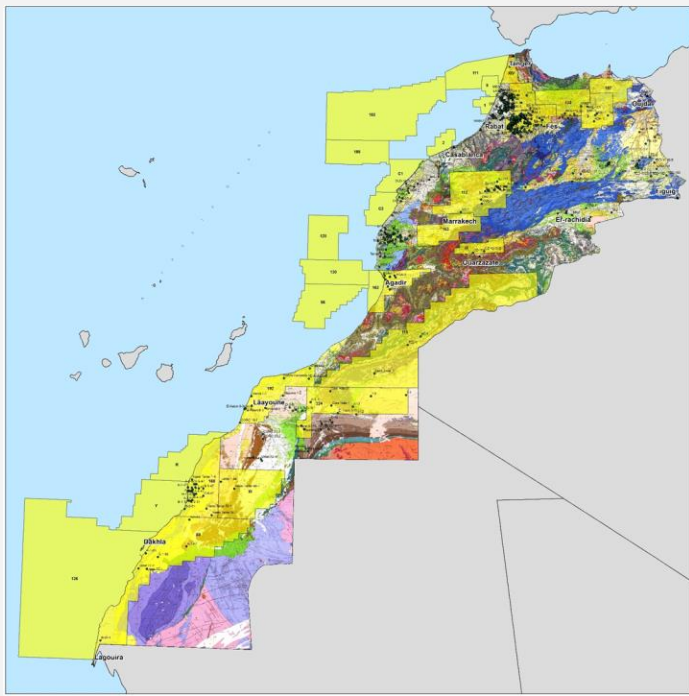
ONSHORE :

- Essaouira basin: 2/4 wells drilled in hit gas discovery (to be confirmed with cased hole testing program and delineation wells);
- Gharb basin : 9/17 wells drilled identified the presence of commercial biogenic gas accumulations;
- High Plateaux: 2/3 wells drilled encountered gas discovery.

HYDROCARBON EXPLORATION: PROSPECTS & LEADS

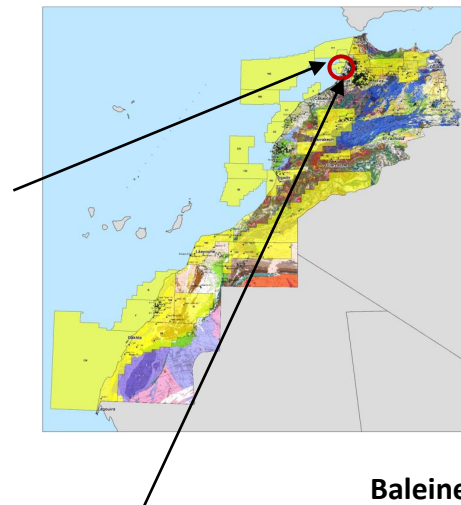
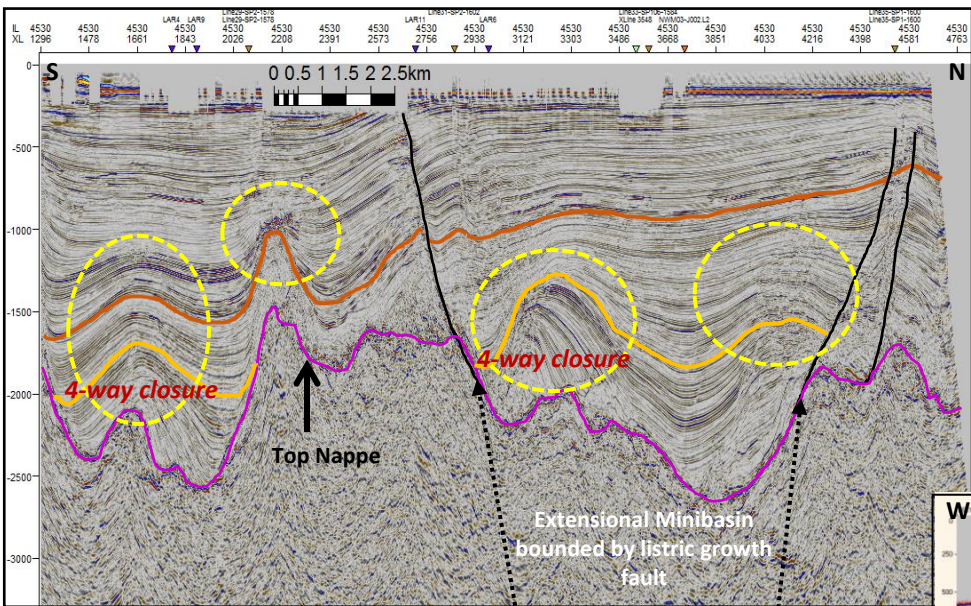
- More than **800** prospects & leads have been identified in the different plays, onshore and offshore:
 - Pre-Salt Play
 - Salt Related Play
 - Platform Play
 - Turbidite Play
 - Thrust Related Play
- The prospects drilled so far showed some hydrocarbon accumulations and modest discoveries that have proven the identified plays
- Still considerable number of mature prospects deserves to be drilled.





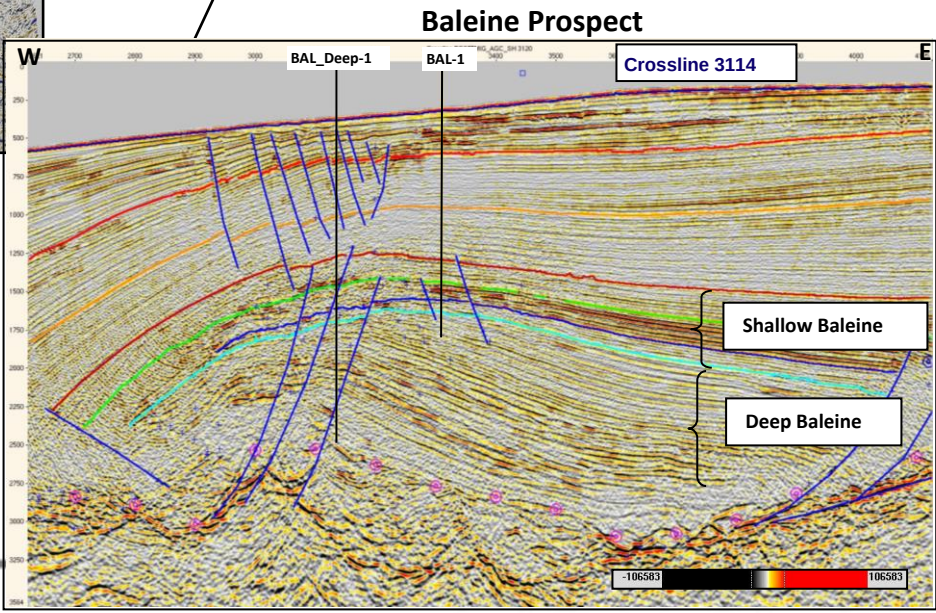
HYDROCARBON EXPLORATION: PROSPECTS & LEADS

