Prospectivity of the Portuguese Deepwater Areas within the Context of the Afro-European East Atlantic Province*

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Abstract

The eastern coast of the Central and North Atlantic is being looked as a promising region for deepwater oil and gas exploration, including the deep offshore areas of Mauritania and Morocco, in Northern Africa, and Portugal and Spain in Western Europe. In Mauritania, the Coastal Basin extends into deep offshore, presenting important Tertiary leads, with some producing areas (Chingueti Field) and several prospects with significant oil and gas shows. In Western Morocco, several deep offshore leads have been identified, with two main source rocks (Toarcian and Aptian) and Lower Cretaceous reservoirs. The Portuguese deep offshore presents two distinct sectors, one facing the North Atlantic and the North-American coast and another along the connection between the Mediterranean and the Atlantic, facing the Northern Morocco coast. The Western Iberian margin resulted from the Western Tethys and N. Atlantic evolution, with a thick Late Triassic to Neogene infill. Along its 1,000 km long N-S section, some important differences may be noted in the timing of the main rift events and both Mesozoic and Cenozoic sediment thicknesses. Seismic scale observations suggest an earlier and more pronounced rifting with Tertiary subsidence and infill in the Southern sector (offshore Alentejo Basin). The Northern Sector (Peniche Basin) seems to have a more recent rifting and less recent subsidence and infill. This contrast may point to a better development of the Cretaceous-Cenozoic play in the south, related with the Mediterranean and North African mainly Tertiary play, and of the Jurassic play in the north, related with a North Atlantic mostly Jurassic play. At the southern Portuguese margin (Algarve Basin), two superimposed basins may be considered - a L. Triassic to E. Cretaceous Tethys related basin and a L. Cretaceous - Neogene Betic-Guadalquivir related basin. In the deep offshore, both Mesozoic and Tertiary plays may be active. The Portuguese deep offshore is part of a larger deepwater province, where two main plays are well represented: i) a Mesozoic play with different source-rocks (E. Jurassic, L. Jurassic and U. Cretaceous?) and mainly E. Cretaceous reservoirs; and ii) a Tertiary play with the same source-rocks and Cenozoic reservoirs. The detailed knowledge of the source-rocks and its maturation, as well as the distal extension and properties of the Cretaceous to Tertiary siliciclastics, are therefore crucial to address this deepwater province.
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INTRODUCTION

The Eastern coasts of the Central and North Atlantic are being looked by several companies as a promising region for deepwater oil and gas exploration, including the deep offshore areas of Mauritania and Morocco, in Northern Africa, and Portugal and Spain in Western Europe.

This contribution presents a regional overview of this province, starting with the NW African basins and detailing the Western Iberian Margin's basins. Similarities and differences are discussed within a prospectivity approach.

NW AFRICAN BASINS

In Mauritania, the Coastal Basin extends into deep offshore, presenting important Tertiary leads, with some producing areas (Chinguetti Field) and several prospects with significant oil and gas shows.

In Western Morocco, several deep offshore leads have been identified, considering two main source rocks (Toarcian and Aptian) and Lower Cretaceous reservoirs.

MOROCCO

SOURCE-ROCKS – Mainly Toarcian and Cenomanian-Turonian; also Late Jurassic and Aptian-Albian?
RESERVOIRS – Mainly Late Cretaceous to Miocene siliciclastics; also Jurassic carb.?
TRAPS – Roll-over and salt-related structures

REFERENCE:

Davison, 2005.
WESTERN IBERIAN MARGIN

The Portuguese deep offshore presents two distinct sectors. The Western sector faces the North Atlantic and the North-American coast, including the Porto Basin, Lusitanian Basin and Alentejo Basin. The Southern sector corresponds to the Algarve Basin, along the connection between the Mediterranean and the Atlantic, facing the Northern Morocco coast.

