Hydrocarbon Exploration in Morocco: Current Activities and Opportunities

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O N H Y M

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Outline

- Background
- Hydrocarbon potential of Morocco
- Non-Conventional Hydrocarbon Resources
- Preliminary results
- Summary

Background

- Gateway to Europe
- Casablanca : Regional business and air hub
- Well developed Human Resources
- Strong entrepreneurial culture
- Strong economy
- Robust infrastructure

Background

- Stable modern and secure country
- Elected pro development government
- Open door policy to investors
- Offering most attractive fiscal terms
- Providing investors by improving business climate

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Hydrocarbon Potential of Morocco

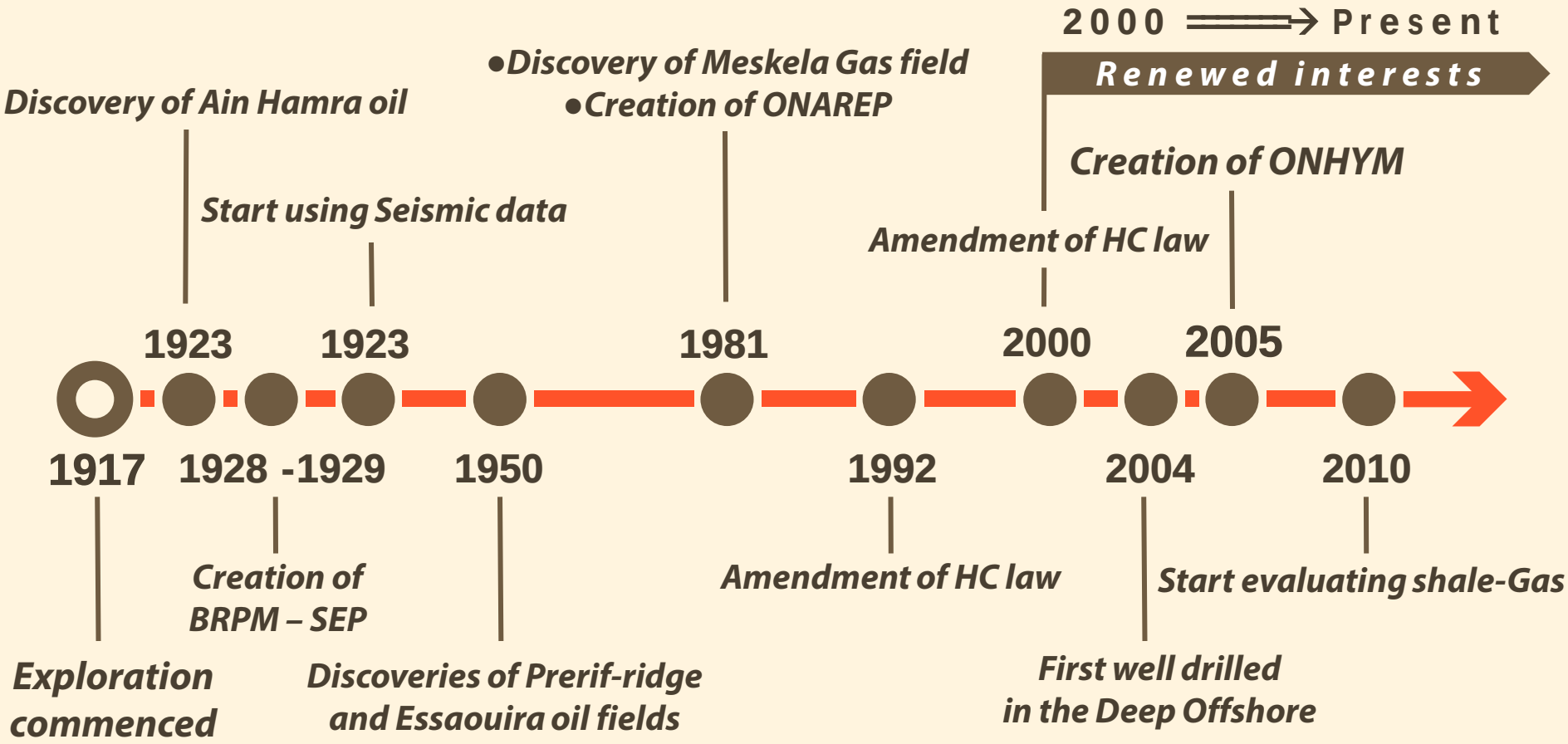
Sedimentary Basins

- **Onshore**
  - **More than 85% Sedimentary cover**
  - **Objectives ranging from Precambrian to Neogene**
- **Offshore**
  - **Atlantic and Mediterranean**
  - **Objectives ranging from Paleozoic to Neogene**

Wherever adequately explored Moroccan Sedimentary Basins have produced Hydrocarbons