Example of Tertiary 4-way closure structures (Gharb Offshore) Amplitude supported play



Baleine prospect	
Water Depth (m)	253
Closure (Km²)	11.4
P mean Resources (BCF)	209.9

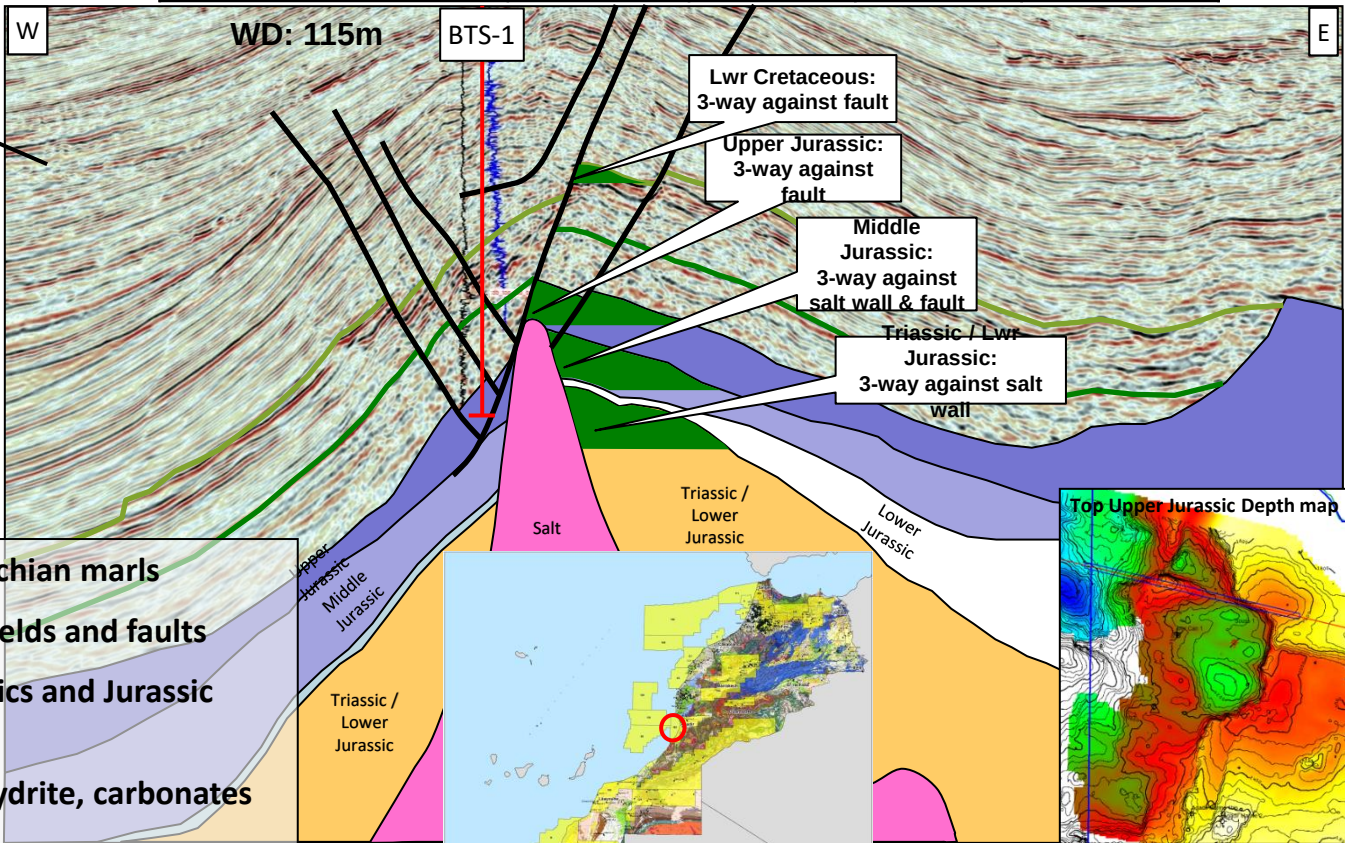
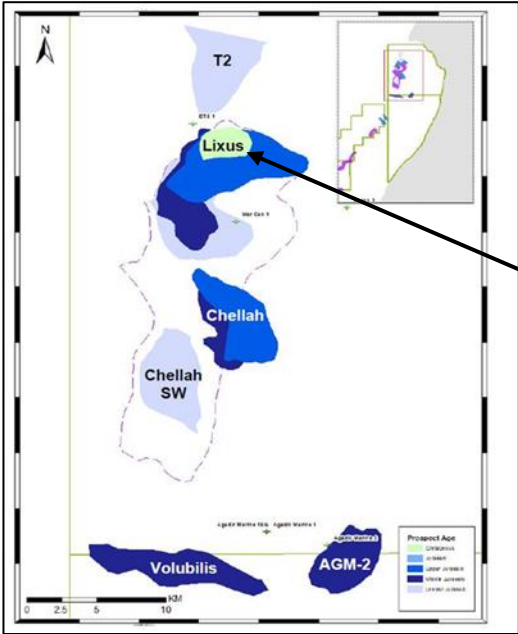
- 1. Source Rock: Miocene/Cenomanian-Turonian marls in mini basins
- 2. Migration: Vertical short pathway through faults
- 3. Reservoir: Mio-Pliocene turbidite channel sandstones
- 4. Seal: Plio-Pleistocene hemipelagic shale draping over reservoir sand beds
- 5. Trap: 4 & 3-way closure roll overs



