

FLAGSHIP HYDROCARBON EXPLORATION CONCEPTS IN MOROCCO

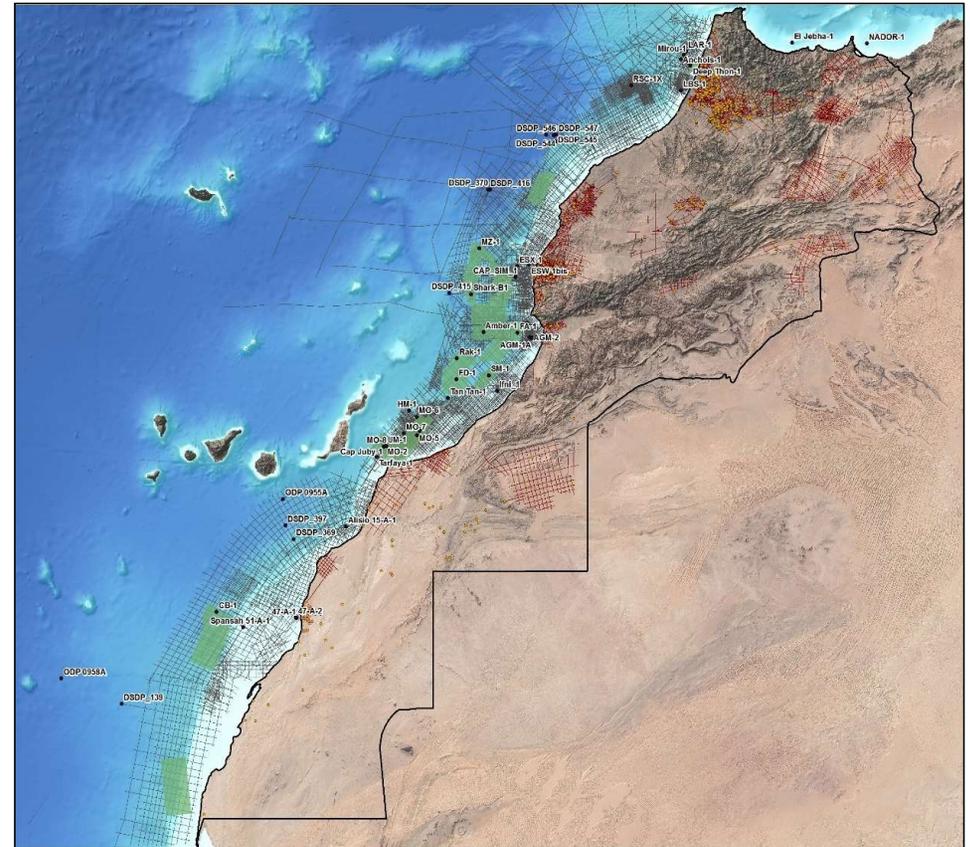


1	Status of the Hydrocarbon Exploration <ul style="list-style-type: none">• Seismic and drilling achievements• Petroleum exploration results
2	Flagship plays (prospects/leads) and successful analogs <ul style="list-style-type: none">• Presalt• Overthrust and Subthrust• Subsalt and Inverted Mini Basins
3	Current Plays
4	Unconventional Hydrocarbons
5	Conclusions

STATUS OF THE HYDROCARBON EXPLORATION

ONGOING WORKS

- **ONHYM Internal basins evaluations**
 - Regional and local petroleum evaluation projects
 - Regional geochemical modeling
- **Seismic reservoir characterization of an offshore segment**
 - ongoing
- **Multi-client long offset 2D seismic interpretation and margin evaluation**
- **Morocco-Nova Scotia margins restoration (MOU between ONHYM and OERA of the province of Nova Scotia)**
 - Data sharing agreement
 - Joint effort to explore geology and petroleum opportunities in both margins

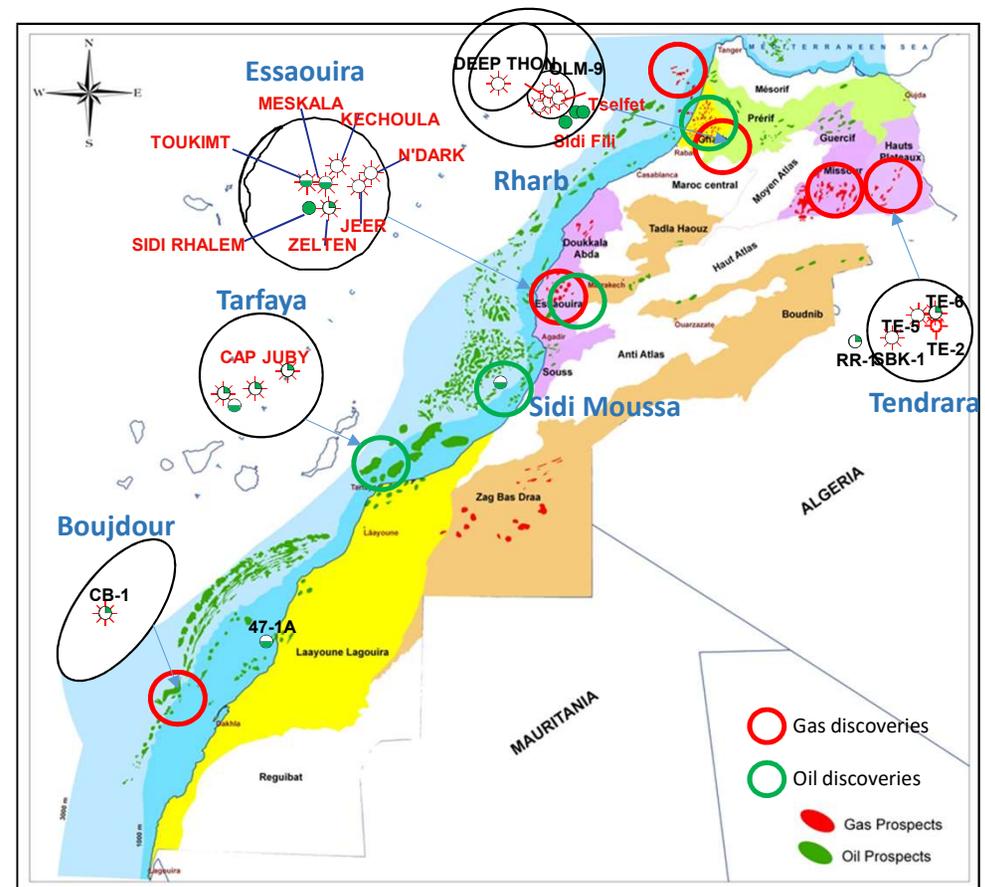


STATUS OF THE HYDROCARBON EXPLORATION

TO DATE EXPLORATION RESULTS

- More than **800** prospects & leads of various plays have been identified in the onshore and the offshore. Some of these prospects were tested successfully
 - Pre-Salt Play
 - Gas and condensate fields
 - Paleozoic Source Rocks
 - Salt Related Play
 - Jurassic carbonate Platform Play
 - Oil fields and sub-commercial accumulations
 - Jurassic Source Rocks
 - Turbidite Play
 - Gas and condensate shows and sub-commercial accumulations
 - Thrust and Sub-thrust Play
 - Oil fields and numerous oil seeps
 - Jurassic Source Rocks

- Still considerable number of mature prospects deserves to be drilled.



