



المكتب الوطني للهيدروكاربورات و المعادن
ΕΘΣΟ. Α.Ε.Ε.Ο. | ΗΦΣΛΟ:Κ.ΟΘ:Ο.+ Λ Σ*84.*
OFFICE NATIONAL DES HYDROCARBURES ET DES MINES



3-5 MARCH 2020

Hydrocarbon Potential in Morocco: Outstanding Opportunities in Underexplored Basins

ASMAE BENARCHID
South Offshore Department
Manager



Country key aspects

Hydrocarbon Exploration Outlook

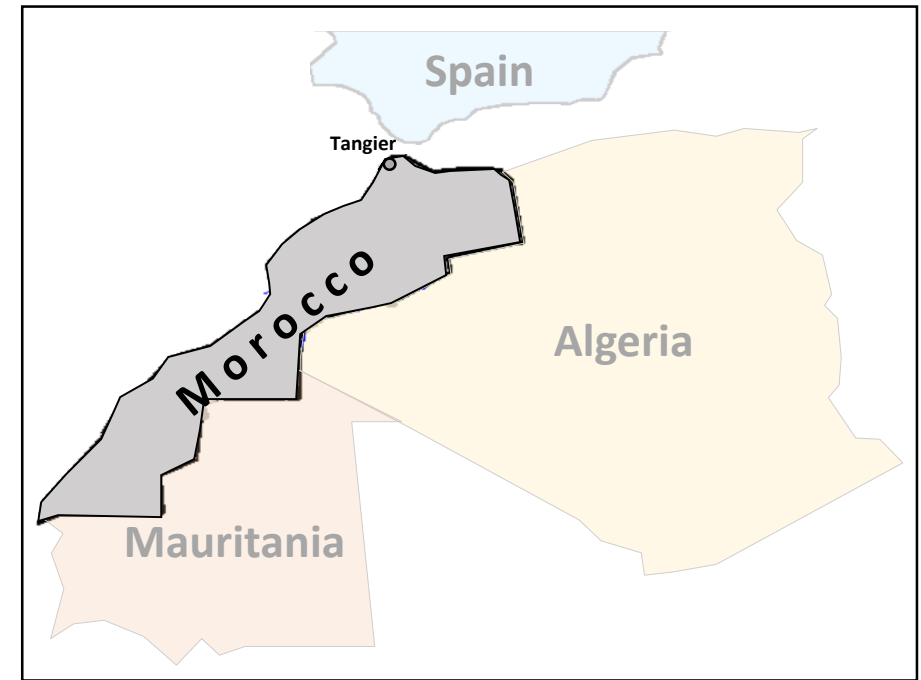
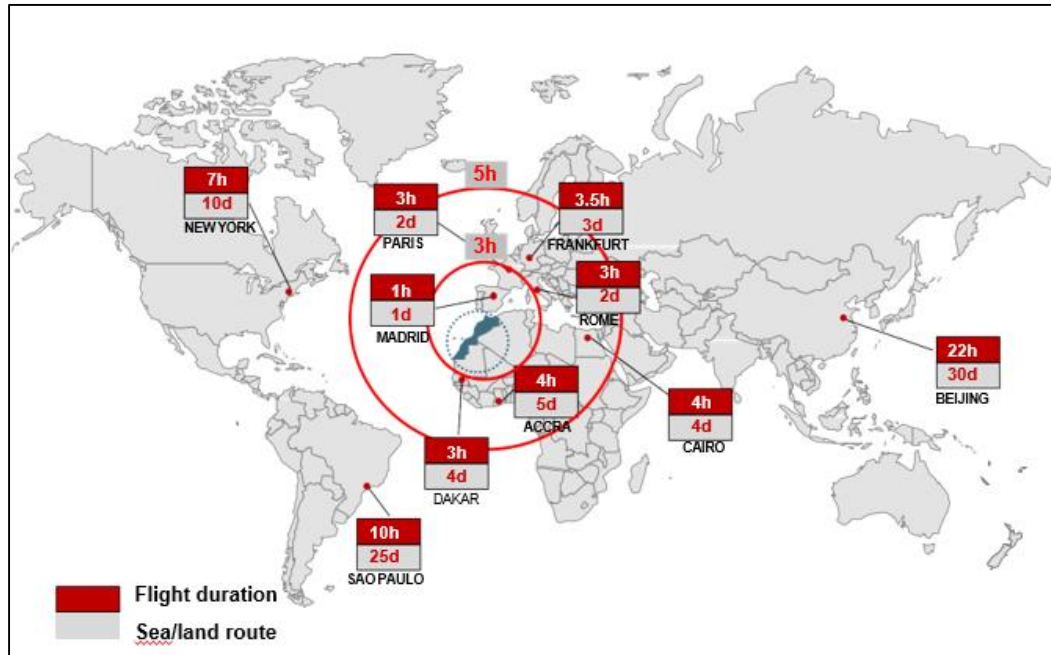
Potential Petroleum Systems

Basins Analogs

Examples of untested Plays, Leads & Prospects

Morocco Incentives

MOROCCO: A CROSS-ROAD FROM AFRICA TO EUROPE



- A unique geographic location with 3 500 Km coastline on the Atlantic Ocean and the Mediterranean sea
- 15 Km distance from Europe

- 1st in North Africa in terms of infrastructure quality
- 14 foreign trade ports and 18 airports
- Tangier Med Port: A growing global connectivity with 174 ports and 74 countries

MOROCCO: A FAST GROWING ECONOMY



- **Population:** 35.5 million
- **Language:** Arabic, Amazigh, French, Spanish and English
- **Primary Energy Consumption :** 20 million TOE
- **Dependency on imports :** 96 %
- **Net energy bill :** 8.77 billion \$ (2018)
- **2030 energy consumption forecast :** 43 million TOE
- **GDP:** 120 billion \$
- **Growth:** +3.2 %
- **Inflation rate:** 2 %
- **Foreign Direct Investment:** 3.3 billion \$
- **Currency:** Moroccan Dirham (MAD) 1 US \$ = 9.65 MAD

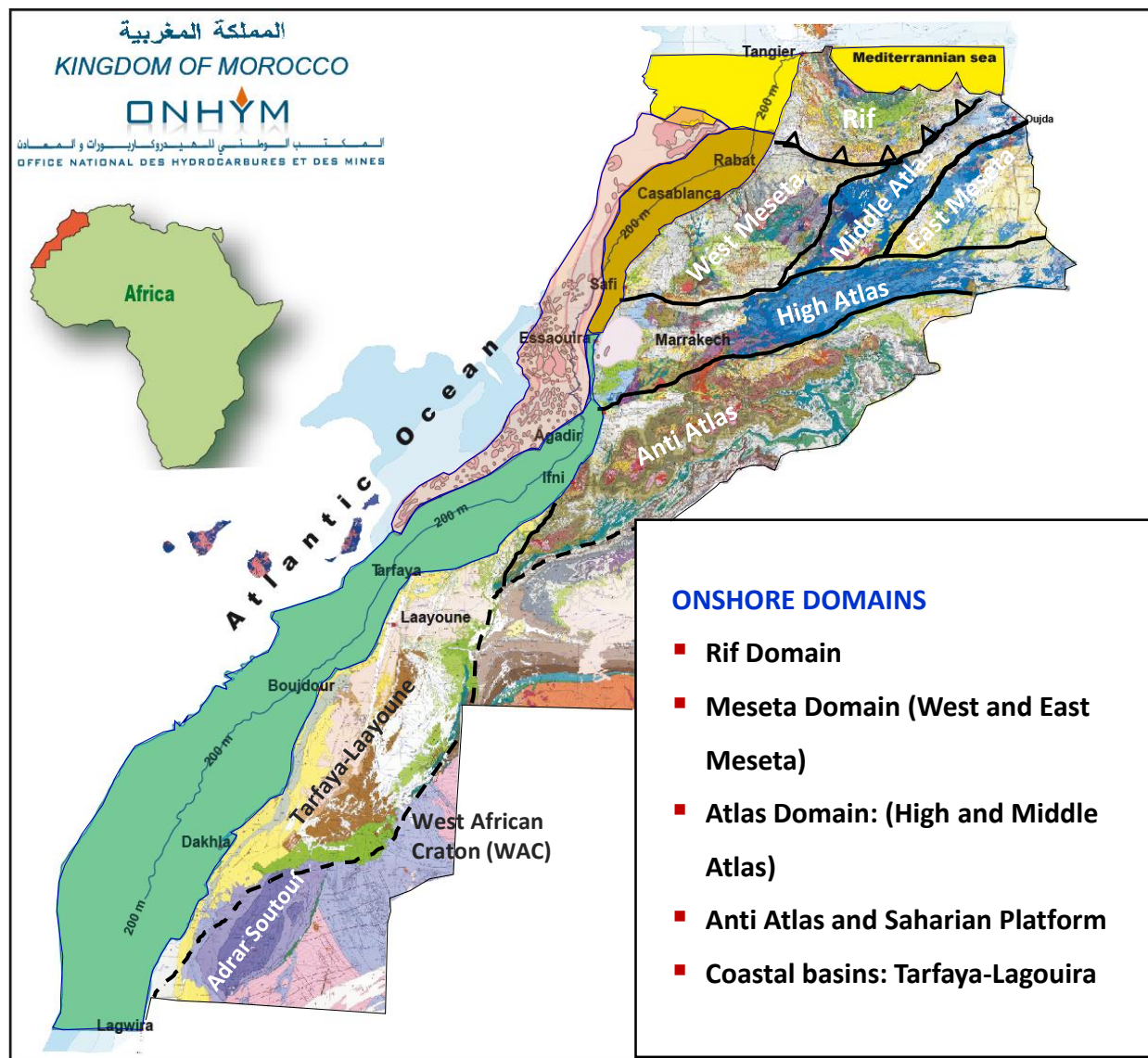
General Information

Capital	Rabat
Institutional System	Democratic and social Constitutional Monarchy
Area	710 850 km ²
Time Zone	GMT+1