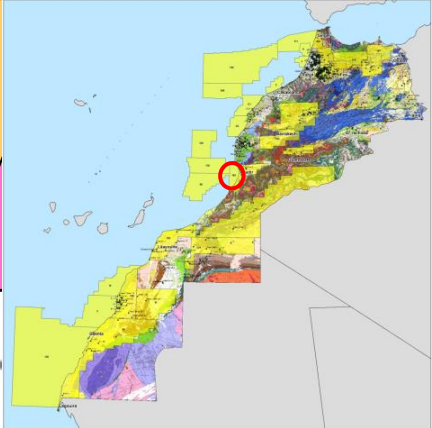
HYDROCARBON EXPLORATION: PROSPECTS & LEADS

Example of 3-way closures with multi-targets (Mir Left Offshore)

Target	Lw Cret	Up Jur	Mid Jur	Lw Jur
Reservoir Crest (m)	1880	2560	2900	3150
Mean STOIP (MMbbls)	164	441	286	565



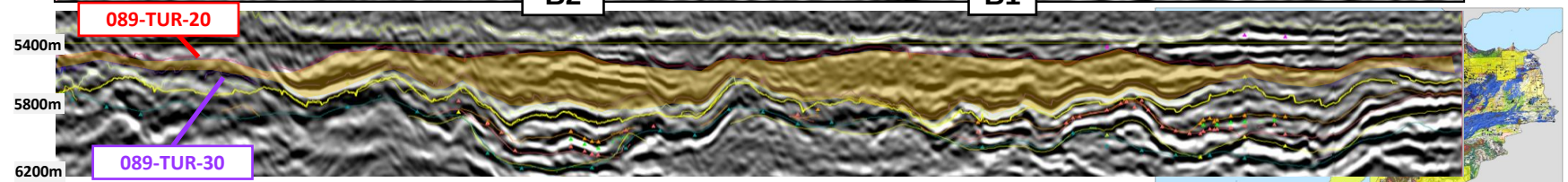
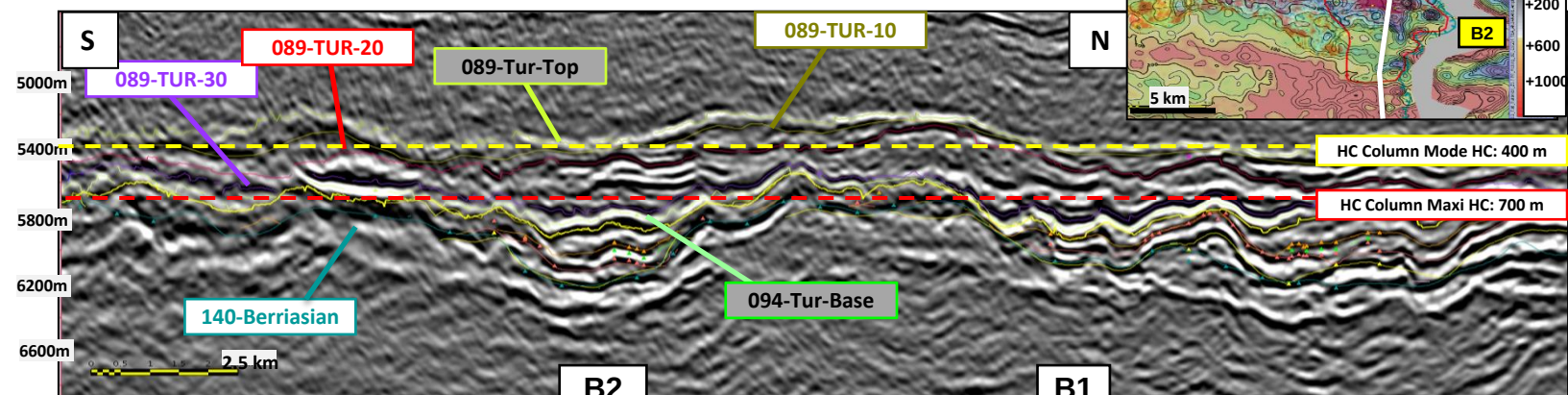
- 1. Source Rock: Toarcian to Pliensbachian marls
- 2. Migration: Vertical through salt welds and faults
- 3. Reservoir: Lower Cretaceous clastics and Jurassic carbonates
- 4. Seal: Jurassic and Cretaceous anhydrite, carbonates and transgressive shale
- 5. Trap: Structural and Stratigraphic



HYDROCARBON EXPLORATION: PROSPECTS & LEADS

Example of Upper Cretaceous canyons (Dakhla Offshore)

	Water Depth (m)	Closure (Km²)	Unrisked recoverable resources-Mean (MMbbls)
Canyon B1	1200	7-61	169
Canyon B2	980	7-45	133