STATUS OF THE HYDROCARBON EXPLORATION

Licensing status

Exploration permits

- 41 offshore 62 158,87 km²
- 28 onshore 45 830,43 km²

Reconnaissance licenses

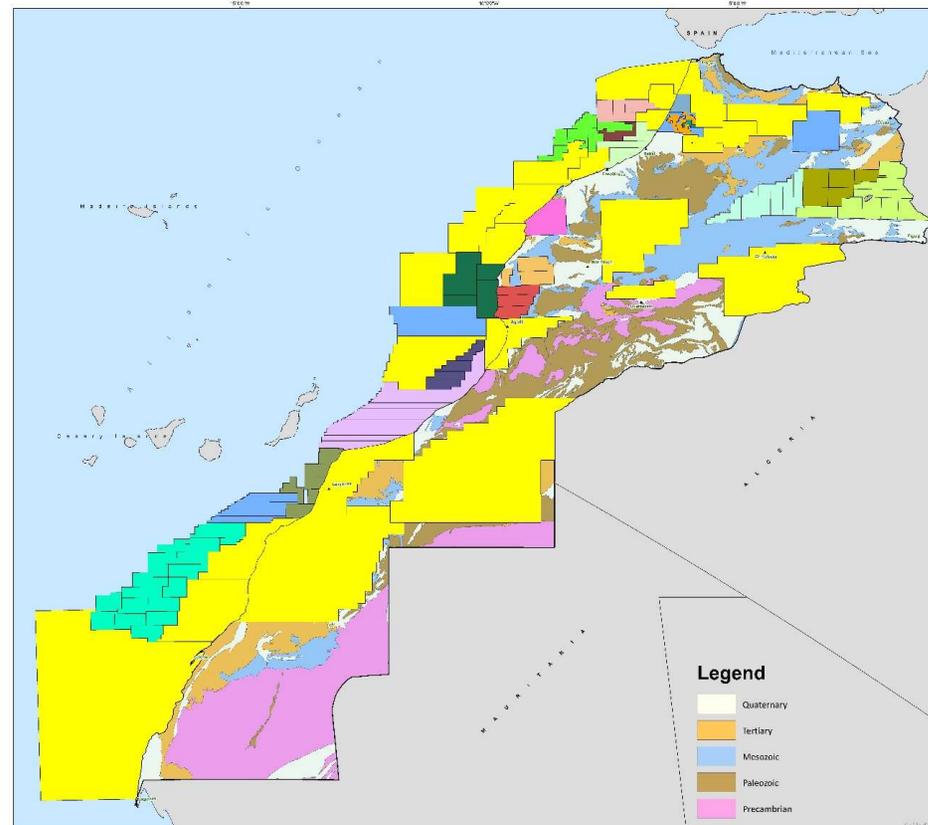
- 1 offshore 7 989,90 km²

Exploitation concessions

- 9 Exploitation 162,40 km²
- 1 ONHYM 38.7 km²

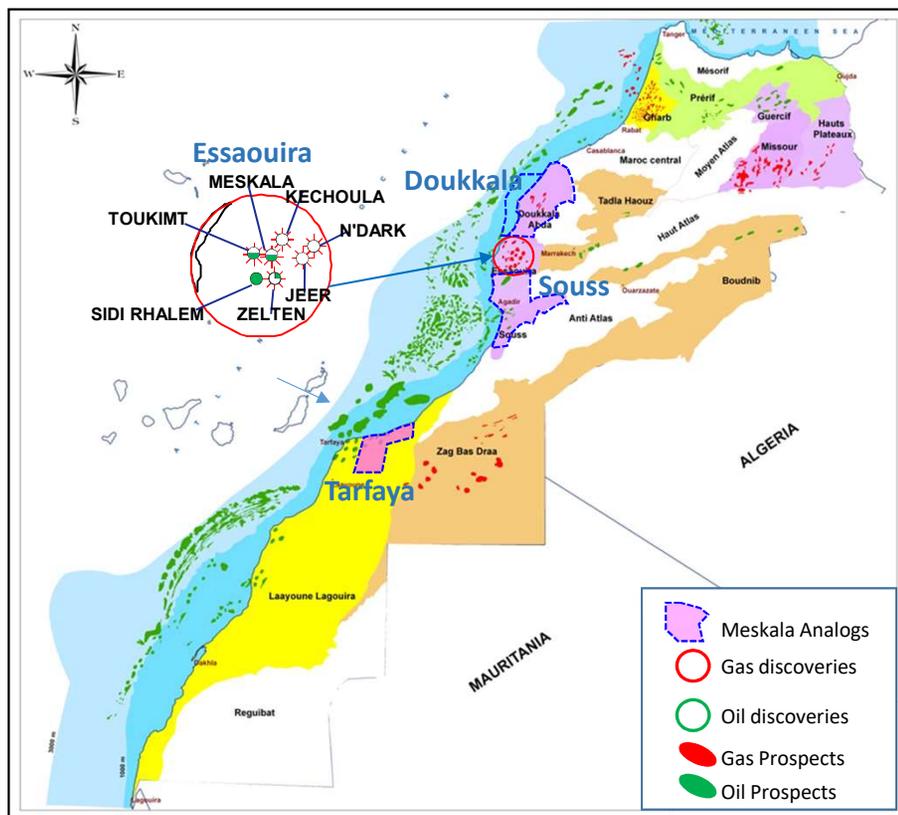
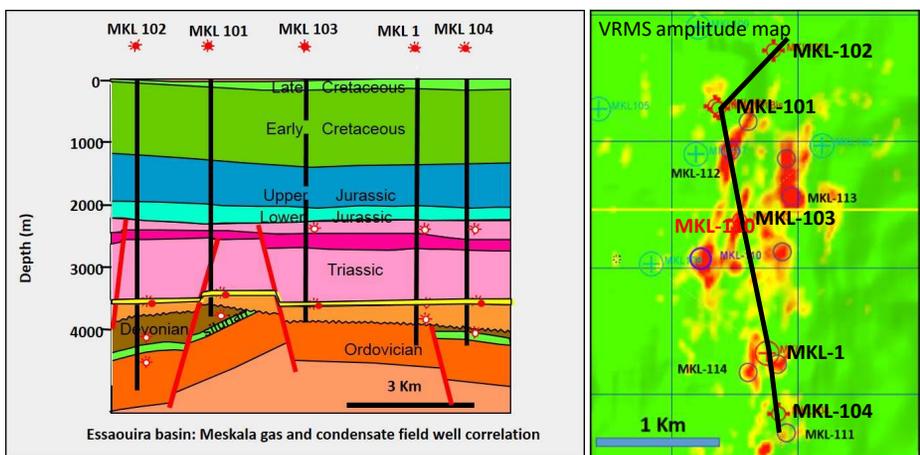
Open blocs