Hydrocarbon Potential of Morocco

Exploration History



Hydrocarbon Potential of Morocco

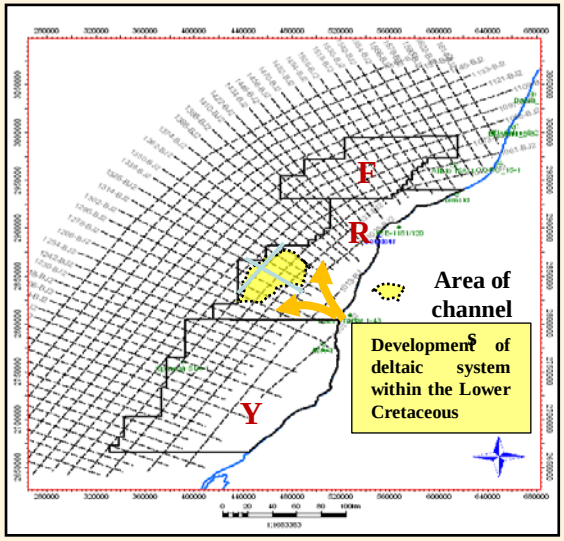
Data-base

- 200 000 km of 2D seismic
- 22 000 sq km of 3D seismic
- +300 Exploratory wells
- Oil seeps
- Oil shows in most wells

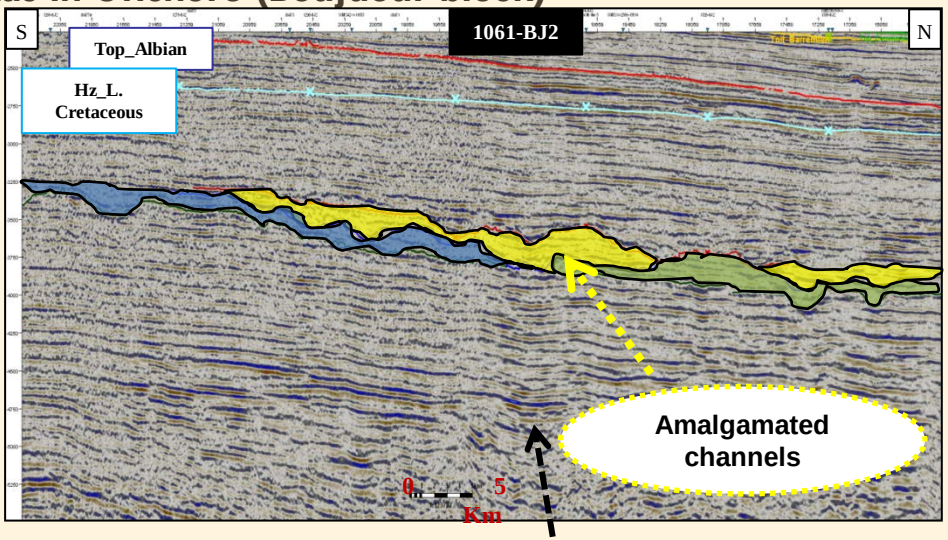
All the data acquired are
well preserved and managed

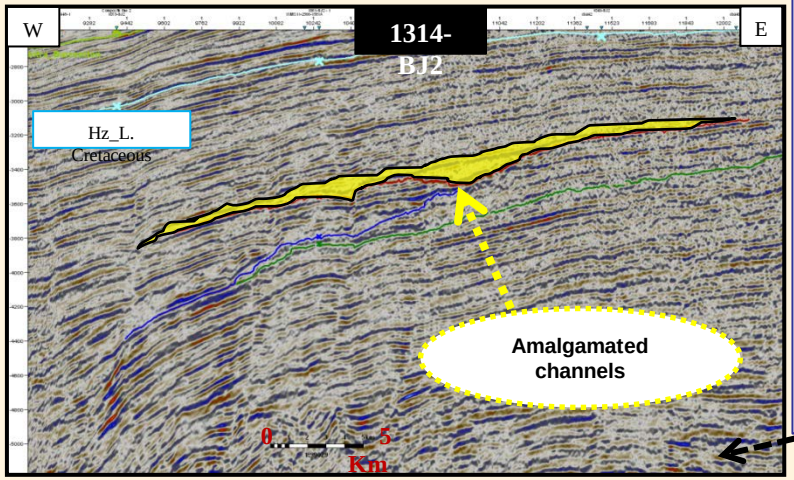
Conventional Hydrocarbon Resources

Offshore Basins

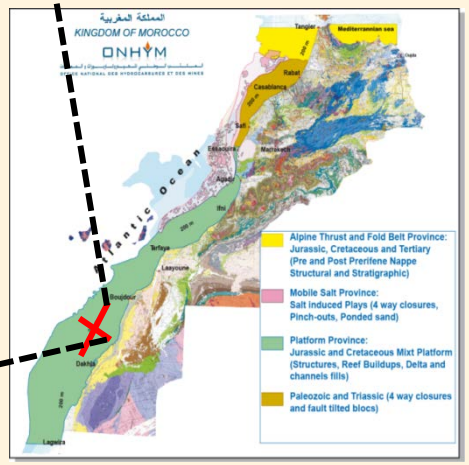


Examples of play concepts : Lower Cretaceous leads in Offshore (Boujdour block)