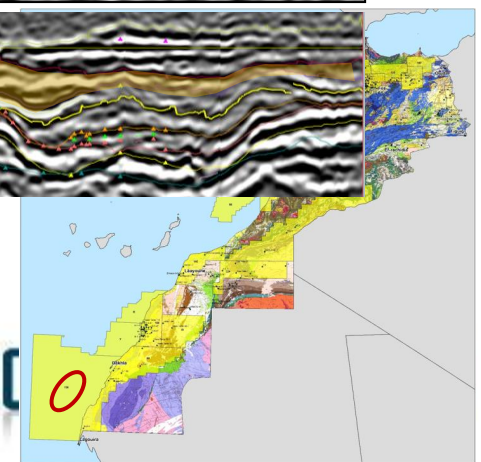


1. Source Rock: Turonian marls

3. Reservoir: Turonian sands

5. Seal: Vertical regional MFS and lateral pinch-out on the carbonate platform
2. Migration: Vertical short pathway

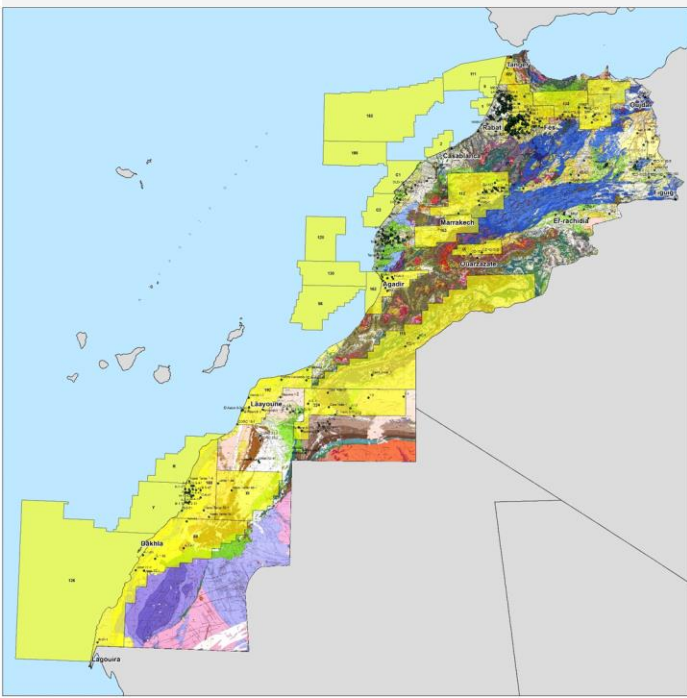
4. Trap: Stratigraphic





المكتب الوطني للهيدروكربونات و المعادن
ΕΘΣΟ. Ι. Γ. Ο. | ΗΦΣΛΟ:Κ.ΟΘ:Ο.+ Λ Σ%:4.>%
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

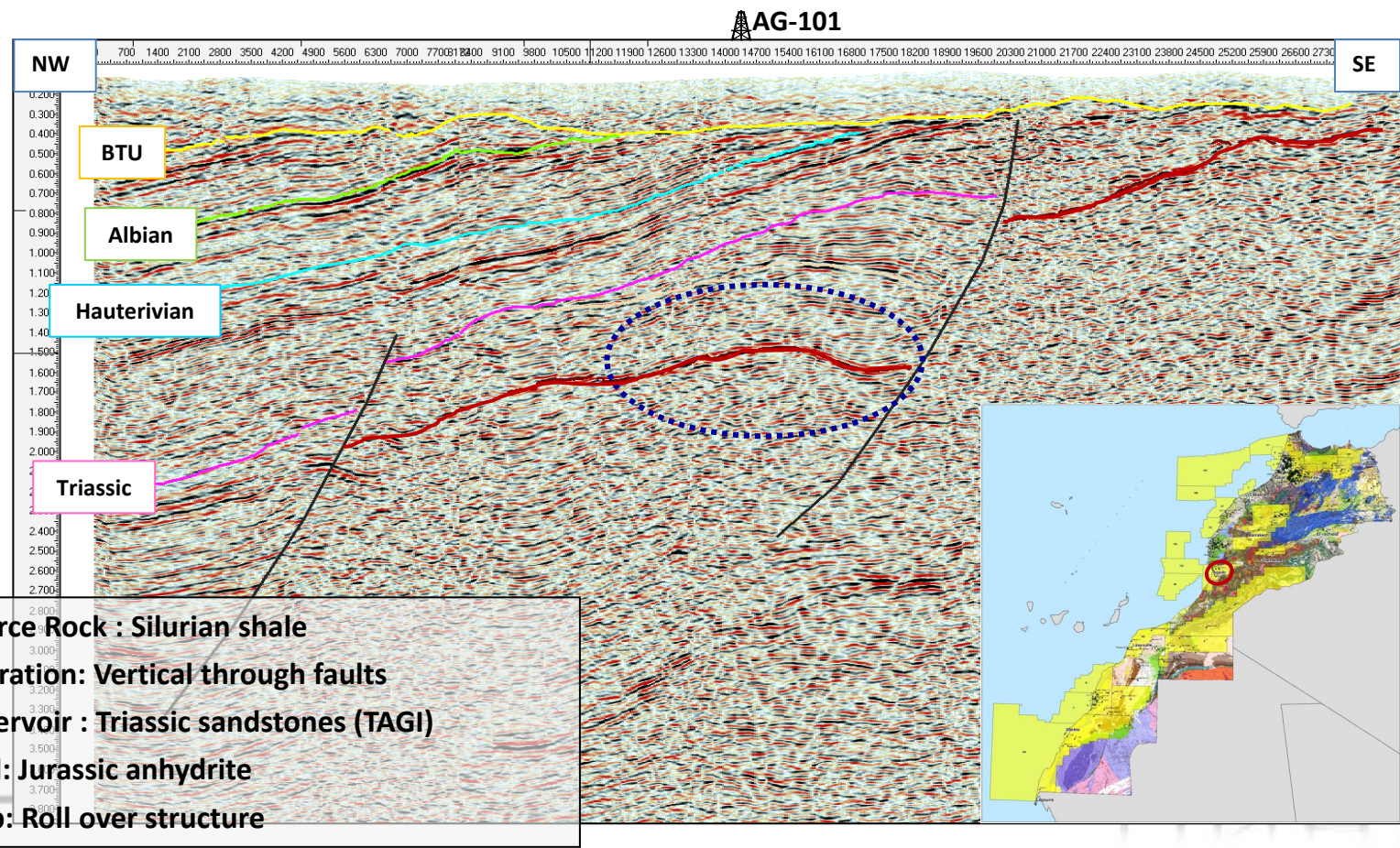
OPEN ACREAGE: EXAMPLES OF PROSPECTS & LEADS- ONSHORE MOROCCO



HYDROCARBON EXPLORATION: PROSPECTS & LEADS

Example of Triassic structures (Souss basin)