OFFSHORE & ONSHORE MOROCCO: GEOLOGICAL SNAPSHOT

Main onshore structural domains and associated Petroleum Objectives

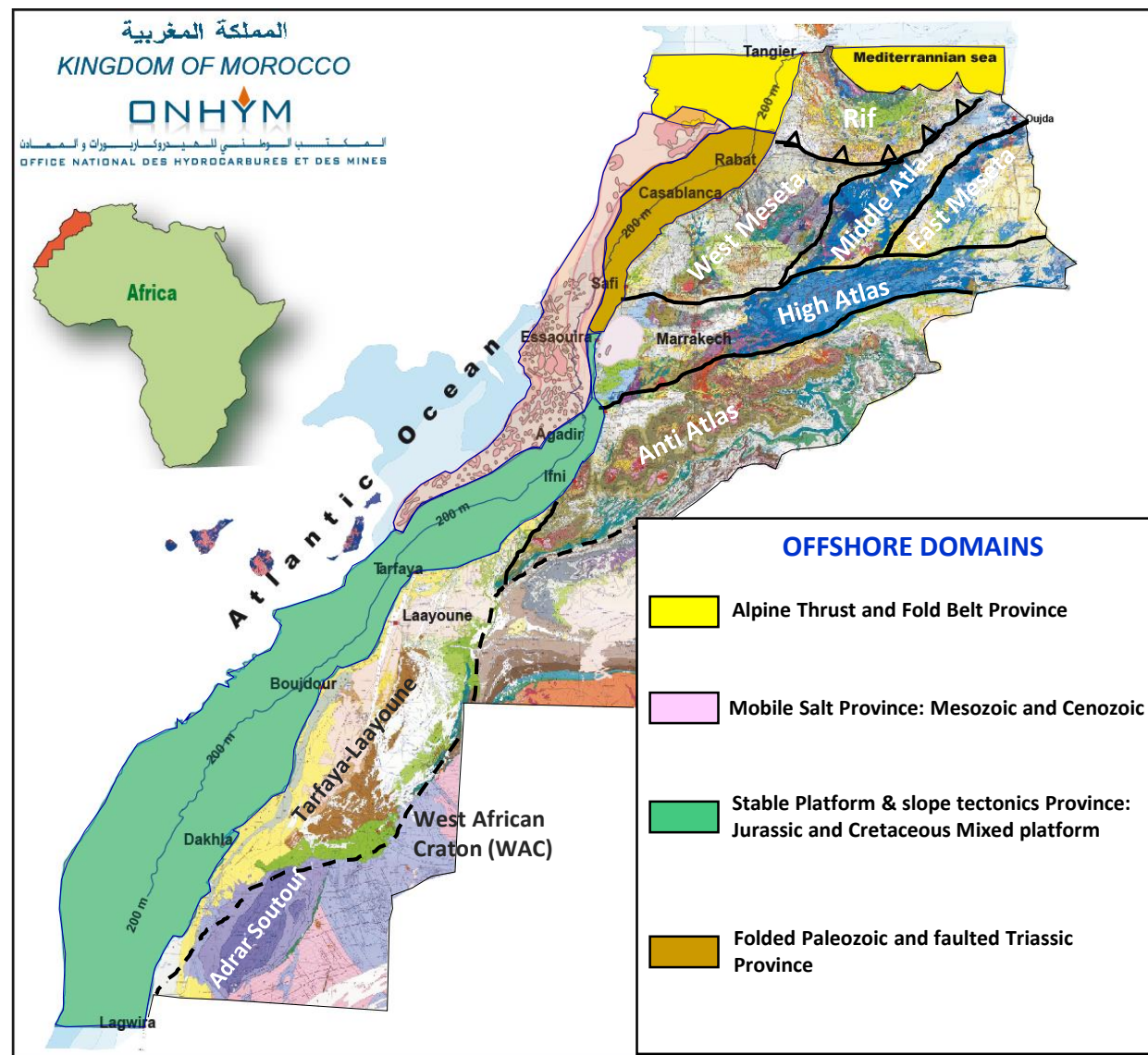
- **The Rif Domain:** Alpine folded and thrust belt (Mesozoic and Tertiary Objectives)
- **The Meseta Domain:** Hercynian Folded & thrust belt and Meso-Cenozoic rift & Passive margin (Paleozoic, Triassic and Jurassic objectives)
- **The Atlas Domain:** Early Mesozoic Tethysian Rift and Alpine Inverted and Folded belt (Triassic and Jurassic objectives)
- **The Anti Atlas and Saharian Platform:** Hercynian domain (Paleozoic objectives)
- **The Coastal basins:** Atlantic Mesozoic-Cenozoic Passive Margin (Triassic, Jurassic, Cretaceous and Tertiary objectives)



OFFSHORE & ONSHORE MOROCCO: GEOLOGICAL SNAPSHOT

Main offshore structural domains and associated Petroleum Objectives

- **Alpine thrust and folded belt province:** Extension of the Rif domain (Jurassic, Cretaceous and Tertiary Objectives)
- **Folded Paleozoic and faulted Triassic Province:** Extension of the Meseta (Paleozoic and Triassic Objectives)
- **Mobile salt province:** Mesozoic Atlantic Rift & Passive Margin (Triassic, Jurassic, Cretaceous and Tertiary Objectives)
- **Platform and Deep Marine Province:** Mesozoic Atlantic Rift & Passive Margin (Jurassic, Cretaceous and Tertiary Objectives)



OFFSHORE & ONSHORE MOROCCO : HYDROCARBON EXPLORATION STATUS

SEISMIC & WELLS DATABASE

Offshore Atlantic

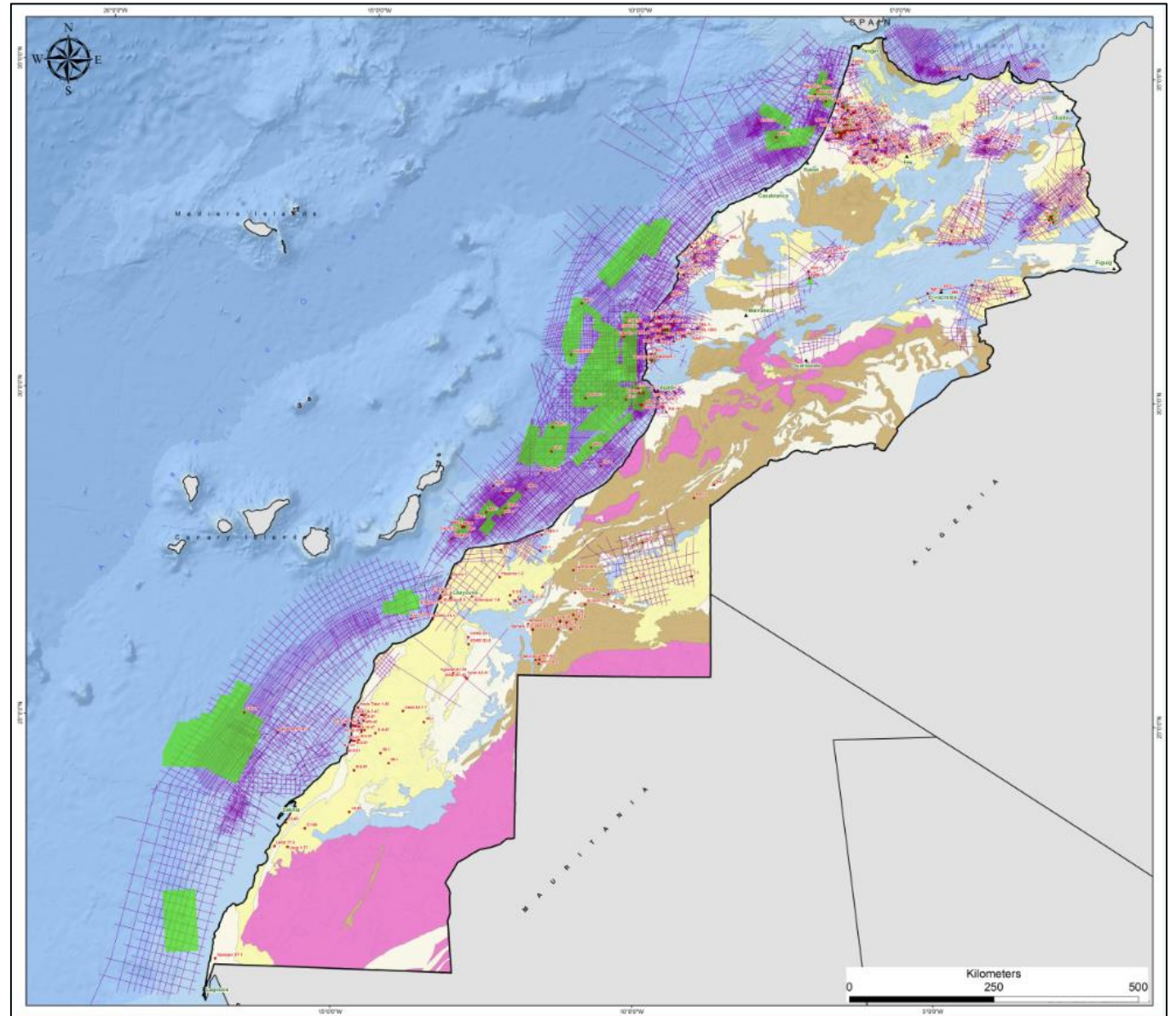
- 2D Seismic: 164 808 Km
- 3D Seismic: 70 242 Km²
- 2D Multi-clients: 13 195.9 Km
- 42 exploration wells