- 13 offshore
- 13 onshore



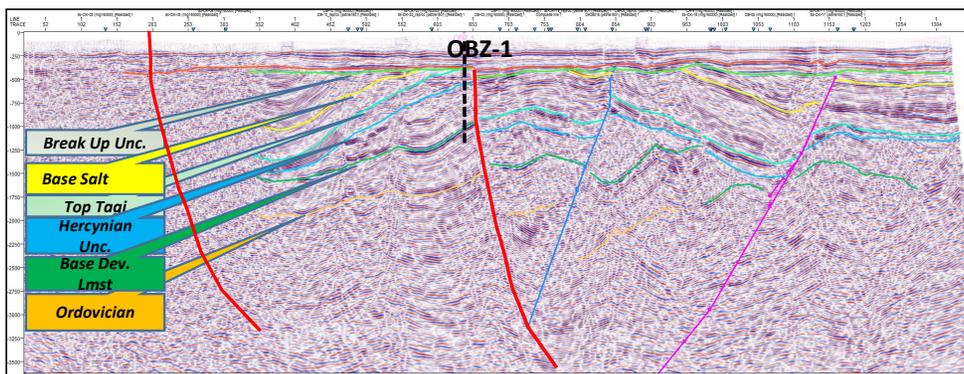
UNTESTED PRESALT PROSPECTS/LEADS AND ANALOGS

Positively tested presalt play (Meskala gas and condensate field in Essaouira basin)



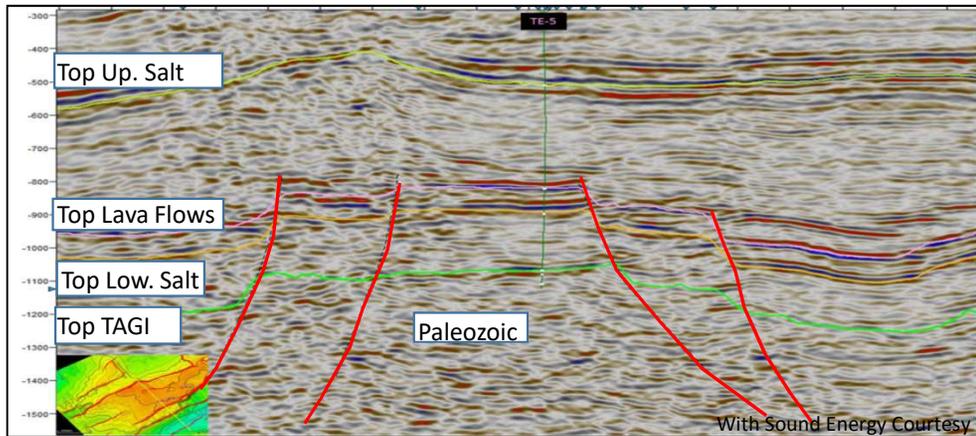
Presalt Play in the Atlantic Rift Basins

Untested Presalt play related prospects in the Dokkala basin

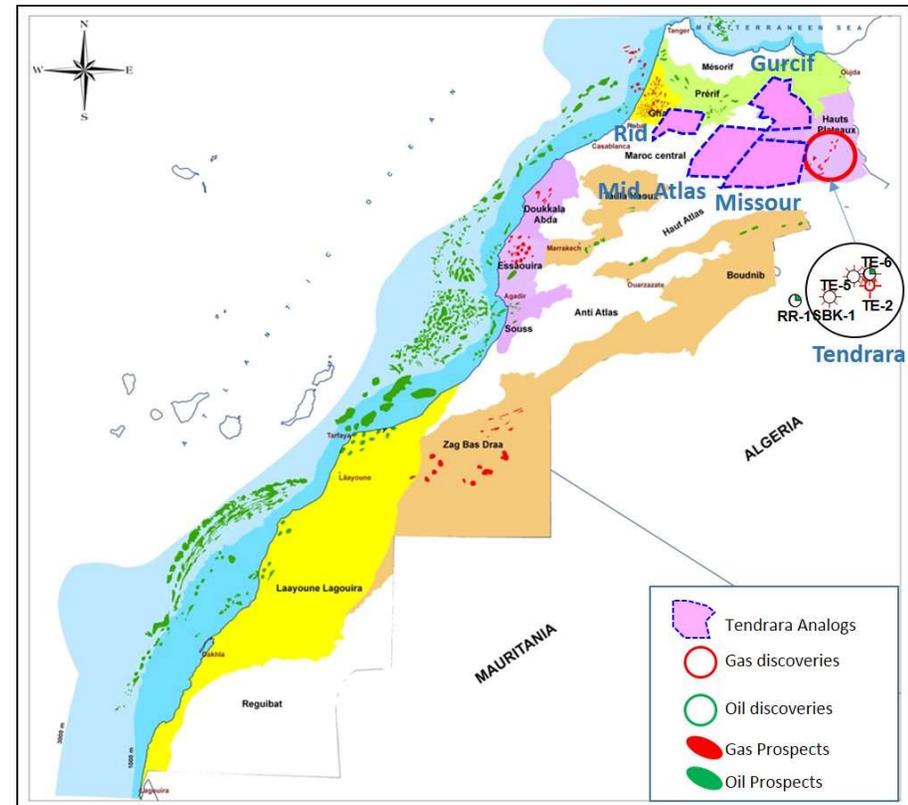
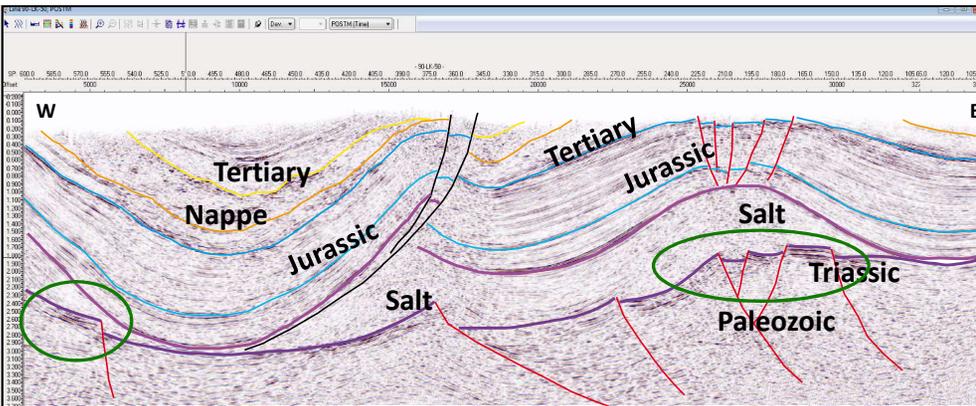


UNTESTED PRESALT PROSPECTS/LEADS AND ANALOGS

Positively tested presalt play in Tendirara Area



Untested Presalt play related prospects in the Prerif Ridges



Presalt Play in the Tethys Rift Basins

UNTESTED SUBTHRUST PROSPECTS/LEADS AND ANALOGS

Subthrust Play main drivers

Hydrocarbon occurrences:

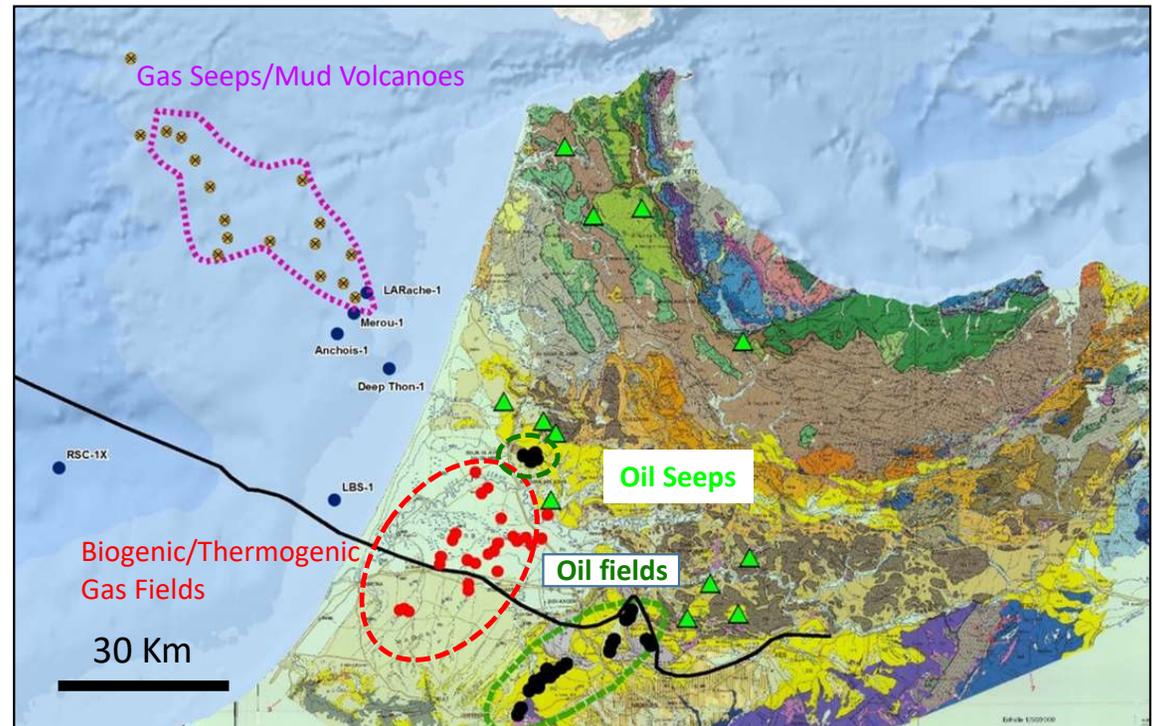
- Oil seeps
- Oil fields
- Biogenic and thermogenic gas
- Gas seeps associated with mud volcanos.

Four (4) proven marine and organic rich source rocks :

- Miocene up to 10% Toc
- Cenomanian-Turonian 0.6 to 10.7%Toc
- Toarcian 0.5 to 2.5 % Toc
- Domerian 0.5 to 1.2 % Toc

Four (4) proven reservoir intervalles:

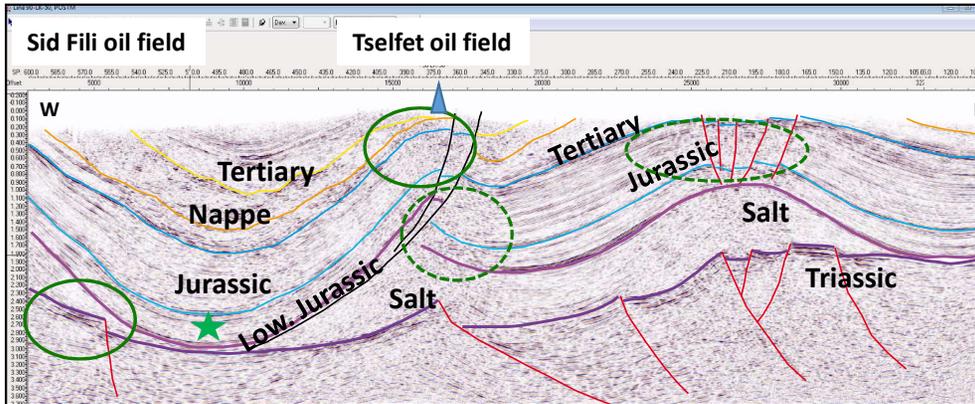
- Miocene turbidite sandstones
- Mid. And Up. Jurassic deltaic and turbidite sandstones
- Low. And Mid. Jurassic carbonates
- Triassic fluvial sandstones



Hydrocarbon Occurrences in the Moroccan Alpine (Rif) folded and thrust belt

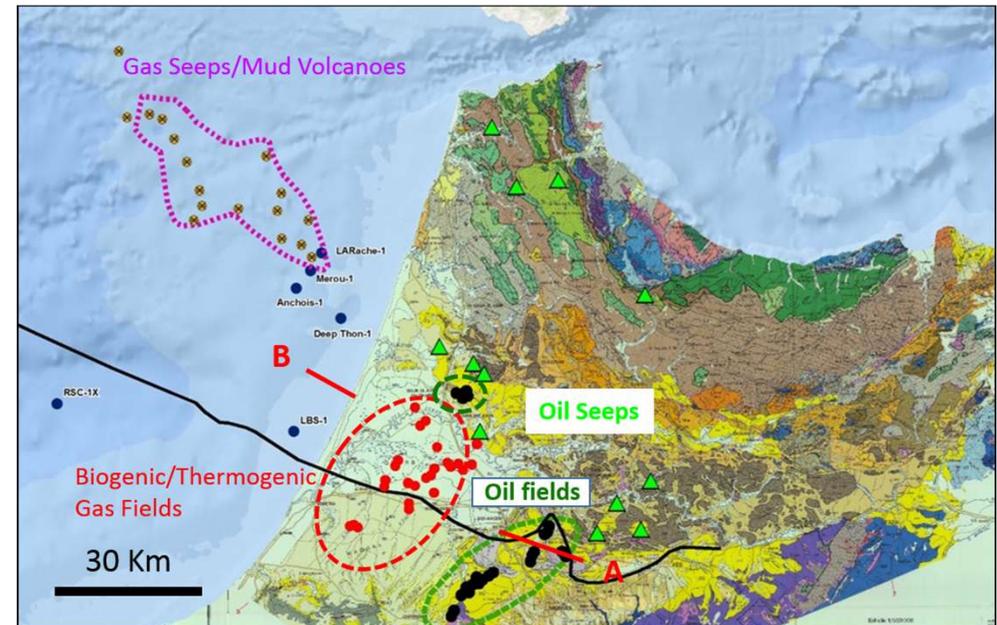
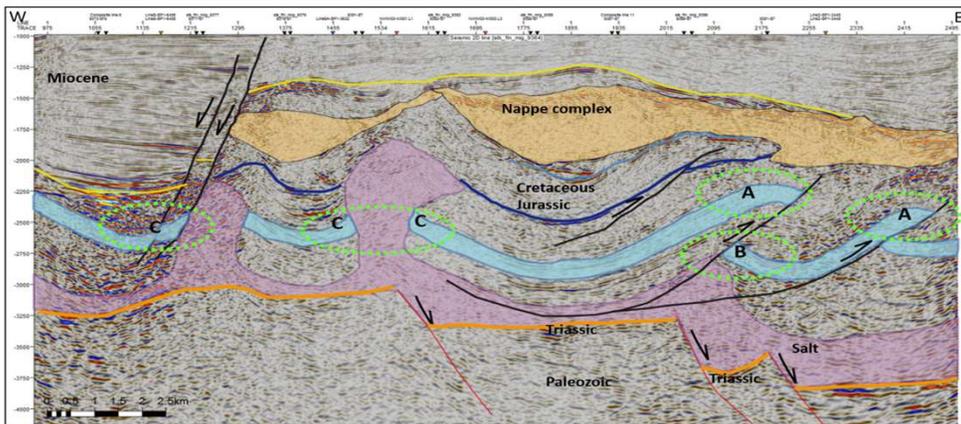
UNTESTED SUBTHRUST PROSPECTS/LEADS AND ANALOGS