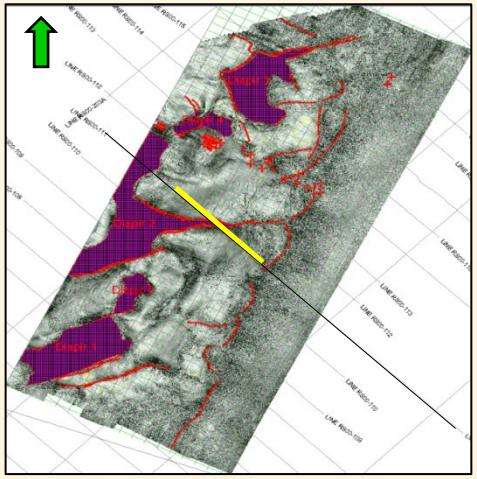


- Traps : Stratigraphic (Amalgamated Channels)
- Reservoirs: Lower Cretaceous sandstones
- Source rocks: Aptian and Jurassic
- Seals: Tertiary & Upper Cretaceous marls and shales

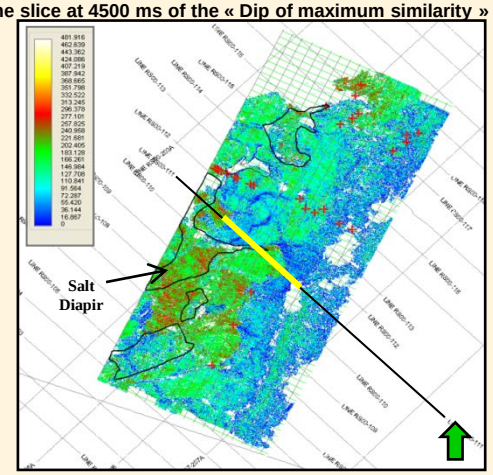


Conventional Hydrocarbon Resources

Offshore Basins

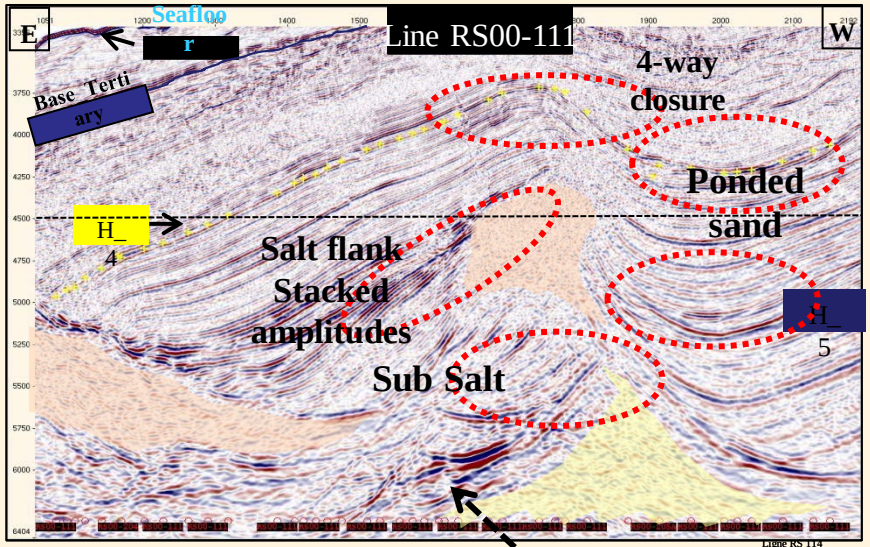


Time slice at 4500 ms of the « Dip of maximum similarity » attribute

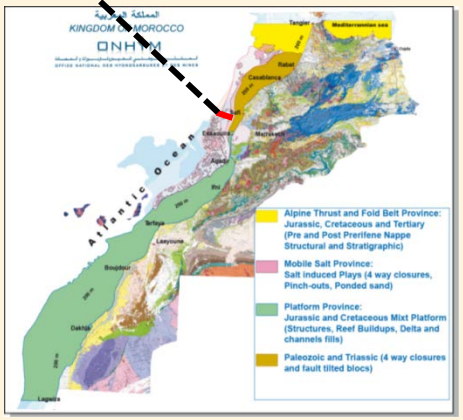


«Shale indicator» attribute map extracted at the Lower Cretaceous (H_5)

Examples of play concepts : Lower Cretaceous leads In Offshore (Safi block)