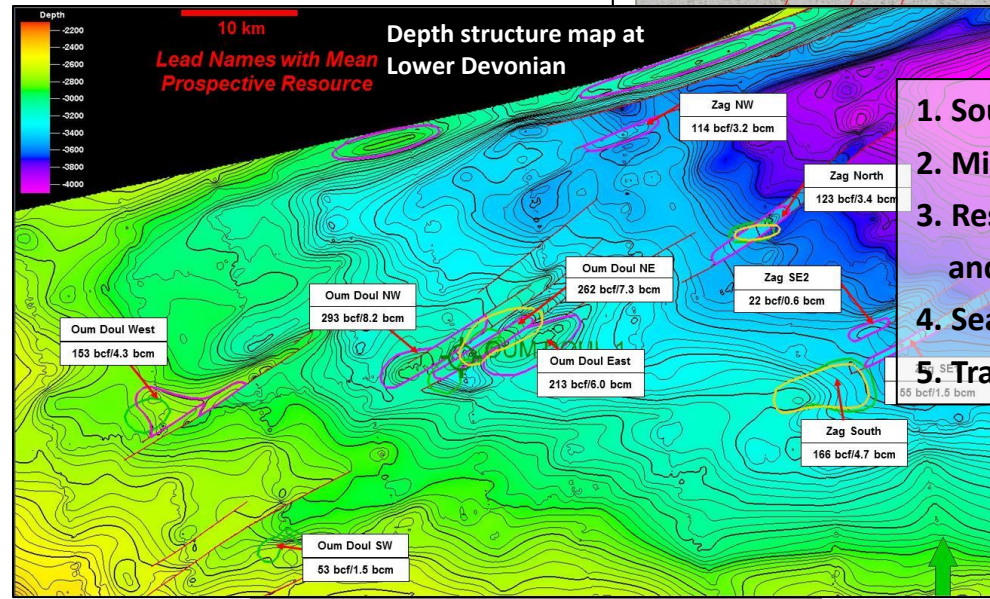
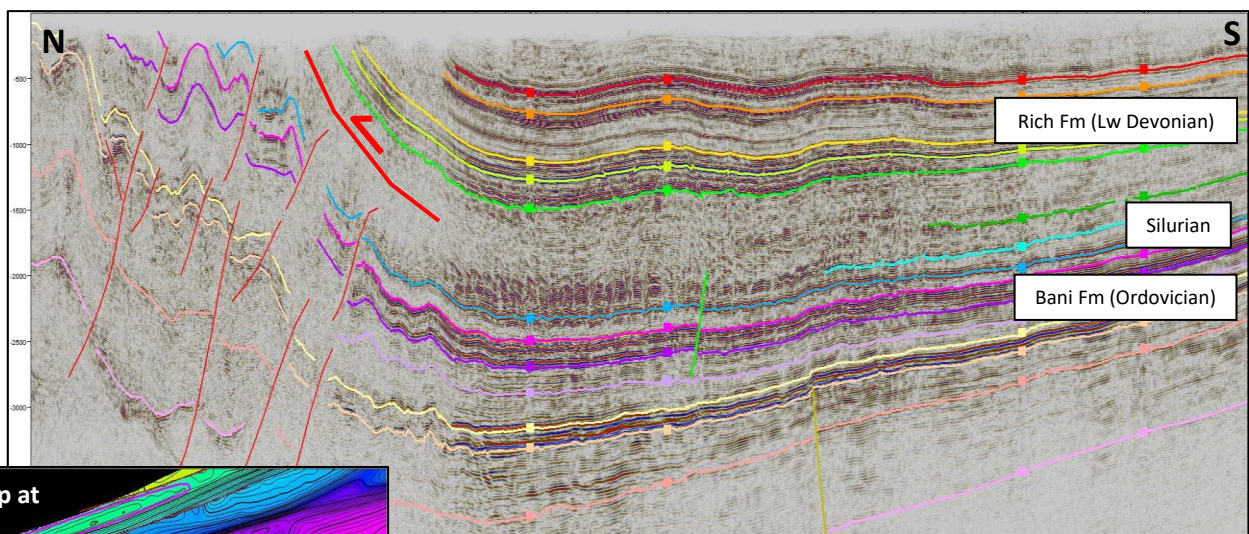
	Areal Closure (Km ²)	Recoverable resources (Gas case-BCF)	Recoverable resources (Oil case-MMBO)
El Khemis Lead	40	457	63



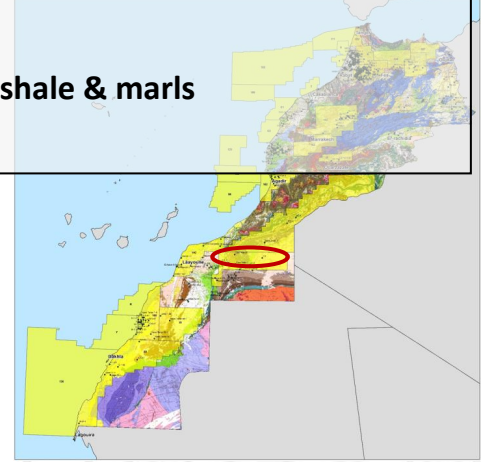
HYDROCARBON EXPLORATION: PROSPECTS & LEADS

Example of Palaeozoic structures (Zag Basin)

- Several 3 to 4-way closures were identified at the Palaeozoic. These closures are comprised between 3 Km² and 30 Km².



1. Source Rock : Silurian hot shale & Frasnian shale
2. Migration: Vertical through faults & lateral
3. Reservoir : Ordovician Sandstones and Devonian sandstones and carbonates
4. Seal: Palaeozoic interbedded shale & marls
5. Trap: Hercynian structures