WESTERN BASINS

The Western Iberian margin resulted from the Western Tethys and North Atlantic evolution, with a thick Late Triassic to Neogene infill. Along its 800 km long N-S section, some important differences may be noted in the timing of the main rift events and both Mesozoic and Cenozoic sediment thicknesses. Seismic scale observations suggest an earlier rifting (Late Jurassic) and a more pronounced Tertiary subsidence and infill for the Southern sector (offshore Alentejo Basin), whereas the Northern Sector (offshore Peniche Basin) seems to have a more recent rifting (Early Cretaceous) and less recent subsidence and infill.

This contrast may point to a better development of the Cretaceous-Cenozoic play in the Southern areas, related with the Mediterranean and North African mainly Tertiary play, and of the Jurassic play in the Northern areas, related with a North Atlantic mostly Jurassic play.

SOUTHERN BASINS

At the southern Portuguese margin (Algarve Basin), two superimposed basins may be considered – a Late Triassic to Early Cretaceous Tethys-related basin and a Late Cretaceous – Neogene Betic/Guadalquivir-related basin. In the deep offshore, both a Mesozoic and a Tertiary play may be active.
The Portuguese deep offshore areas present basins with different characteristics, resulting from slightly different evolutions within the same geodynamic context. An integrated analysis of the broader Afro-European East Atlantic Province shows some common features of the Portuguese and the NW African basins, although with different associations.

A Mesozoic and a Tertiary play may be identified in this Province, but its relative importance varies from basin to basin and sometimes even from the proximal to distal part of the same offshore basin. At the Peniche Basin, the Mesozoic Play seems to be predominant, whereas at the Alentejo Basin both Plays may have equivalent importance. At the Algarve Basin, the Tertiary Play is well known in the adjacent Cadiz Basin, but a Mesozoic Play is probably also present.

A compressive up-lifted sector may have affected further Tertiary maturation in the areas closer to the Azores-Gibraltar Fault Zone (Algarve and Northern Morocco?). In all Portuguese basins, salt-corridors should be looked at and salt-related antlines should be looked at with care regarding compression-related fractures and leakage.

A final remark should be done about the hypothesis of the presence of Paleozoic source-rocks feeding Mesozoic and even Cenozoic conventional reservoirs. This hypothesis should be explored and tested in this Province, in which Silurian and Carboniferous black-shales are known in many places.

### SOURCE-ROCKS

<table>
<thead>
<tr>
<th>Region</th>
<th>Source-Rocks</th>
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<tbody>
<tr>
<td>PT - Peniche</td>
<td>Lower and Upper Jurassic - U. Jurassic + L. Cretaceous + Tertiary</td>
</tr>
<tr>
<td>PT - Alentejo</td>
<td>Lower and Upper Jurassic - U. Jurassic + Cretaceous Siliciclastics (Proximal Areas)</td>
</tr>
<tr>
<td>PT - Algarve</td>
<td>U. Jurassic + L. Cretaceous + Tertiary Siliciclastics</td>
</tr>
<tr>
<td>W Morocco</td>
<td>Jurassic and Cenomanian Turritan, Also Late Jurassic and Aptian-Albian</td>
</tr>
<tr>
<td>W Mauritania</td>
<td>Cenomanian Turritan, Also Cretaceous to Tertiary Siliciclastics</td>
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</tbody>
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### RESERVOIRS

<table>
<thead>
<tr>
<th>Region</th>
<th>Reservoirs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT - Peniche</td>
<td>Salt-Diaper + Alpine Compression Antlines</td>
</tr>
<tr>
<td>PT - Alentejo</td>
<td>Stratigraphic + Alpine Compression Antlines</td>
</tr>
<tr>
<td>PT - Algarve</td>
<td>Salt-Diaper Related</td>
</tr>
<tr>
<td>W Morocco</td>
<td>Roll-Overs and Salt-Related Structures</td>
</tr>
<tr>
<td>W Mauritania</td>
<td>Salt-Diaper Related Antlines and Top- Thrusts</td>
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### TRAPS

<table>
<thead>
<tr>
<th>Region</th>
<th>Traps</th>
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<tbody>
<tr>
<td>PT - Peniche</td>
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### REFERENCES