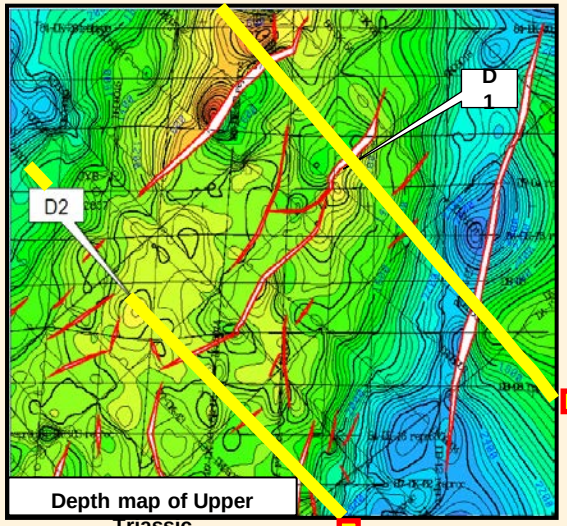
- **Traps:**
  - Structures related to salt tectonics
  - Stratigraphic: ponded sand
- **Reservoirs:**
  Lower Cretaceous sandstone turbidites
- **Source rocks:**
  Aptian and Lower Jurassic (Toarcian)
- **Seals:**
  Upper Cretaceous marls & shales



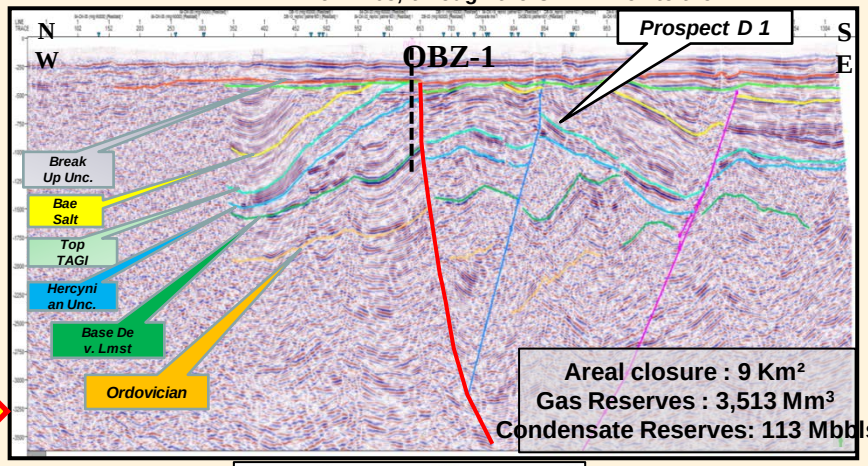
Conventional Hydrocarbon Resources

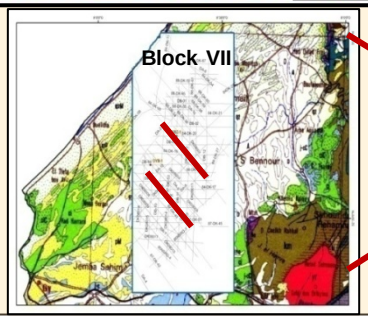
Onshore Basins

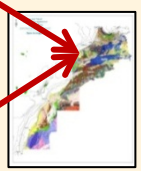
Examples of play concepts : Triassic prospects in Onshore (Abda block)