Onshore Line A: Jurassic play positively tested in overthrust structures



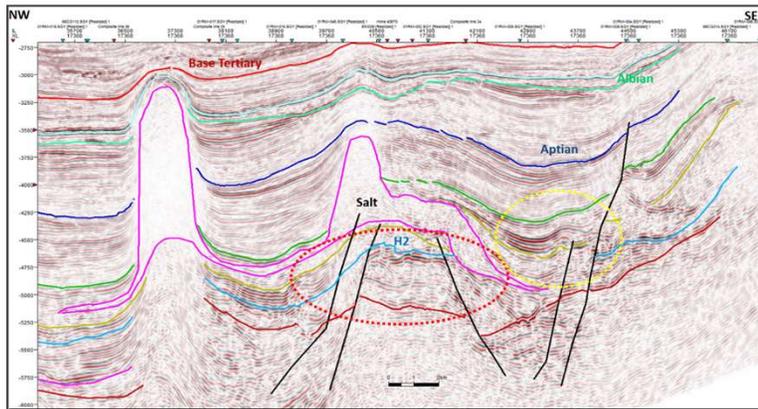
- Onshore overthrust structures positively tested: Tselfet, Bou Draa, Ain Hamra, Baton etc...
- Source Rock: is lower Jurassic black shales (TOC up to 8%)
- Offshore Overthrust (A), subthrust (B) and salt related structures (C) remain untested

Offshore Line B: Untested Jurassic play

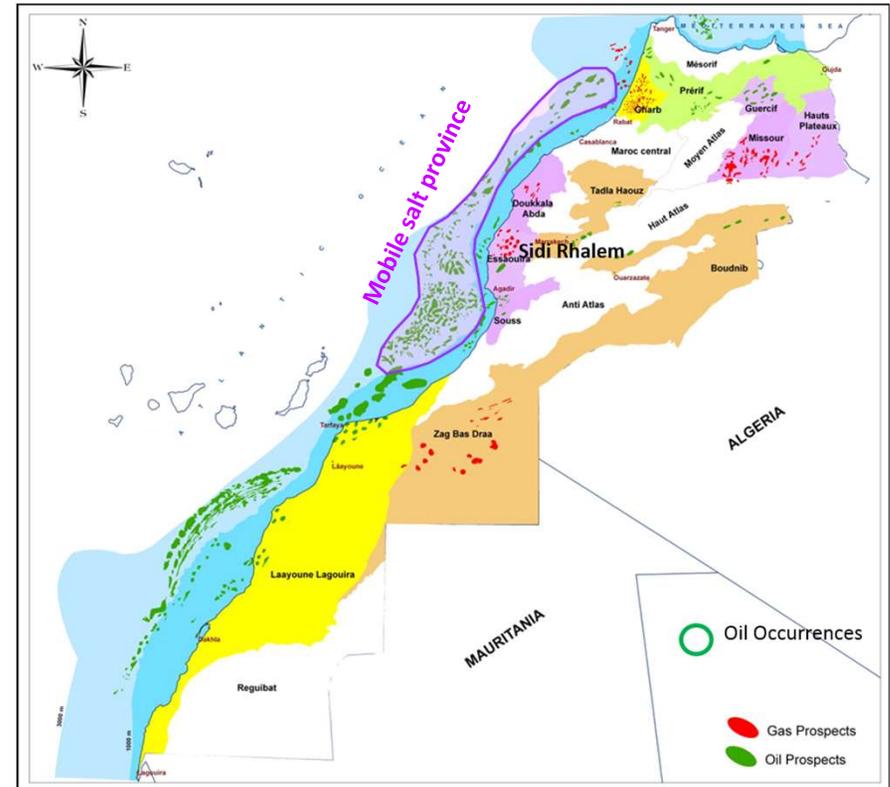
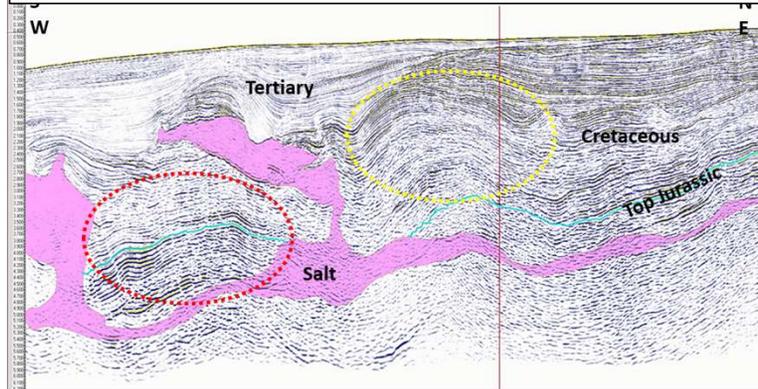


UNTESTED SUBSALT AND INVERTED MINI BASINS

- Previous exploration targeted and tested lower Cretaceous at tops and flanks of salt diapirs.
- Only thin bedded sandstone intervals with oil or gas shows.
- New focus on Jurassic and Lower Cretaceous inverted mini basins and subsalt