Offshore Mediterranean

- 2D Seismic: 10 745 Km
- 2 Exploration wells

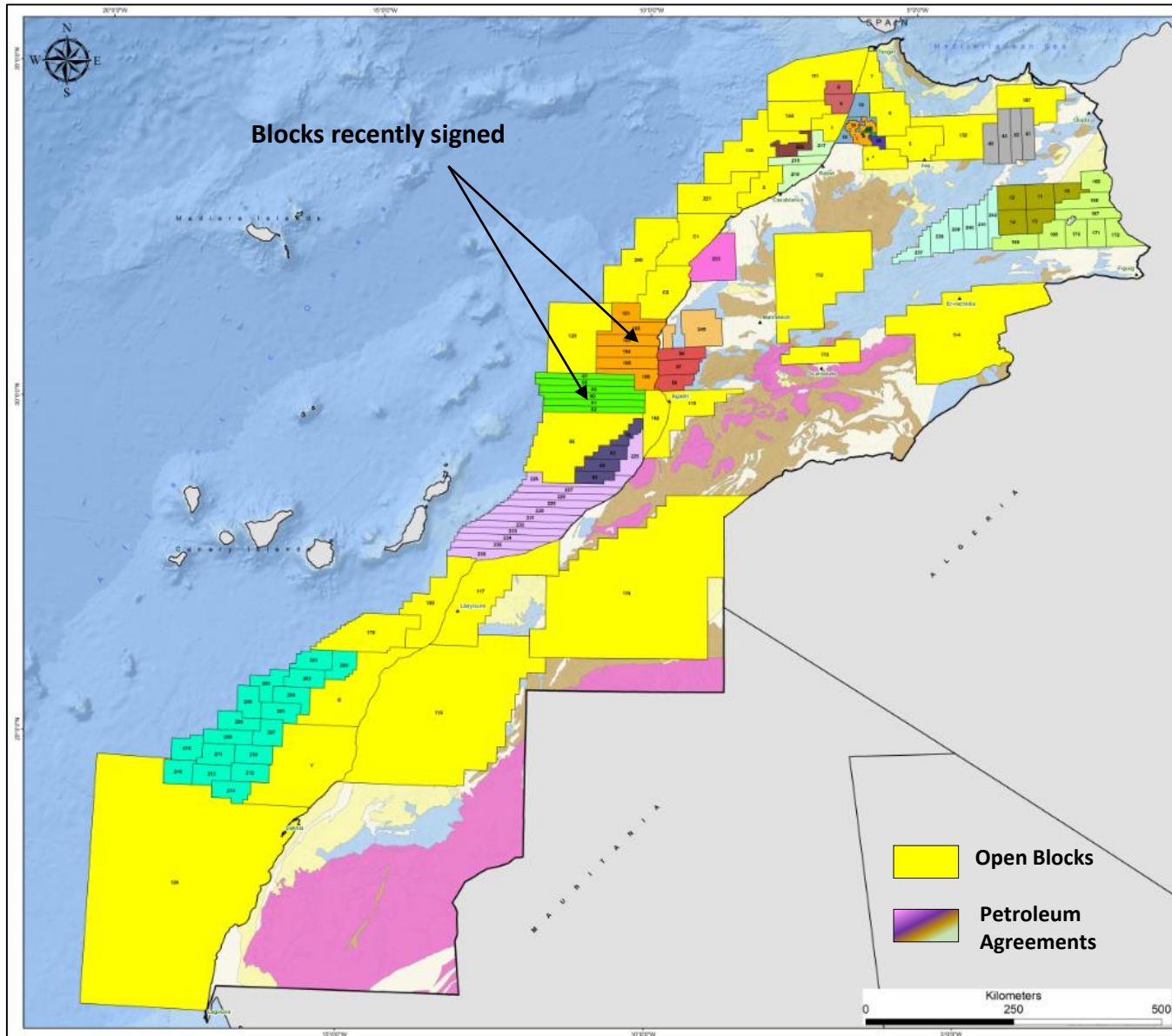
Onshore

- 2D Seismic: 56 808 Km
- 3D Seismic: 2 192 Km²
- 316 Exploration wells



OFFSHORE & ONSHORE MOROCCO : HYDROCARBON EXPLORATION STATUS

E&P ACTIVITIES



Main ongoing Exploration Activities in Offshore & Onshore Morocco:

Partners

- 3D & 2D seismic processing
- G&G Evaluation of the Areas of Interest
- Drilling activity in the Rharb onshore Basin (9/12 in 2019-2020)
- Mid stream project

ONHYM

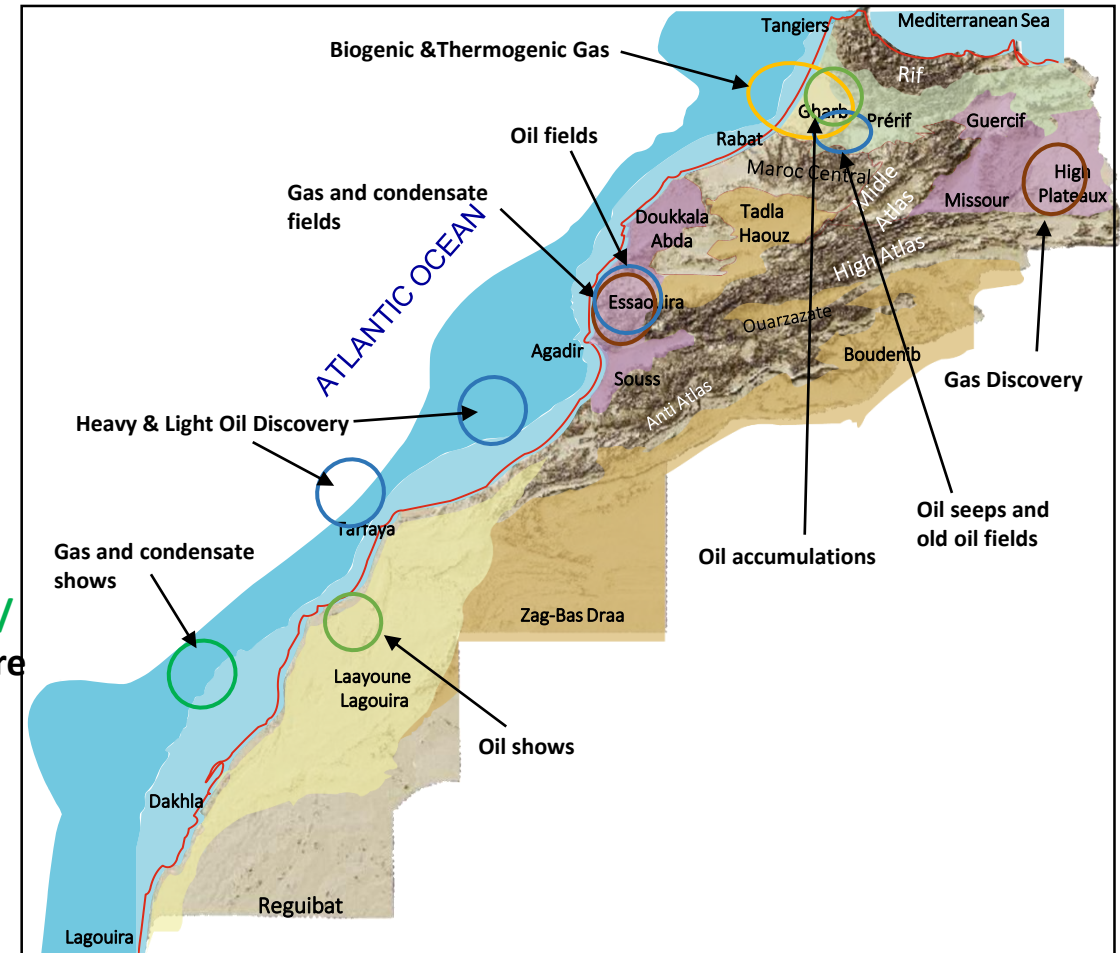
- Reservoir distribution studies & geochemical modelling
- G&G Evaluation of the open blocks
- Data room organization in ONHYM Offices (12 data room in 2019)

