Hydrocarbon Exploration in Morocco: Status & Perspectives
Outline

- Conventional HC Exploration;
  - Licensing Status;
  - Exploration ancient objectives and New ones
  - Perspectives;
- Objectives of the Remaining open blocs;
- Unconventional HC Exploration status
- Summary

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Conv. H.C. Licensing Status

Open acreage
- 06 blocks offshore
- 05 blocks onshore

Under negotiation
- 04 blocks offshore
- 09 blocks onshore

PA & RL
- 31 Petroleum Agreements offshore and onshore
- 08 Reconnaissance Licenses (6 onshore and 2 offshore)

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Conv. H.C. Licensing Status

2D and 3D Seismic Acquisitions offshore 1998 - 2013:

Reconnaissance Cycle
- 98 739 Km 2D Seismic
- 35 319 Km² 3D Seismic

Exploration Cycle

Km / Km²

- 30,000.00
- 25,000.00
- 20,000.00
- 15,000.00
- 10,000.00
- 5,000.00
- 0.00


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2D and 3D Seismic Acquisitions onshore since 1998:

- Exploration Development Cycle

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Ancient Exploration Objectives

Ancient offshore exploration

- Reconnaissance phase;
- Had set the bases for advanced exploration;
- Identified myriad of prospects and leads (Over 200);
- Focused on one unique play,
  - Outboard of the central part of the salt province;
  - Salt related Targets;
  - Focused on one unique Source Rock/Reservoir pair (Cenomanian, Turonian).

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Objectives in relation with structural provinces:

- Alpine thrust and fold belt province (Cretaceous and Tertiary)
- Northern Shallow Offshore Province (Paleozoic and Triassic)
- Mobile salt province (Jurassic, Cretaceous and Tertiary)
- Platform and Deep Offshore Province (Jurassic, Cretaceous and Tertiary)
(Source Rocks , Reservoir Rocks) Proven Pairs:

- Alpine thrust and fold belt 
  (Cenomanian,Tertiary)
- Northern Shallow Offshore 
  (Silurian, Devonian) and 
  (Silurian,Triassic)
- Mobile salt province 
  (Toarcian, Cretaceous / Tertiary)
- Platform and Deep Offshore Province 
  (Jurassic, Cretaceous / Tertiary)
Objectives in relation with the Main structural domains:

- The Rif fold and thrust belt (Mesozoic and Tertiary)
- The Meseta domain (Paleozoic, Triassic and Jurassic)
- The Atlas fold belt (Triassic and Jurassic)
- The Anti Atlas and Zag Hercynian domain (Paleozoic)
- The Saharian Coastal basins (Triassic, Jurassic, Cretaceous and Tertiary)
(SR , RR) Pairs: Onshore

Source Rocks-Reservoir Rocks Proven Pairs

- The Rif fold and thrust belt
  (Toarcian , Domairian)
  (Cenomanian , Tertiary)
- The Meseta domain
  (Silurian, Paleozoic)
  (Silurian, Triassic)
  (Oxfordian, Upper Jurassic)
- The Atlas fold belt
  (Silurian,Triassic) and
  (Toarcian, Jurassic)
- The Anti Atlas and Zag basin
  (Silurian , Cambro Ordovician)
  (Silurian, Devonian)
- The Saharian Coastal basins
  (Triassic, Triassic)
  (Toarcian, Jurassic)
  (Cenomanian, Coniancian)
DRILLING
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Conventional Hydrocarbon Resources

Offshore Basins

Example of play concepts: Lower Cretaceous lead in Offshore (Boujdour block)

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

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Conventional Hydrocarbon Resources

Onshore Basins

Example of play concepts: Triassic prospect in Onshore (Abda block)

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

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

Depth map to top Upper Triassic
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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).
Timahdit section

Timahdit Upper Cretaceous oil shale: Up to 250m thick
interval in an area of 900 Km$^2$
Unconventional Hydrocarbons: Shale Gas

- 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.
Paleozoic system

Three potential formation intervals:

- Carboniferous TOC 1-2 %;
- Devonian TOC 1-5.3 %;
- Silurian TOC 1-12 %;

Unconventional Hydrocarbons: Shale Gas

Upper Silurian Source Rock maturity

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• Between 1998 and 2005, ancient Hydrocarbon exploration, in the Moroccan offshore have set, the bases for advanced exploration in frontier areas;
• It was focused one unique play;
• Exploration drilling activity, although limited, have contributed to the understanding Petroleum Systems;
• Present day exploration is looking at plays of different types, ranging in age from Paleozoic to Tertiary and associated with different proven (SR,RR) pairs;
• In terms of unconventional hydrocarbons, preliminary studies indicate that the Moroccan basins have a good potential and are worth to be explored in depth.
Summary

Future exploration orientations

- Resumption of intensive exploration of the untested plays, both onshore and offshore;
- Reevaluation and upgrade of the previously identified prospects and leads to go ahead for drilling;
- Acquisition of high quality seismic data and use of new reprocessing techniques and modeling, to accurately assess and test the delineated plays and prospects;
- Intensive exploration programs to prove the unconventional hydrocarbon potential of the Moroccan basins.