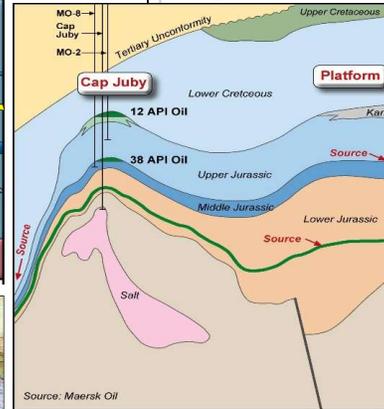
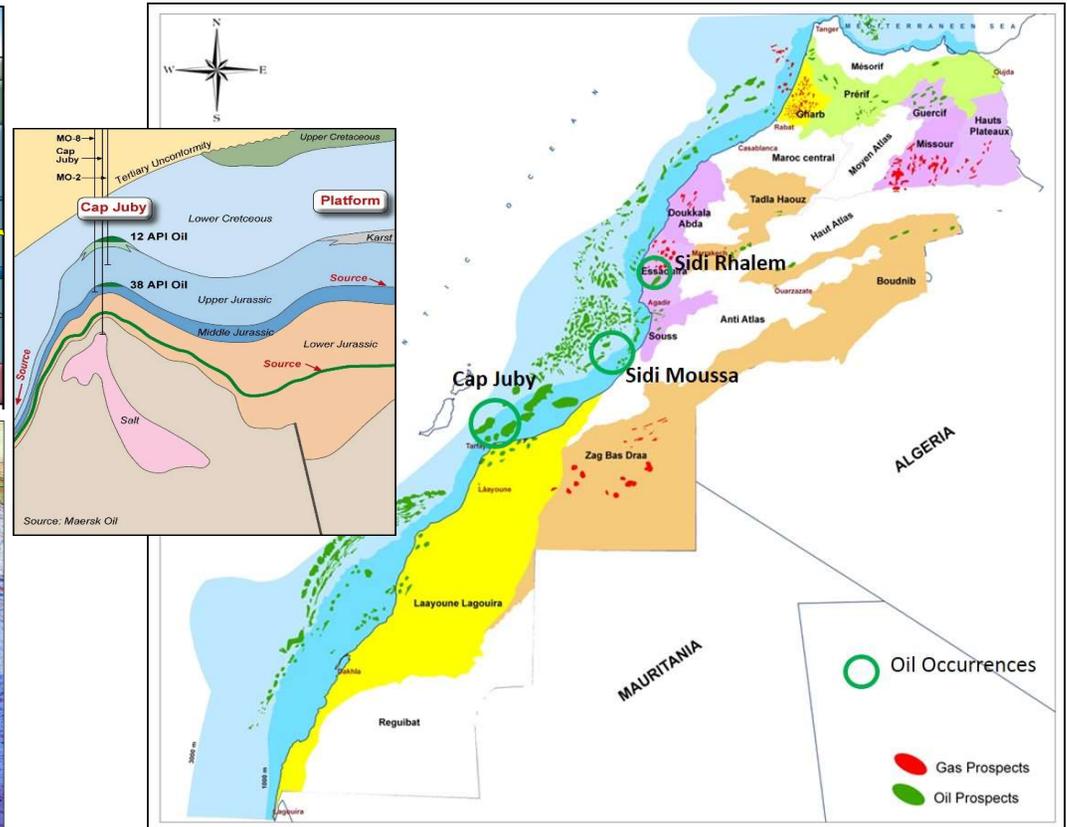
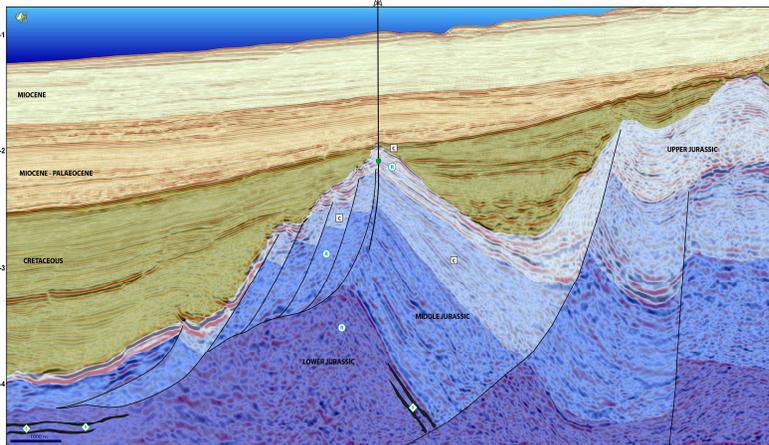
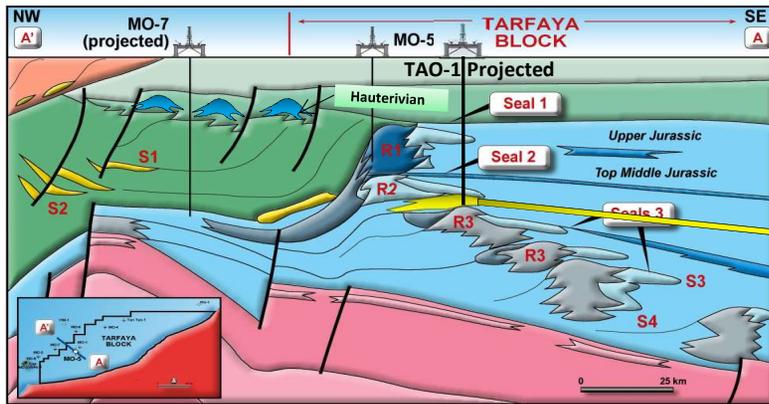