PROJECTS ONHYM/E&P INDUSTRY PARTNERS

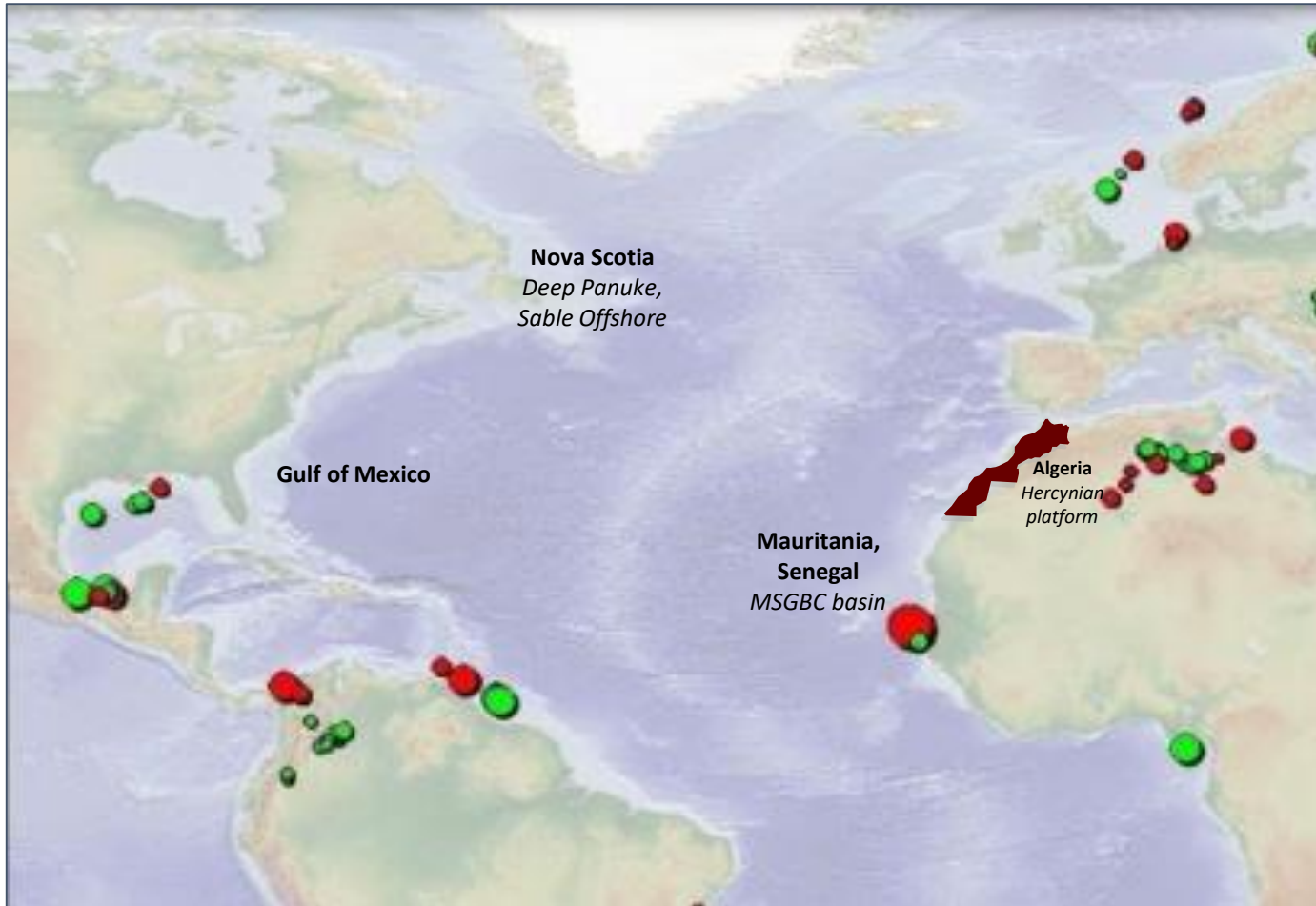
- Cooperation with universities and Groups of Research (NARG, IMAGE, Colorado School of Mines, ...)
- Cooperation with OERA & DOEM from Nova Scotia
- Seismic Reservoir Characterization in Offshore Agadir (CGG)

OFFSHORE & ONSHORE MOROCCO : PETROLEUM SYSTEMS

- The petroleum systems are widely extended in stratigraphic time from Paleozoic into Tertiary. These are proven in the Onshore and Offshore Moroccan sedimentary basins through hydrocarbon occurrences (discoveries, shows, surface oil seeps). The main peers are:
 - **Palaeozoic petroleum systems (Silurian/Triassic & Silurian/Ordovician-Devonian):** e.g. Meskala gas & condensate field and High Plateaux gas discovery
 - **Jurassic petroleum systems (Toarcian-Callovian/ Jurassic):** e.g. oil fields in the rides prerifaines & Essaouira and oil discovery in the Offshore
 - **Lower cretaceous petroleum systems (Jurassic-Lw. Cretaceous/ Lw. Cretaceous):** e.g. oil and gas shows encountered in Offshore Atlantic
 - **Upper cretaceous petroleum systems (Cenomanian-Turonian/Upper Cretaceous-Tertiary):** e.g. Ain Hamra oil accumulation and oil shows in the Onshore
 - **Tertiary petroleum systems (Tertiary/Tertiary):** e.g. biogenic gas fields in Gharb basin



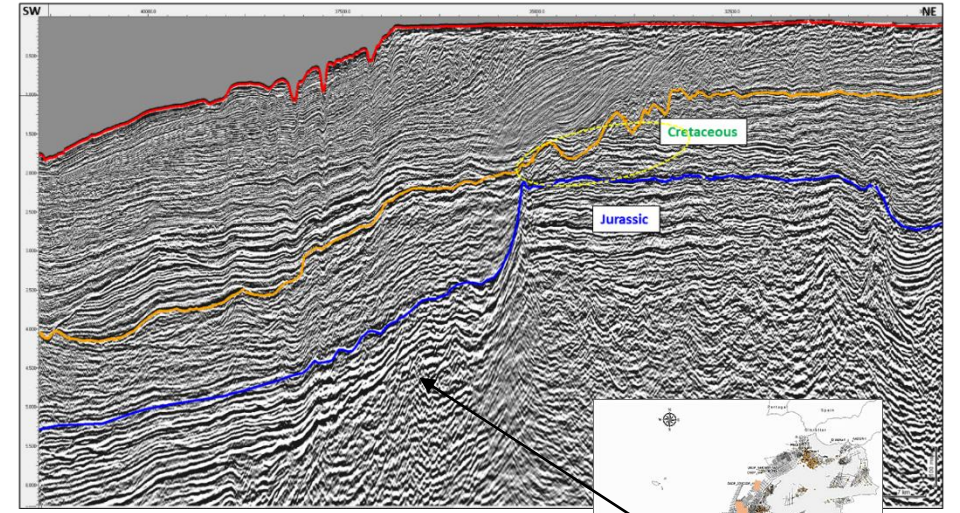
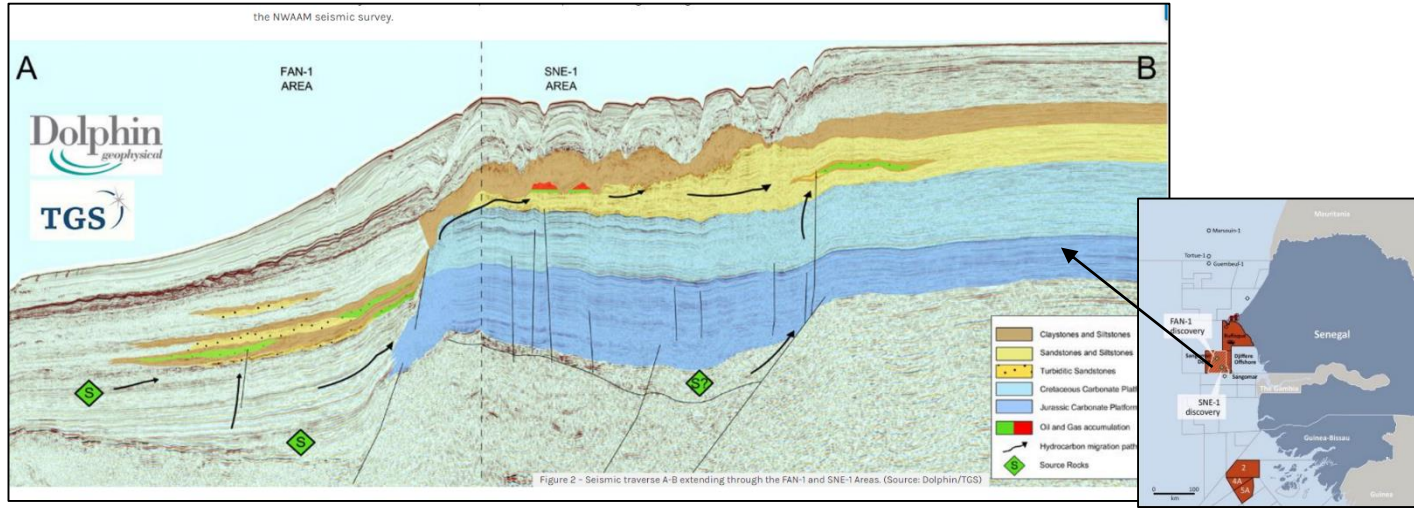
ANALOGIES WITH MAJOR RECENT DISCOVERIES