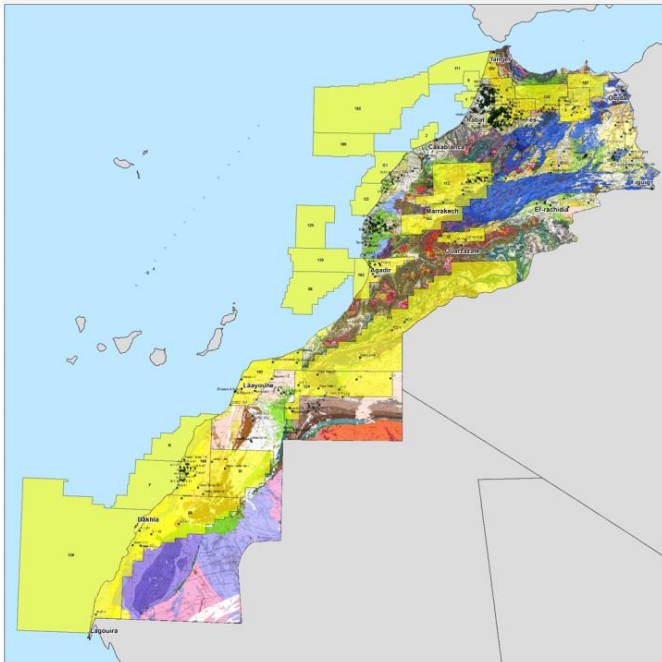


Total Gas resources: 1.454 Tcf



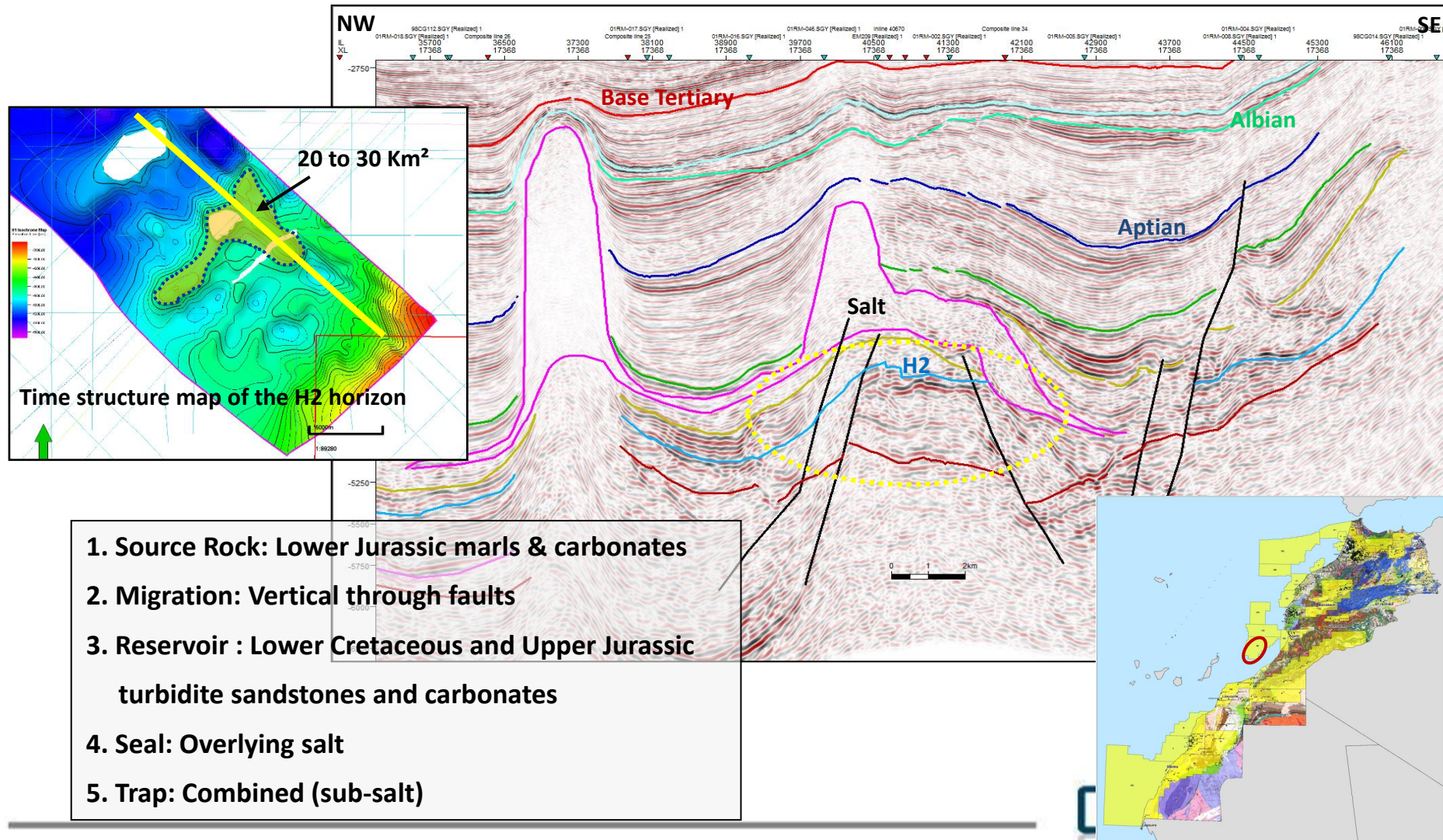
المكتب الوطني للهيدروكربونات و المعادن
ΕΘΣΟ. Ι. Γ. Ο. | ΗΦΣΛΟ:Κ.ΟΘ:Ο. + Λ Σ%:4. %
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