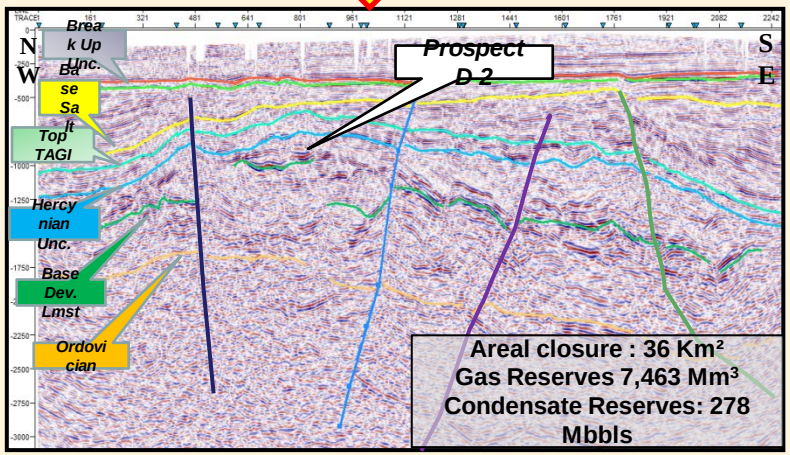


Line DA-05, through the OBZ-1 Well to the D1









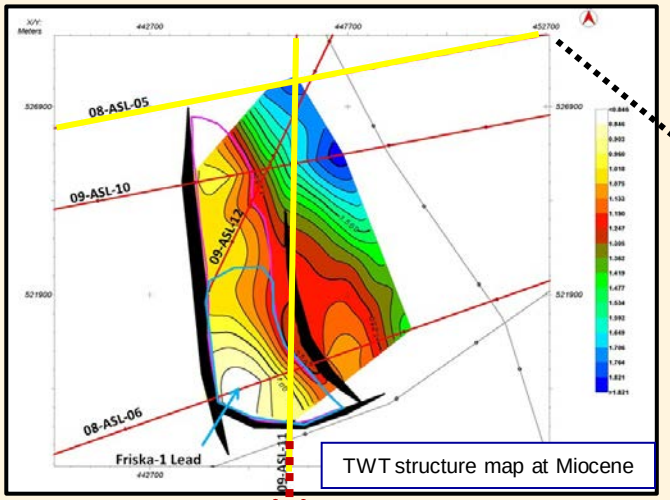
Line DK 080006, through the D2 prospect

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

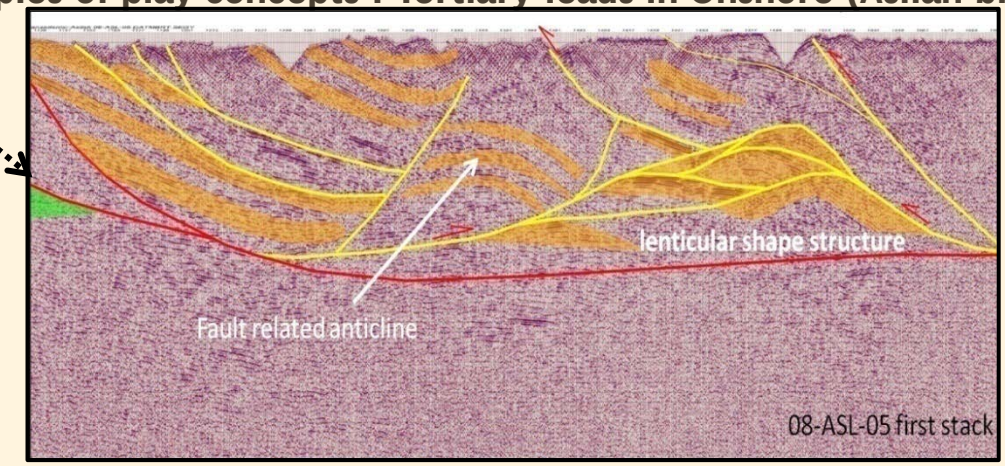
Conventional Hydrocarbon Resources

Onshore Basins

Examples of play concepts : Tertiary leads in Onshore (Asilah block)

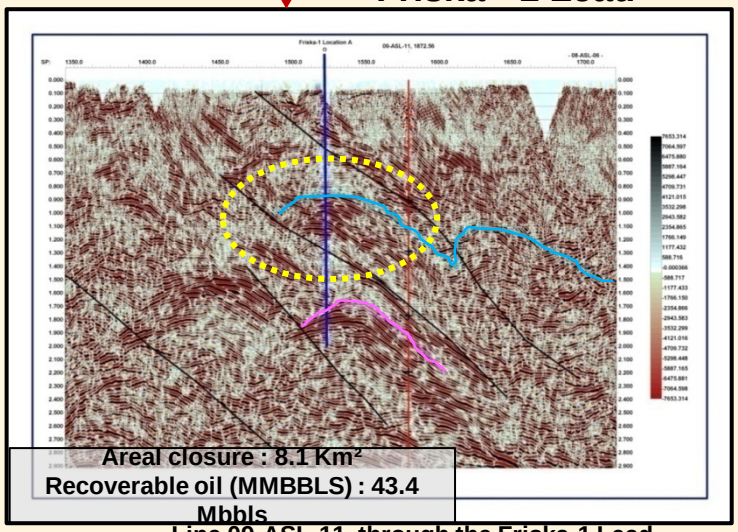


TWT structure map at Miocene



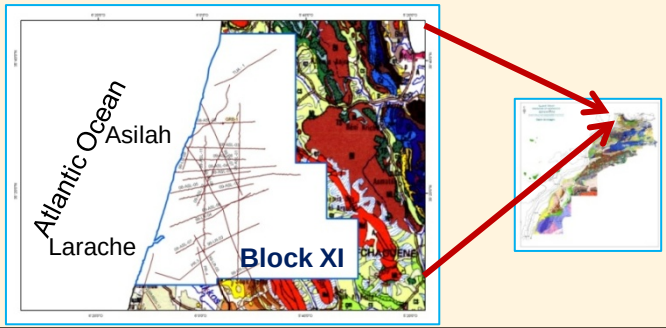
Line 08-ASL-05, imbricated and folded Miocene play concept