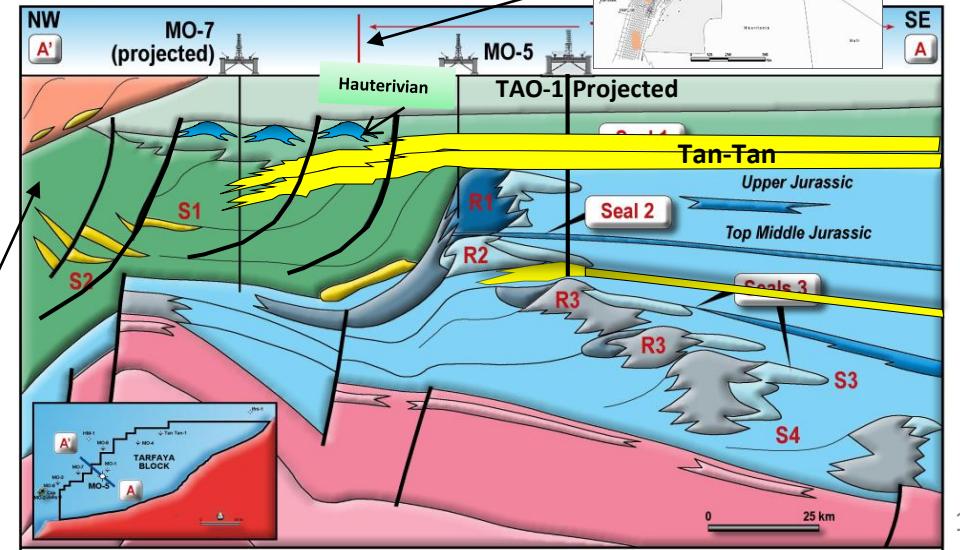
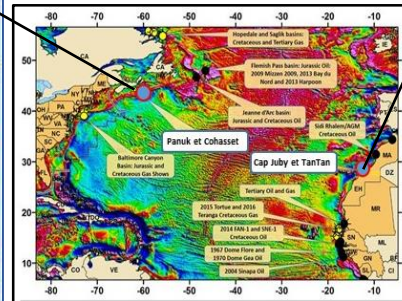
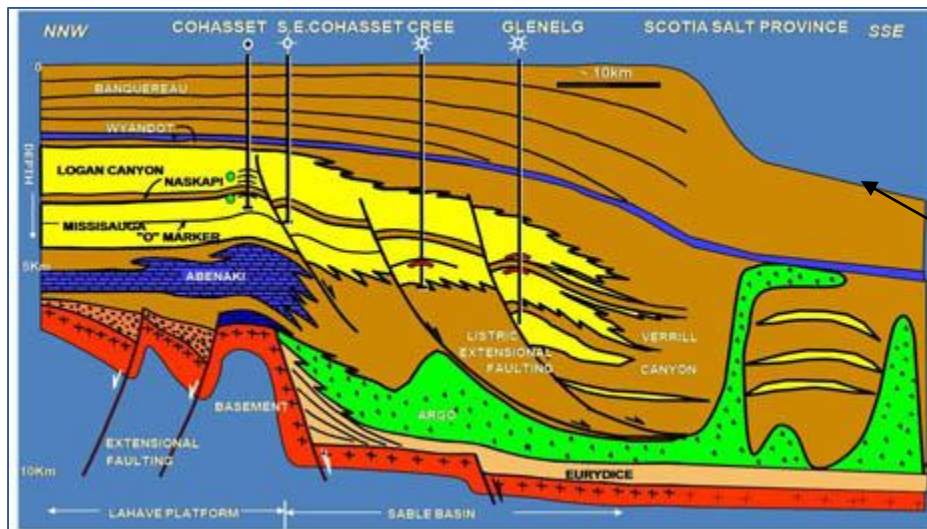
- Morocco basins have **analogies with many recent discoveries** and some of the biggest producing fields in the world.
- Continuity of the **Algerian Triassic Province** and the **Saharan Hercynian platform** in Eastern Morocco.
- Morocco is part of the **Atlantic Mesozoic - Cenozoic Passive Margin** where recent big discoveries have been made (MSGBC Basin).
- **Nova Scotia analogies** : Sable basin and Deep Panuke field.
- **Gulf of Mexico** in terms of salt tectonics.

ANALOGIES WITH MAJOR RECENT DISCOVERIES

MSGBC BASINS

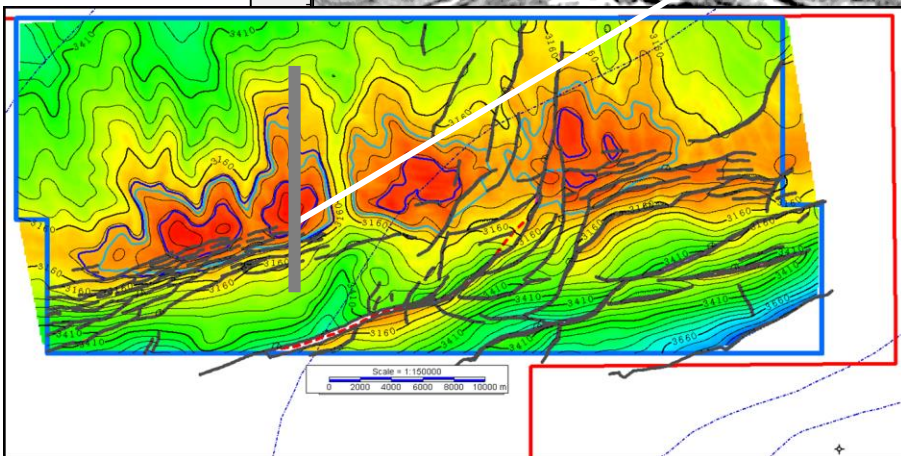
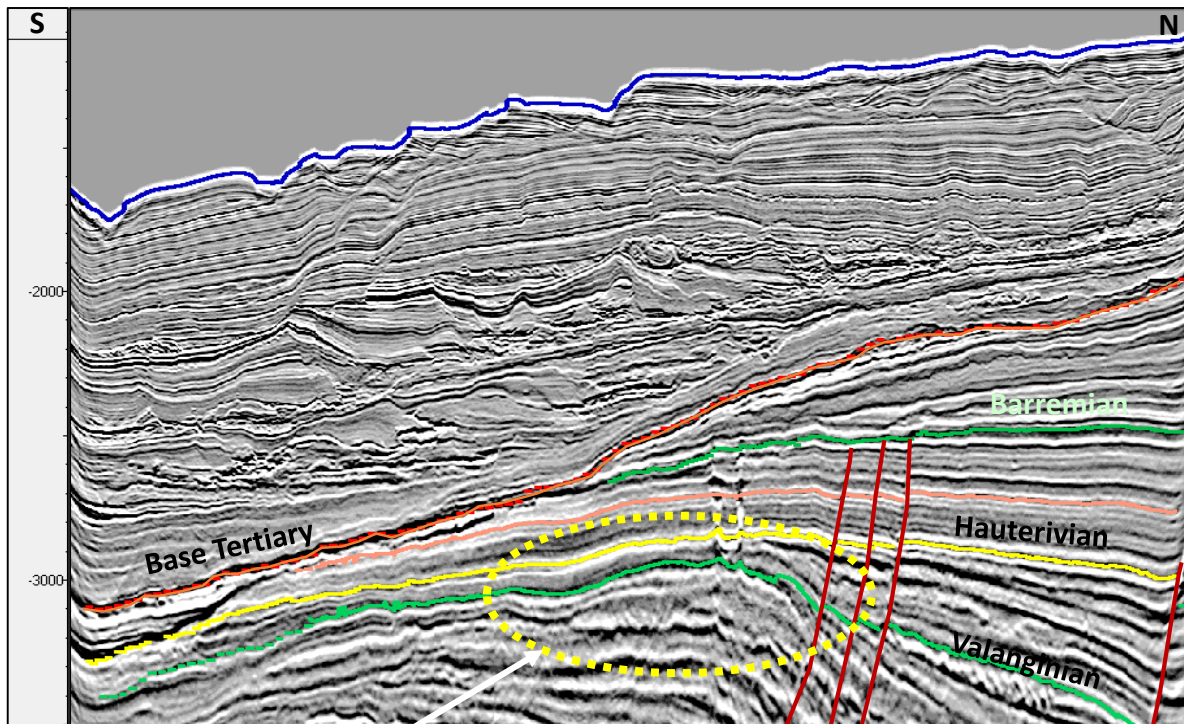


ATLANTIC CONJUGATE MARGINS

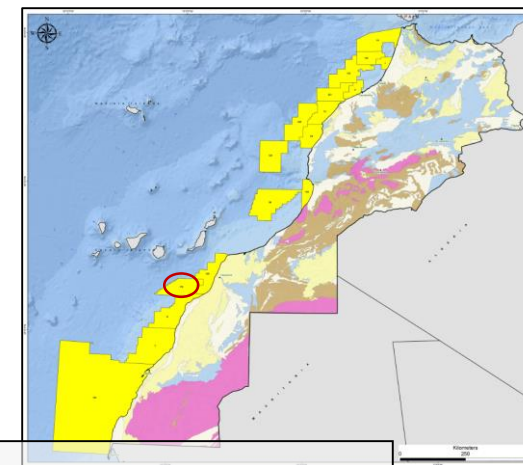


OFFSHORE ATLANTIC MOROCCO : SLOPE ROLLOVER PLAY

LARGE VALANGINIAN 4-WAY CLOSURE WITH GAS PIPES



PROSPECT	
Water Depth (m)	1250
Closure (Km ²) (mean)	43
STOIIP (mean) (MMbbls)	1,556
Recoverable resources (mean) (MMbbls)	470