HYDROCARBON EXPLORATION: EXAMPLES OF NEWLY DEVELOPED PLAY CONCEPTS



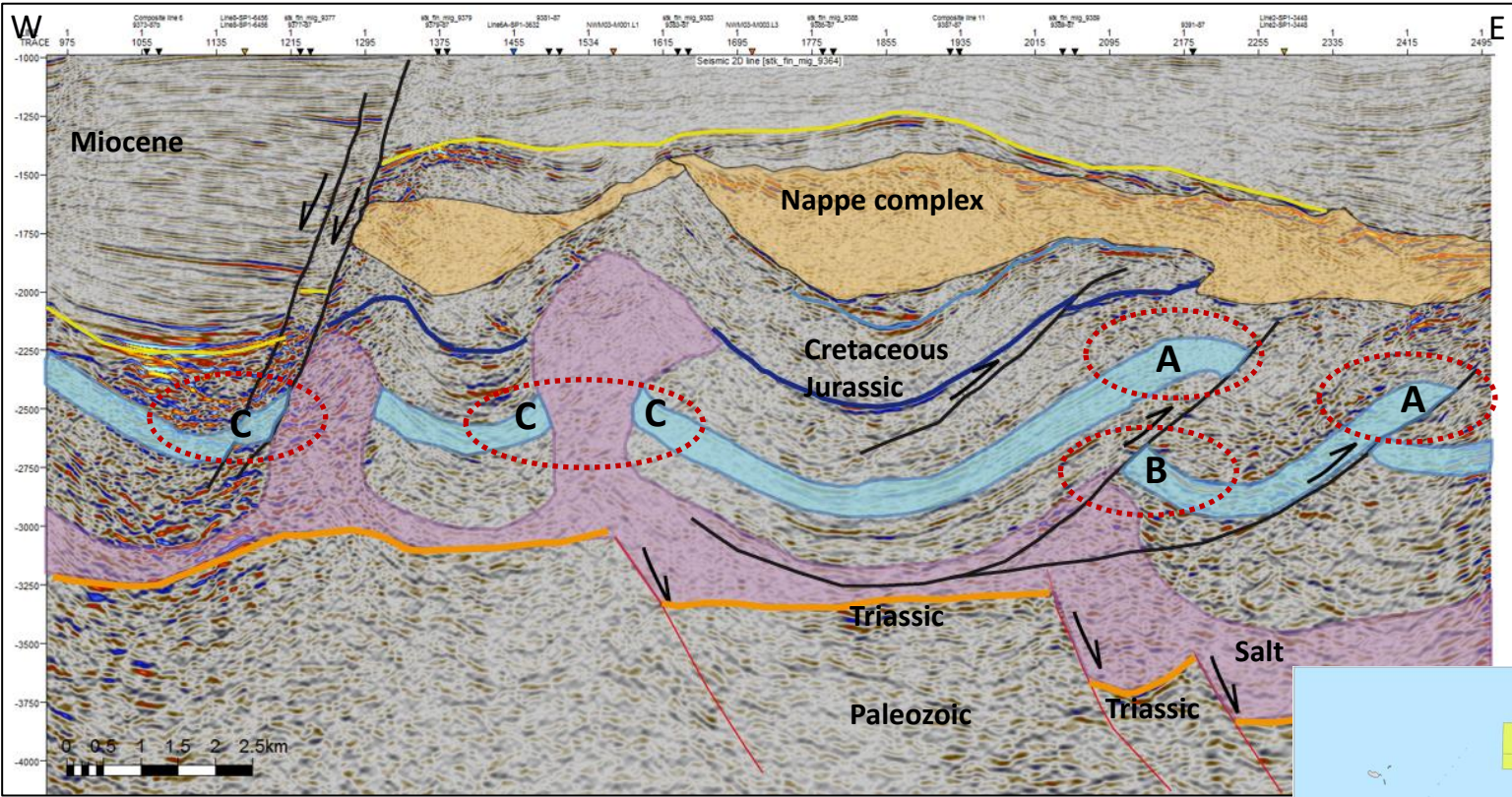
HYDROCARBON EXPLORATION: EXAMPLE OF PLAY CONCEPTS

Sub-salt play (Ifni Deep Offshore)

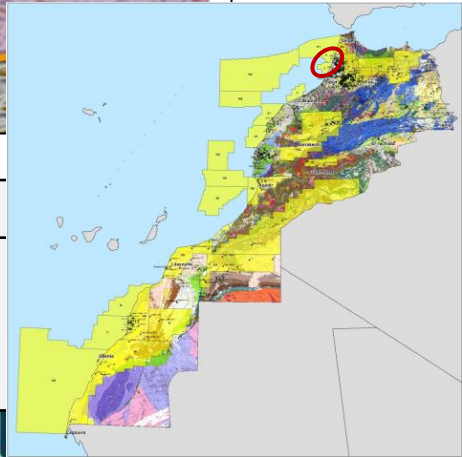


HYDROCARBON EXPLORATION : EXAMPLE OF PLAY CONCEPTS

Pre-nappe structures (Gharb Offshore)

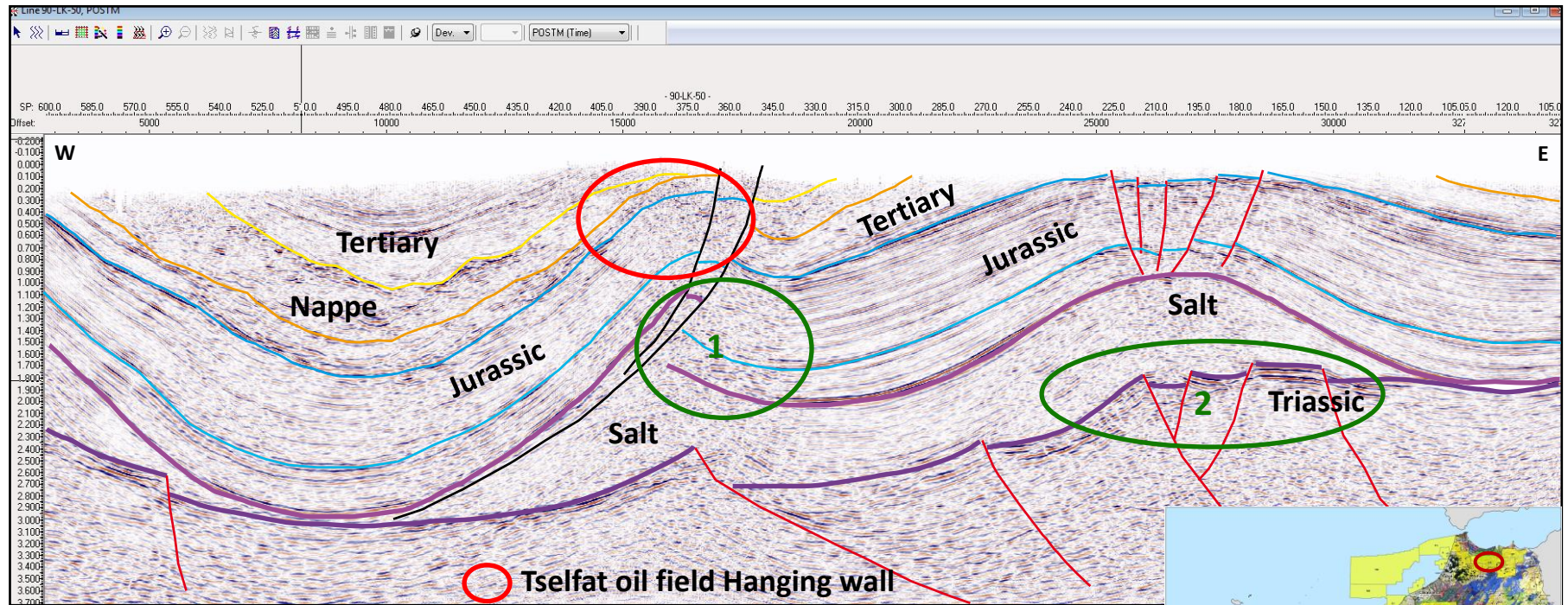


Traps	Source Rocks	Reservoir Rocks	Analogs
A: Over hang anticlines	Toarcian Organic rich shale	- Domerian oolitic limestone - Bajocian Sandstones	Tselfat and Bou Draa oil fields in the onshore Rides Prerifaines
B: Sub thrust			
C: Salt wall related			