Examples of subsalt and inverted mini-basins prospects in the salt province



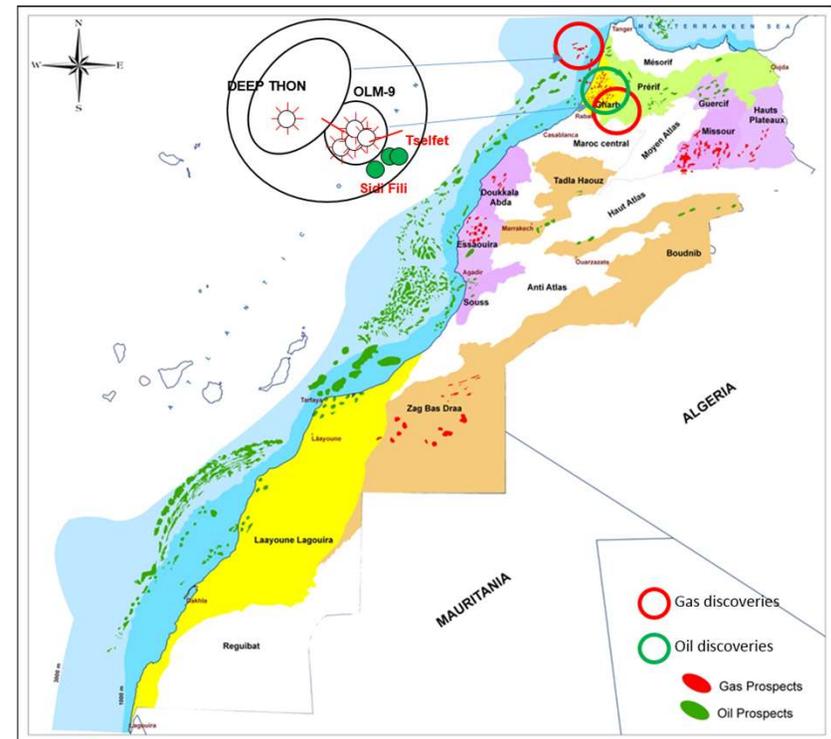
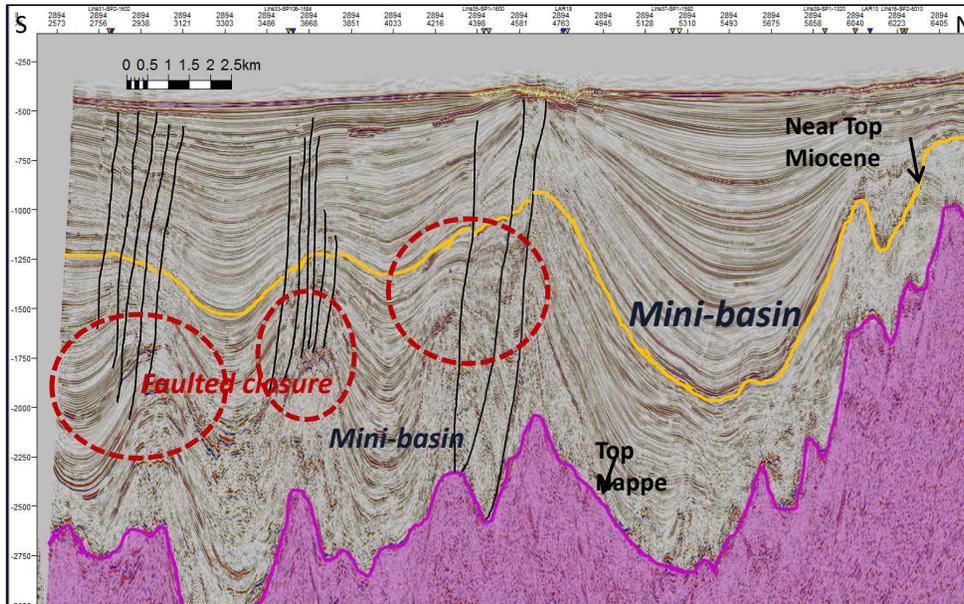
JURASSIC PLATFORM PLAY

- Oil field (Sidi Rhalem), heavy and light oils accumulations (Cap Juby and Sidi Moussa) are associated with the Jurassic platform play and give strong evidence of working petroleum systems.
- New focus on down faulted blocs, reefs and oolite shoals sealed by Cretaceous shale.



CURRENT PLAYS

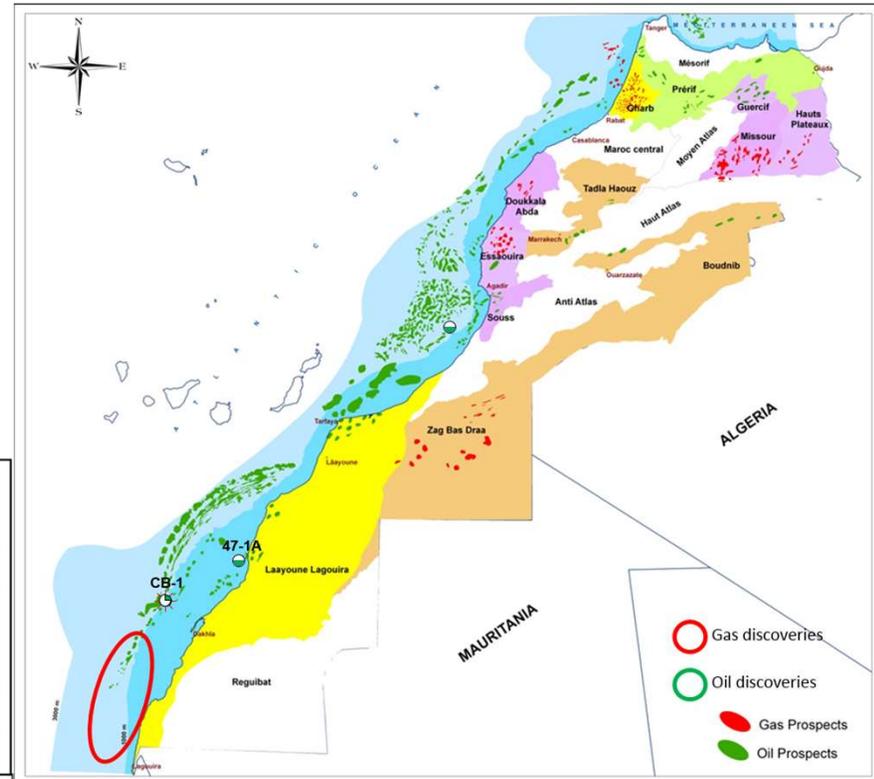
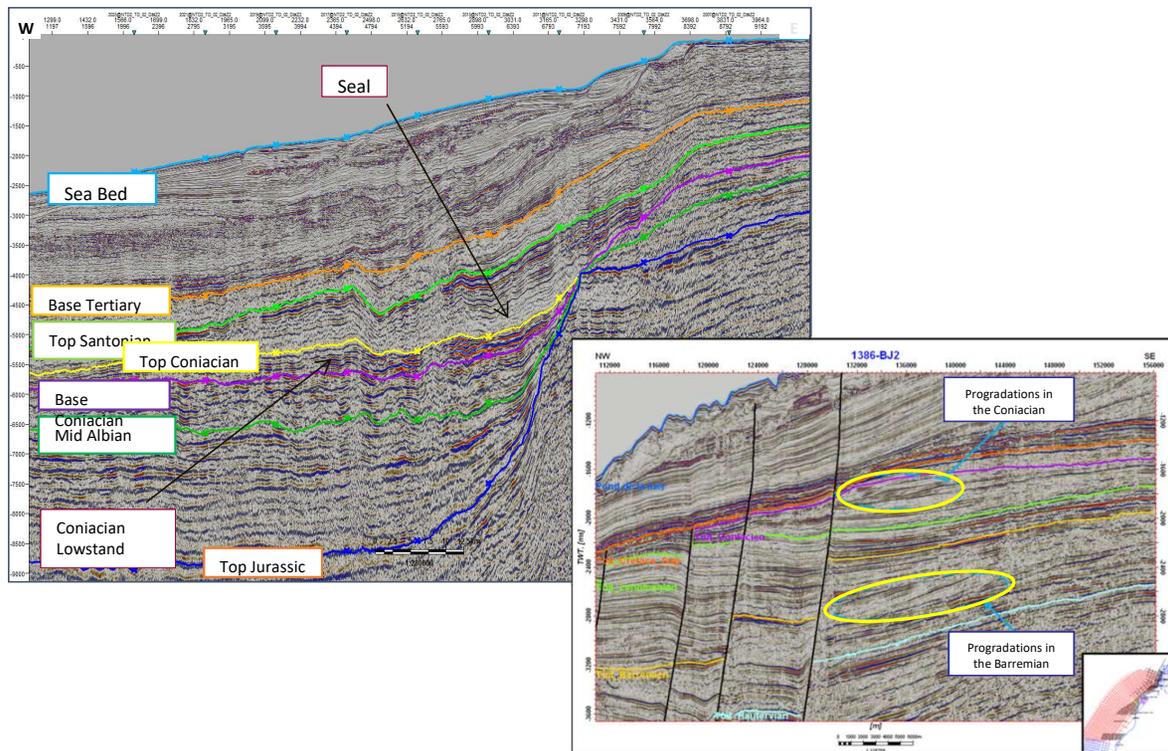
- Biogenic and thermogenic gas in the Miocene turbidite sandstones.
- Alpine tectonics related structures, involving Mesozoic strata within the accretionary wedge “Nappe” and underneath, show up on adequately reprocessed 3D seismic, to constitute new play in the area.