Friska - 1 Lead



Areal closure : 8.1 Km²
Recoverable oil (MMBBLS) : 43.4 Mbbls

Line 09-ASL-11, through the Friska-1 Lead



- **Traps : Faulted anticline structures**
- **Reservoirs: Cretaceous & Tertiary turbidites**
- **Source rocks: Cenomano - Turonian Shales**
- **Seals: Tertiary shales**

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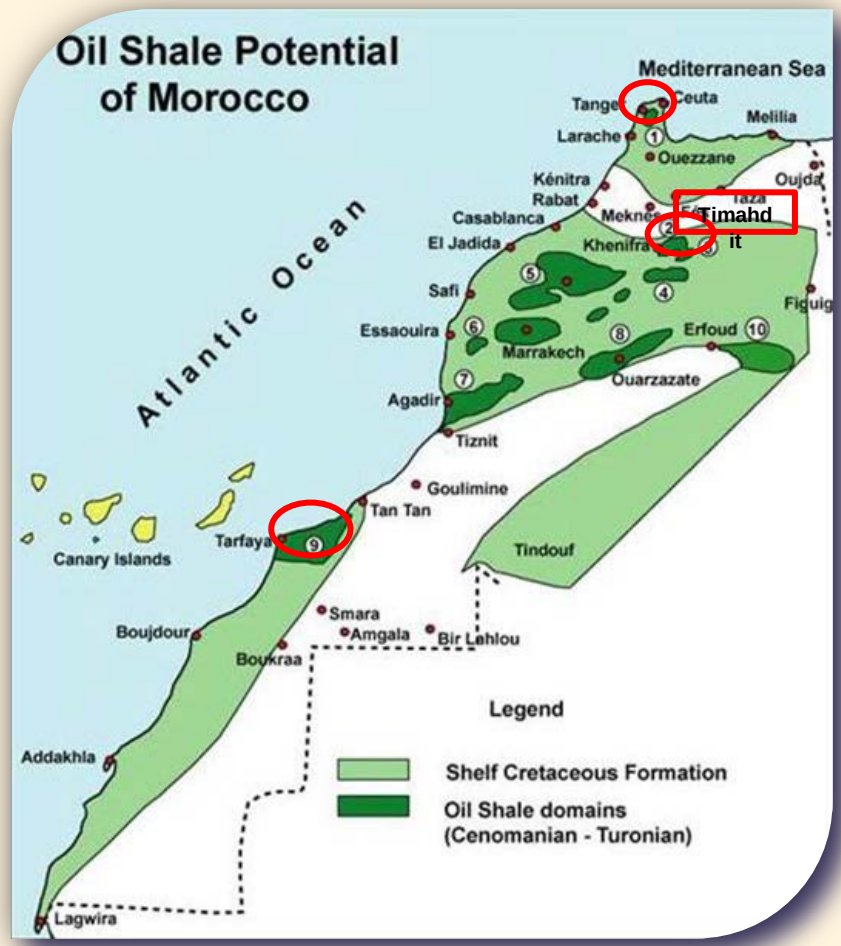
Non-Conventional Hydrocarbon Resources

- Oil Shale
  - In different part of the country
  - 55 bilion barrels of reserves
- Shale Gas and Shale Oil
  - Most Paleozoic formations field Potential
  - First analysis showed encouraging results

Non-Conventional Hydrocarbon Resources

Oil Shale occurrence



- Oil - shale deposits have been identified at ten localities in Morocco (map), the most important of which are Upper Cretaceous . The two deposits that have been explored most extensively are the Timahdit and the Tarfaya deposits ;

- Morocco has important oil reserves contained in the oil shales (approximately 50 billion barrels, just in Timahdit & Tarfaya).