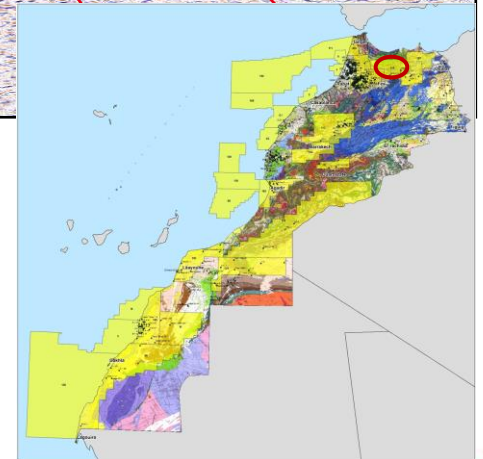
HYDROCARBON EXPLORATION : EXAMPLE OF PLAY CONCEPTS

Sub-thrust and Pre-salt structures (Prerif basin-Prerifaines Ridges)



Untested targets:

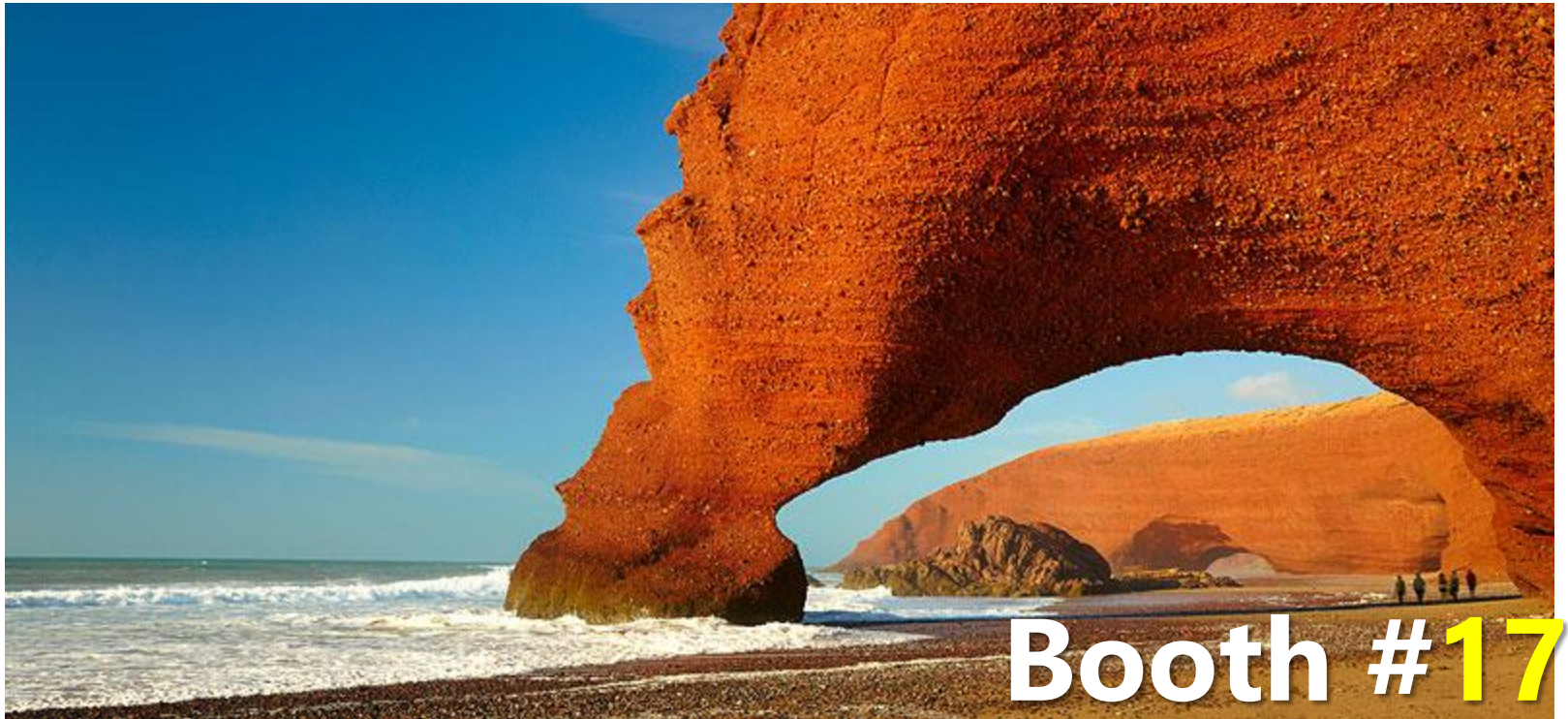
- **Sub-thrust: 1**
 - Domerian platform limestone
 - Mid. Jurassic sandstones (Haricha formation)
- **Pre-salt: 2**
 - Triassic fluvial sandstones



CONCLUSIONS

- Moroccan geology is significantly favorable for oil and gas exploration and production : good evidences for the existence of viable petroleum systems ;
- Different plays were developed in the Moroccan sedimentary basins and have a wide stratigraphic and geographic extension ;
- The play concepts developed are analogue to those identified in North Africa, Nova Scotia, West Africa and the Gulf of Mexico;
- Countless prospects and leads were identified in different sedimentary basins and different geological times in Morocco ;
- The so far drilled wells have discovered modest local hydrocarbon to prove existence of working petroleum systems;
- New incentives and hydrocarbon potential has attracted and continue to attract new investors to explore in Morocco.

THANK YOU



المكتب الوطني للهيدروكاربورات والمعادن
ΕΘΣΟ, ΕΓΣΟ | ΗΦΣΛΟΣΚ, ΟΘΣΟ, + Α ΣΧΣΨ, Χ
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES

APPEX GLOBAL 2018