CURRENT PLAYS

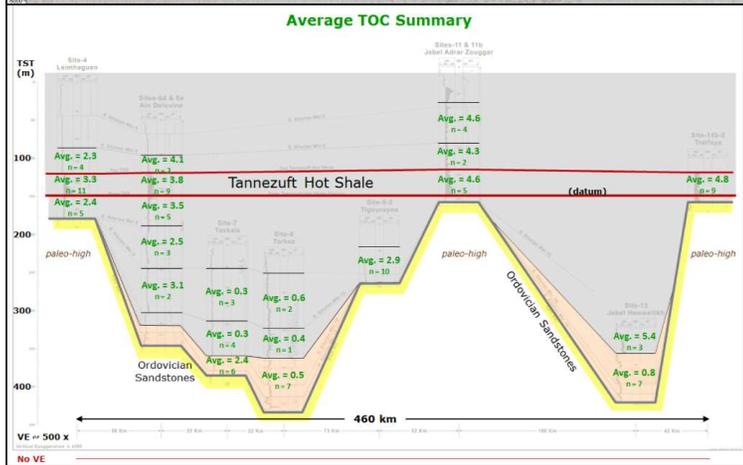
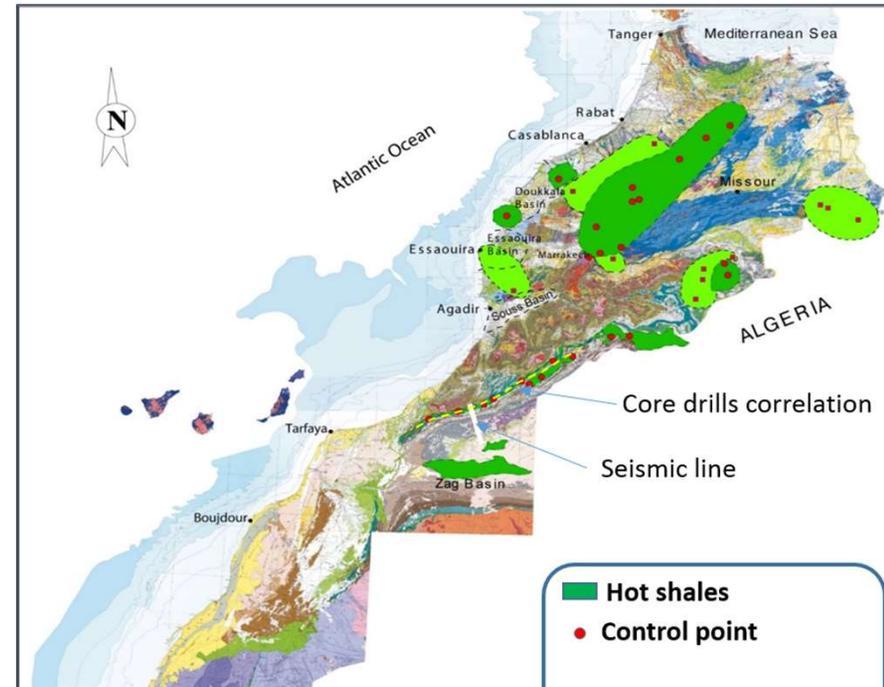
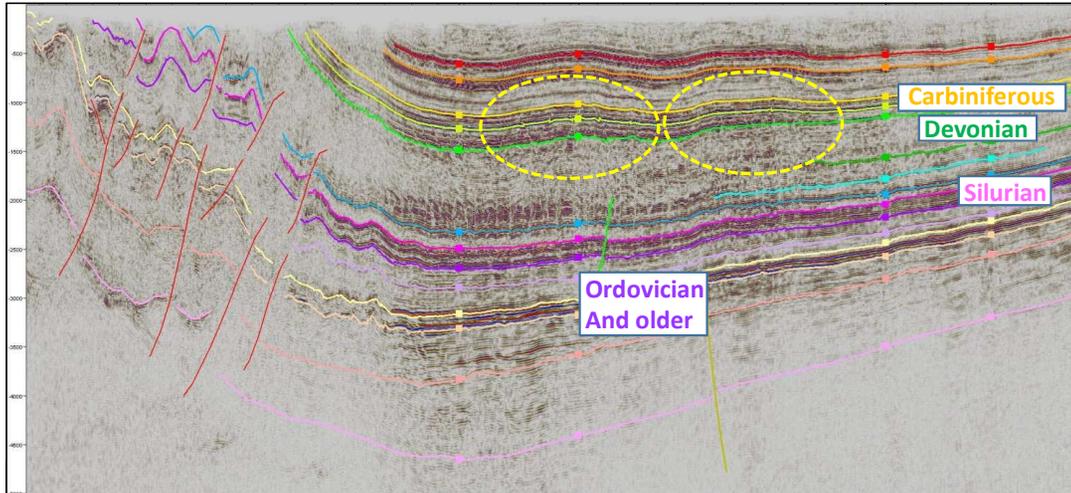
Upper Cretaceous Turbidite Play

- Stratigraphic traps and slope tectonics related structures involving the Upper Cretaceous (Coniacian) turbidite sandstones to be sourced from underlying organic rich Cenomanian Turonian source rocks.



CURRENT PLAYS

Conventional and non conventional



1. Source Rock : **Silurian hot shale & Frasnian shale**
2. Migration: **Vertical through faults & lateral**
3. Reservoir : **Carboniferous sandstones and Devonian carbonates/Sandstones**
4. Seal: **Palaeozoic interbedded shale & marls**
5. Trap: **Structural and Stratigraphic**

CONCLUSION

- **The Moroccan geology is, by its sedimentary and tectonic diversity, considerably favorable for oil and gas generation and production**
- **Strong evidences for the existence of several working petroleum systems, through producing fields, oil and gas accumulations or shows and oil or gas seeps ;**
- **Myriad of play concepts are developed in different sedimentary basins and different geological times in Morocco ;**
- **The so far drilled wells have tested two plays and encountered modest hydrocarbon or shows even though some did not penetrate thick reservoir intervals;**
- **The flagship exploration plays are driven by hydrocarbon occurrences in their neighborhood and their analogies with successful cases in Morocco;**



THANK YOU

Booth
MOROCCO
ONHYM
INTERNATIONAL PAVILLON