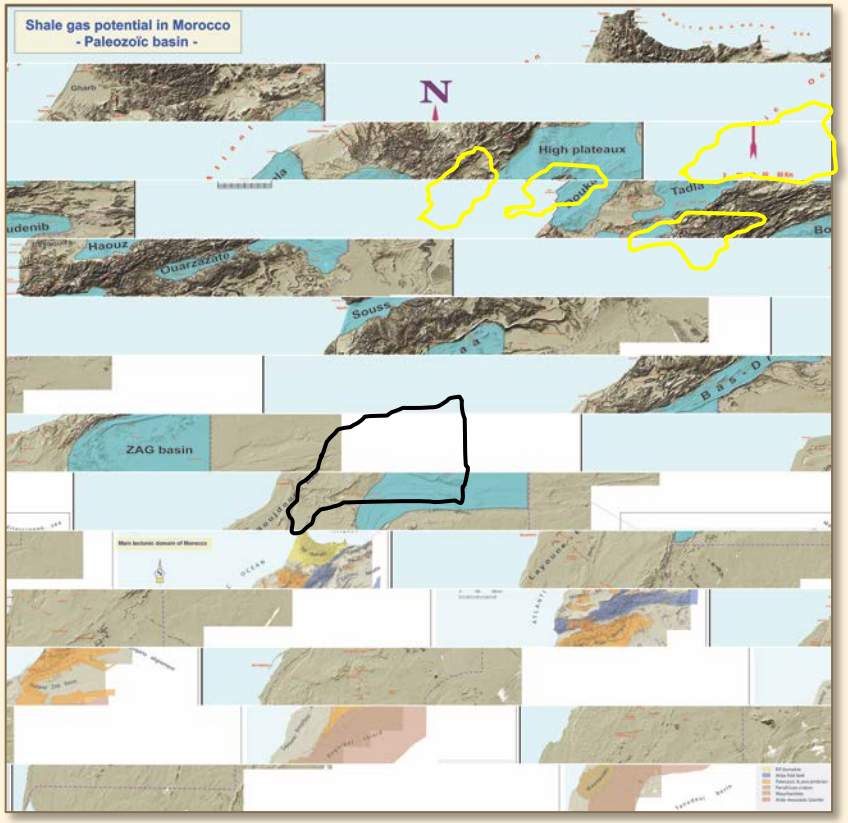
Non-Conventional Hydrocarbon Resources

Shale Gas

- Primary results of the shale gas reservoir evaluations in Morocco are encouraging
- Developing optimal shale gas partnerships: regulatory framework, technology transfer and environmental considerations
- Morocco's rich unconventional resources as a potential new source of Energy in the region