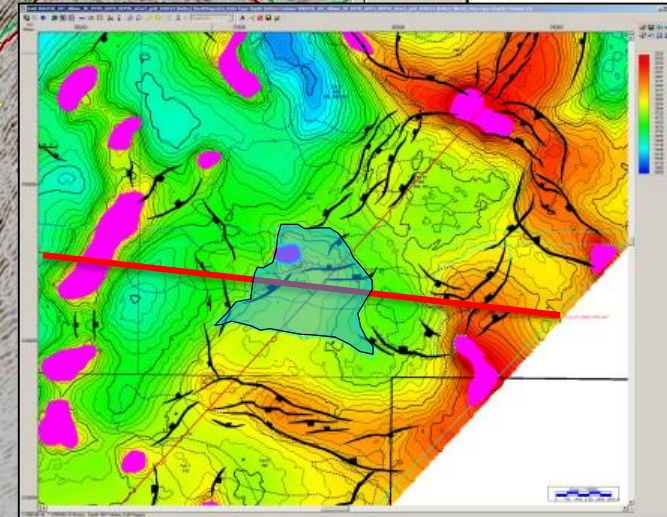
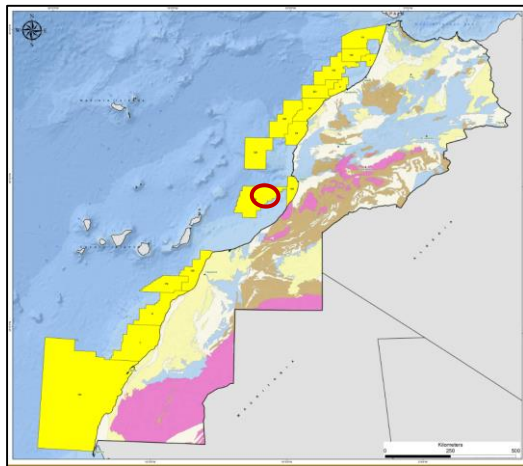
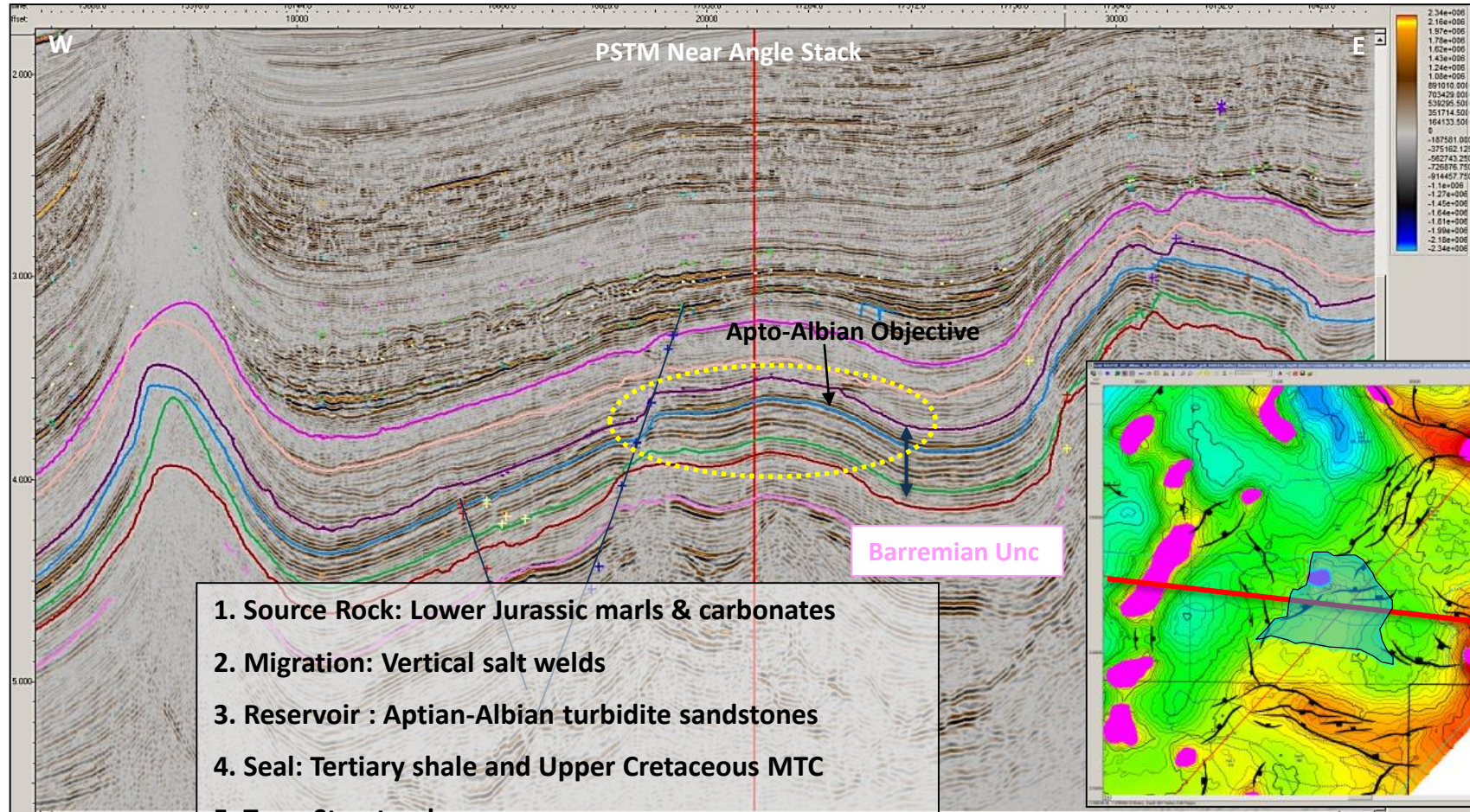
1. Source Rock: Callovian and Toarcian marls & shales
2. Migration: Vertical pathway through faults
3. Reservoir: Valanginian sands
4. Seal: U. Cretaceous & Tertiary Marls & shales
5. Trap: Structural (3 to 4-way closures)

OFFSHORE ATLANTIC MOROCCO : SALT RELATED PLAY

LOWER CRETACEOUS SALT RELATED STRUCTURE (UNTESTED OBJECTIVES)

- Sand bearing Inverted minibasins would be the focus in the next phase of the exploration in the salt province (example of Apto-Albian fan complex).

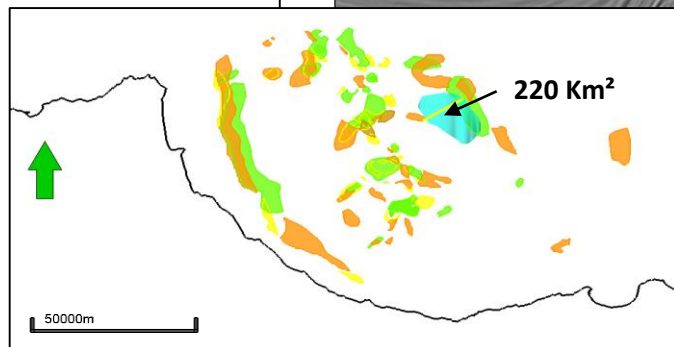
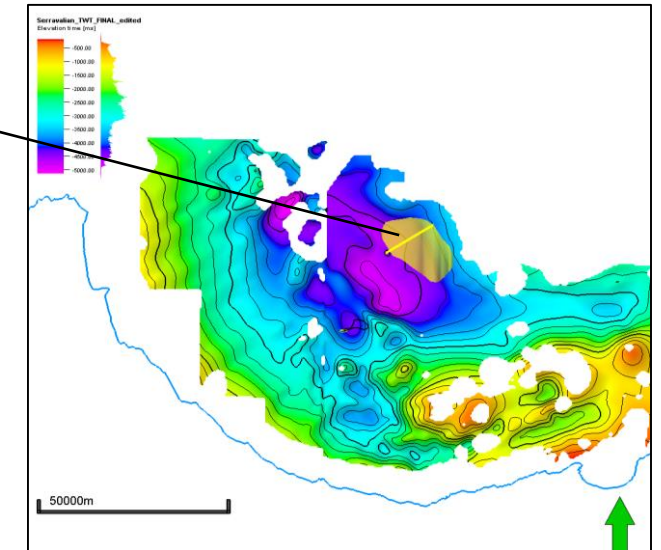
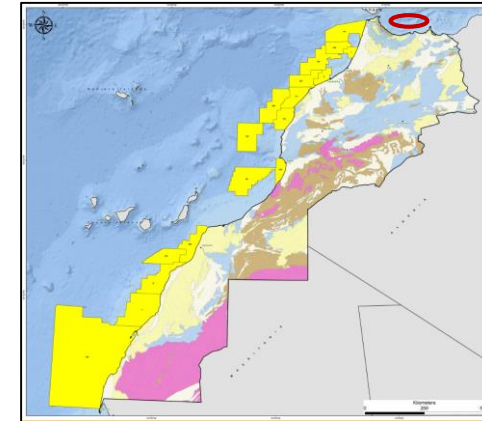
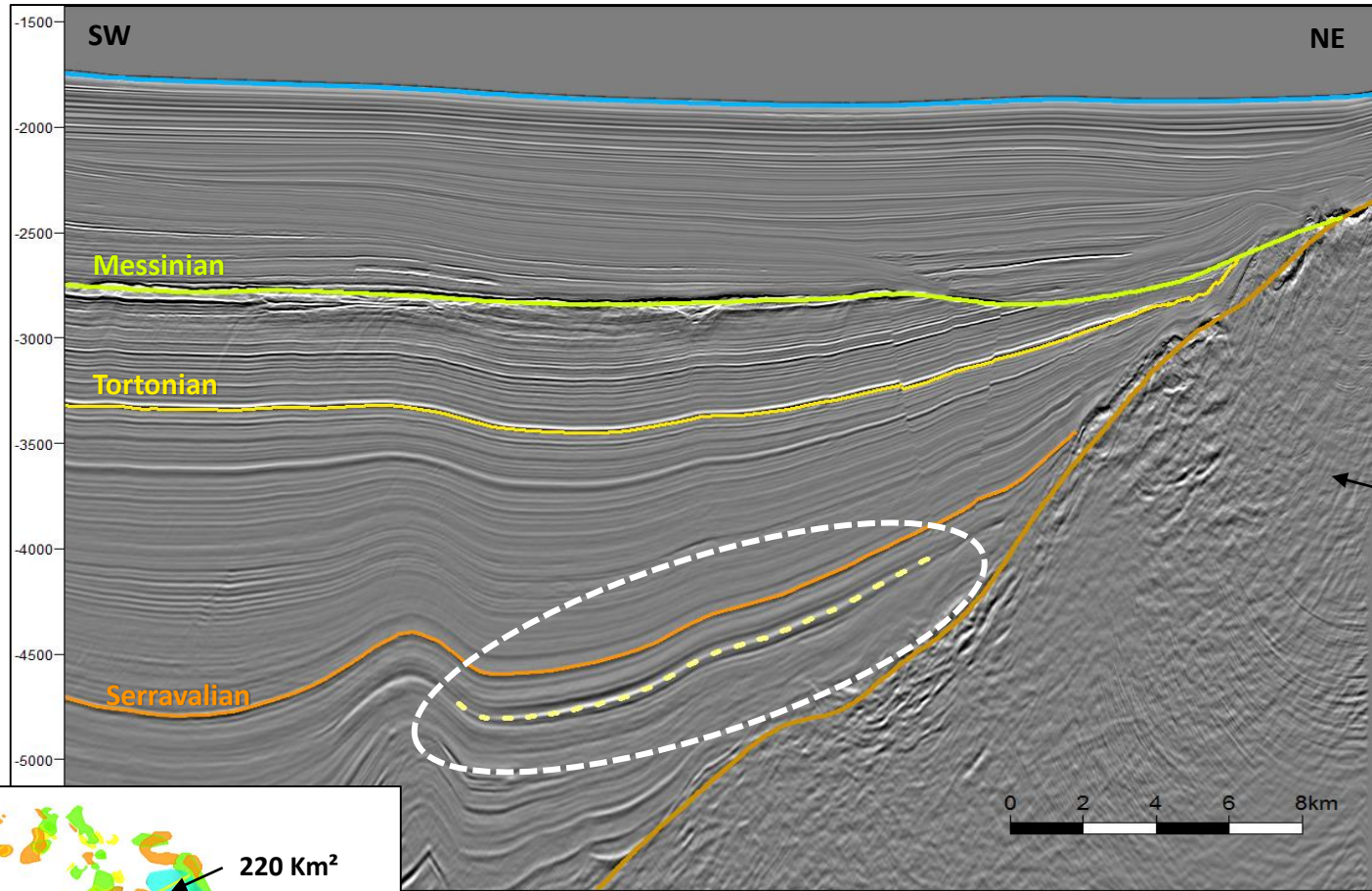
PROSPECT	
Water Depth (m)	975
Closure (Km ²) (P10)	57
P mean Resources (MMBO)	871