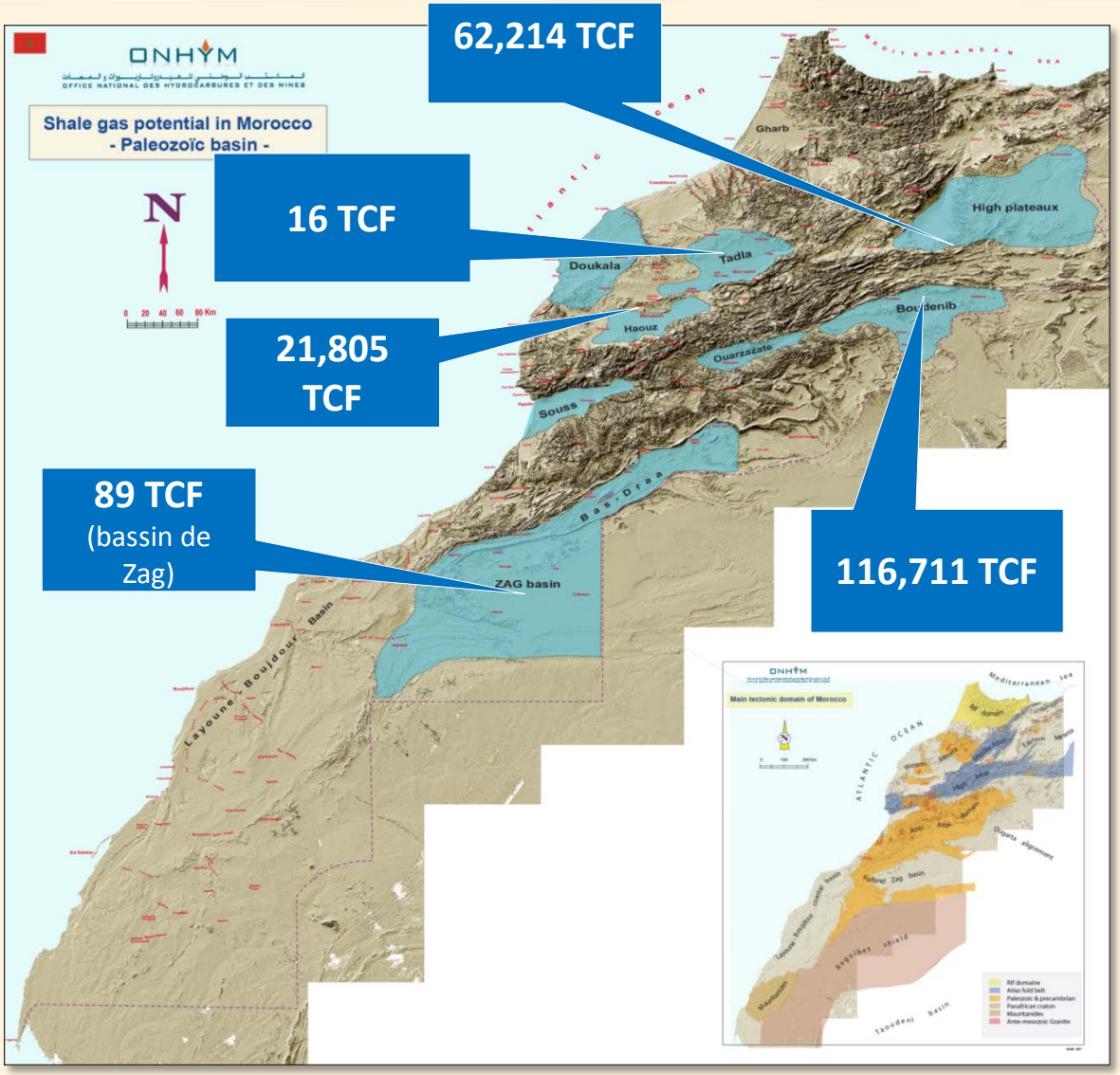
Preliminary results

Paleozoic system



BASIN	AREA (Km²)	FORMATION
Boudenib	34 000	Carboniferous
		Devonian
		Silurian
Tadla	10 000	Carboniferous
		Devonian
		Silurian
Doukkala	8 000	Carboniferous
		Devonian
		Silurian
Zag	65 000	Devonian
		Silurian
High Plateaux	23 437	Carboniferous

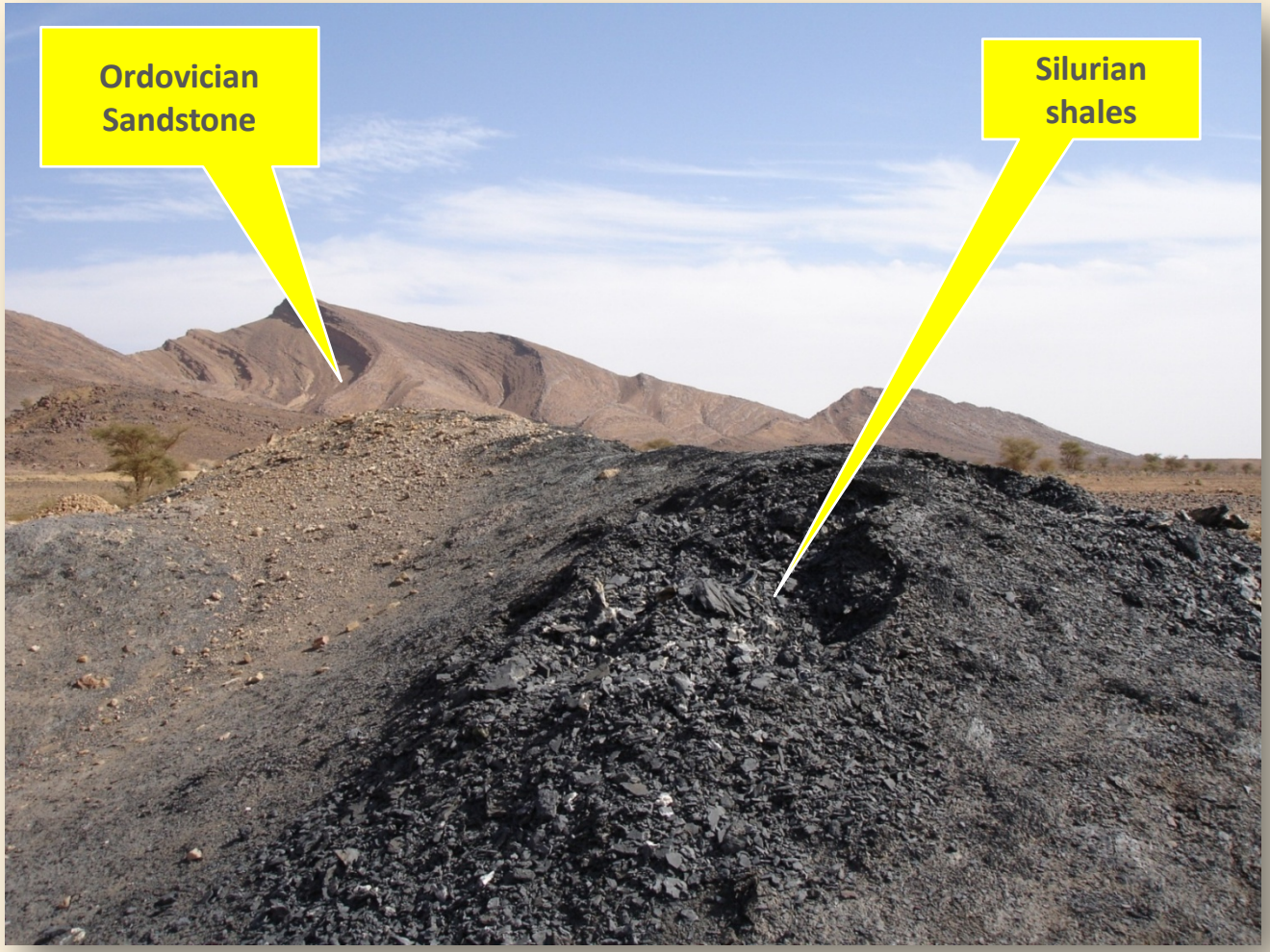
Preliminary results



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

Preliminary results : Silurian shales

(Eastern Anti-Atlas)



Summary

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