1. Source Rock: Lower Jurassic marls & carbonates
2. Migration: Vertical salt welds
3. Reservoir : Aptian-Albian turbidite sandstones
4. Seal: Tertiary shale and Upper Cretaceous MTC
5. Trap: Structural

OFFSHORE MEDITERRANEAN MOROCCO : HYDROCARBON PLAYS

SERRAVALIAN TURBIDITE LOBE



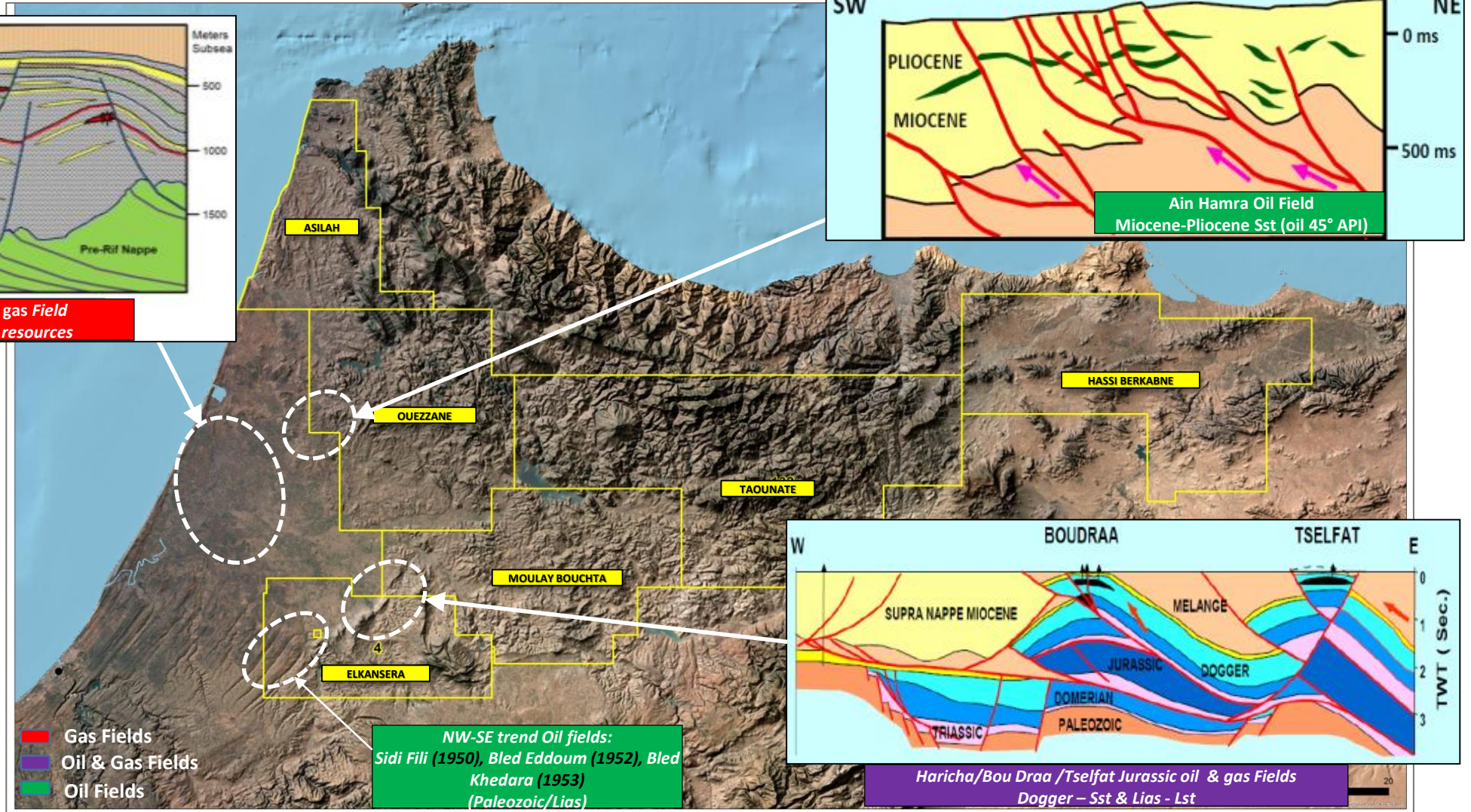
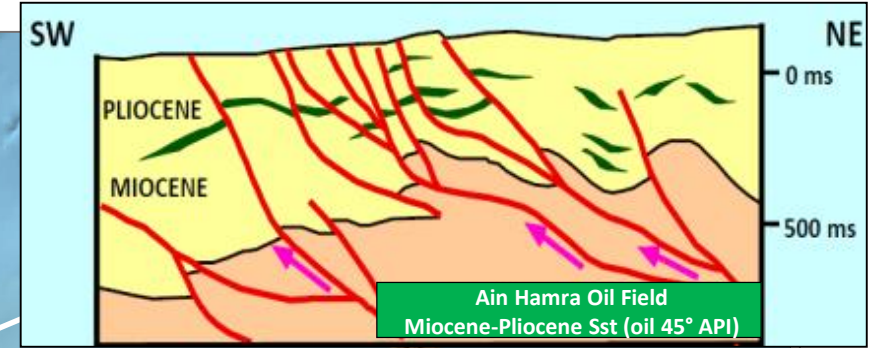
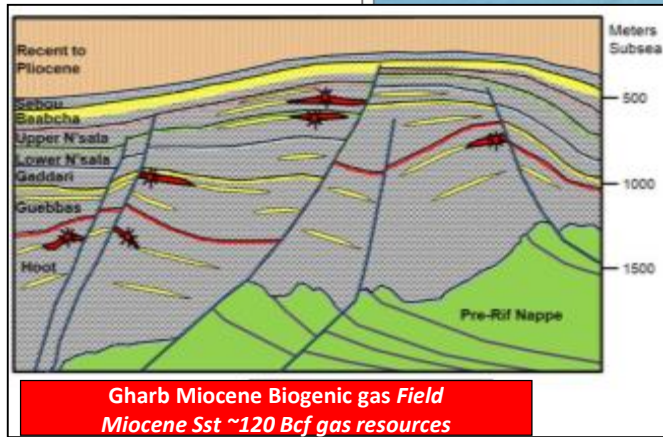
220 Km²

PROSPECT	
Water Depth (m)	1300-1600
Closure (Km ²) (P10)	200-220

1. Source Rock: Paleogene/ Early to Middle Miocene age
2. Migration: Vertical
3. Reservoir: Serravalian turbidite sandstones
4. Seal: Tertiary interbedded Marls & shale
5. Trap: Stratigraphic

ONSHORE MOROCCO : HYDROCARBON PLAYS

WORKING/PROVEN PLAYS IN THE PRE-RIF BASIN



Objectives:

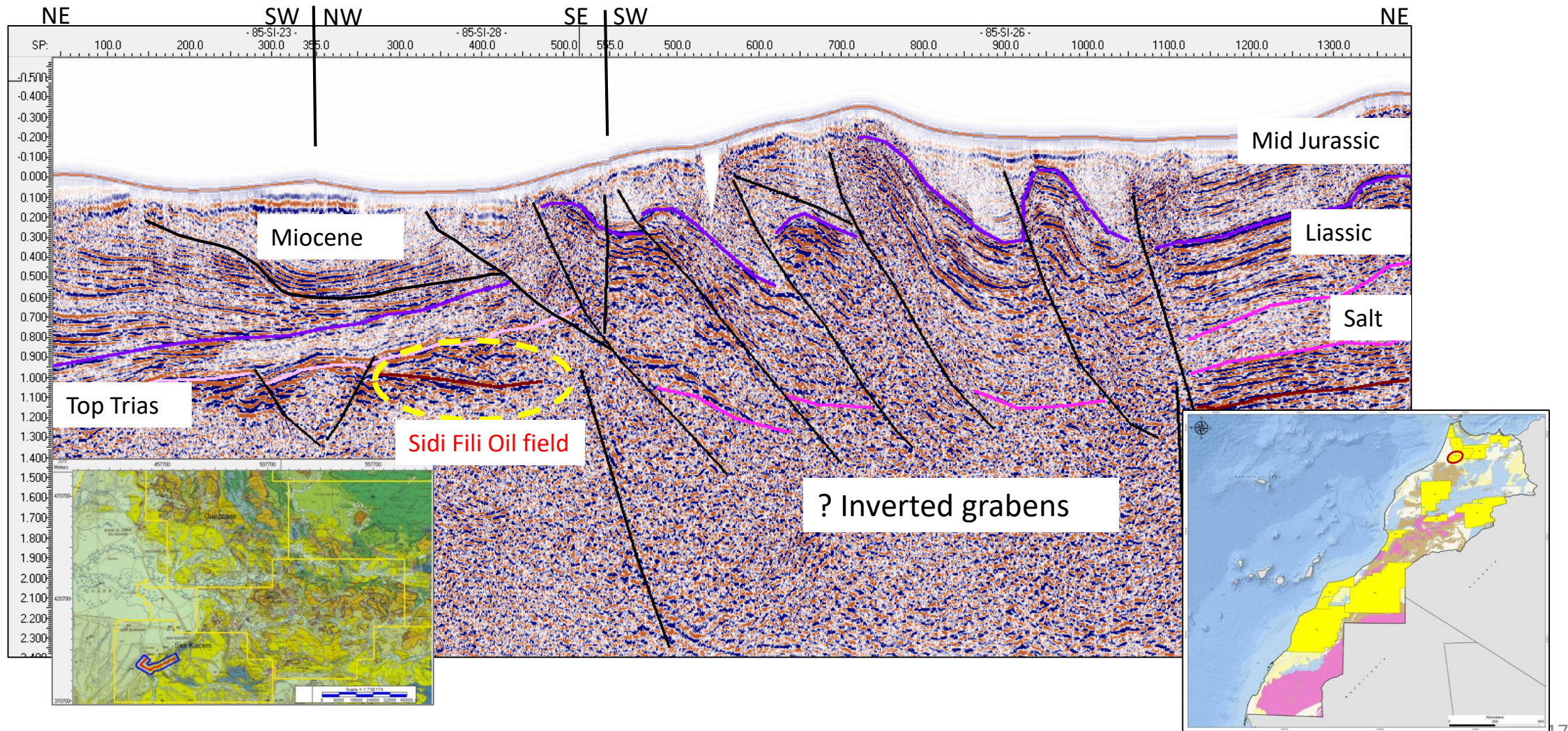
Tertiary sandstones & Jurassic carbonates and sandstones

Source Rocks:

Cenomanian-Turonian & Toarcian

ONSHORE MOROCCO : THRUST RELATED PLAY

OVERTHRUST AND SUBTHRUST UNTESTED STRUCTURES



ONSHORE MOROCCO : PALAEOZOIC PLAY

PALAEOZOIC STRUCTURES (UNTESTED OBJECTIVES)

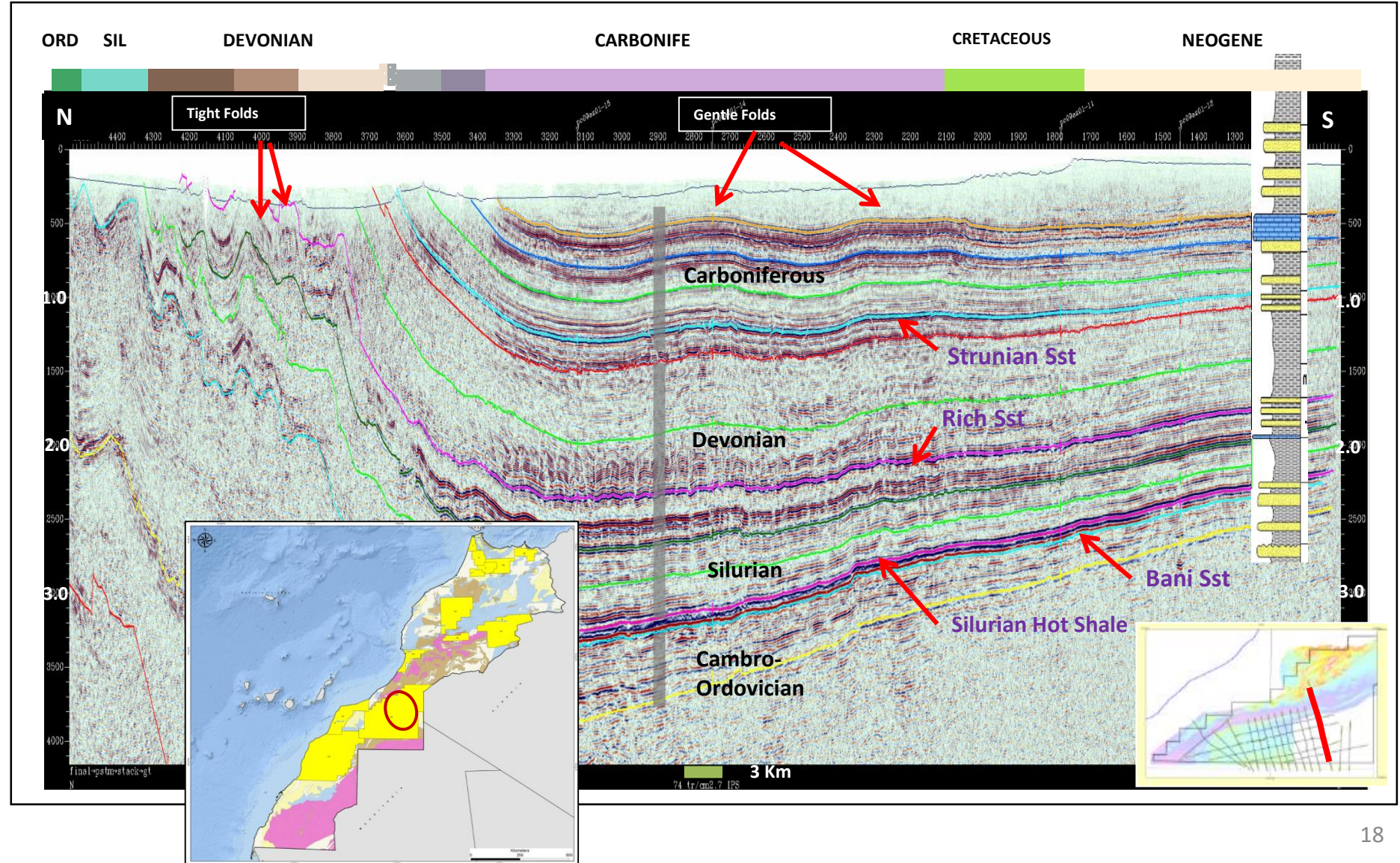
Objectives:

Strunian sandstones &
Lower Devonian sandstones
(Rich formation) &
Ordovician sandstones (Bani
formation)

Source Rocks:

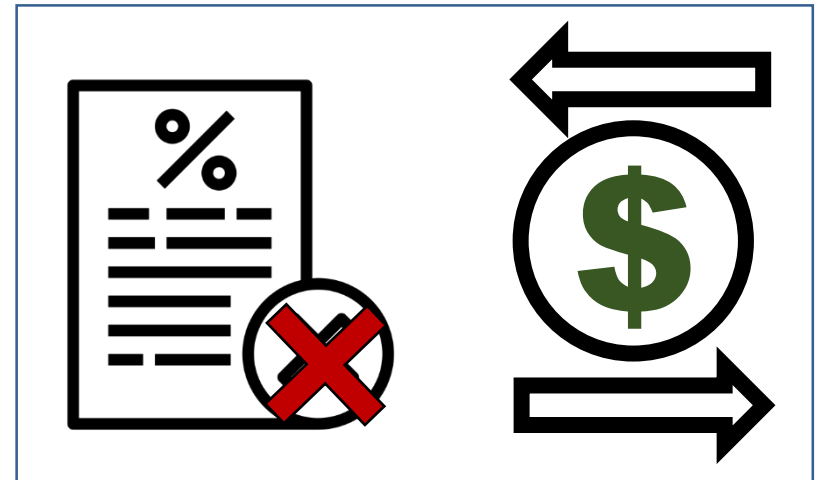
Silurian hot shales and
Frasnian shales

Total Gas Recoverable
Resources (**Lower
Carboniferous and Lower
Devonian**) : 1.45 TCF



MOROCCO HYDROCARBON EXPLORATION INCENTIVES

- **Favourable Geology** for oil and gas exploration and production
- Still largely **underexplored** onshore and offshore basins
- Play concepts with **analogues** to those identified in North Africa, Nova Scotia, West Africa and the Gulf of Mexico
- **Myriad of prospects and leads**. The so far drilled wells have discovered modest local hydrocarbon to prove existence of working petroleum systems
- **Favourable** and attractive **terms**
- **An easy place** to operate and an **outstanding opportunities**.





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