Sergipe-Alagoas Basin

Elaine Loureiro
Geophysicist
Superintendency of Block Delimitation
• Location and Characterization
• Infrastructure and Operacional Conditions
• Exploration Overview
• Tectonostratigraphic Evolution
• Petroleum Systems
• Plays
• Area on offer
• Final remarks
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  • Final remarks
• Elongated in NE-SW direction with 350 km in extension and 35 km of width onshore
• Total area: 44,370 Km²
• Onshore area: 12,620 km²
• The onshore portion is classified as mature
Location and Characterization

- Western Basement Distensional Faults
- Pernambuco-Paraíba Basin
- Alagoas Sub-Basin
- Sergipe Sub-basin
- Jacuípe Basin
- Northern Boundary: Maragogi High
- Boundary between sub-basins: Jaboatã-Penedo High (onshore and watershallow)
- Southern Estância Platform and Vaza-Barris Faults
Location and Characterization

Pilar Field

Fazenda Guindaste Field

25 Blocks in Alagoas Sub-basin

Total Area: 733 km²

Legend:
- Capitals
- State Limits
- Sector
- Round 11 Blocks
- Sedimentary Basin
- Basement

Total Area: 733 km²
The block are in 9 alagoans municipalities. Considering Maceió city, the population is greater than 1 million of inhabitants.
Agenda

- Location and Characterization
- **Infrastructure and Operacional Conditions**
- Exploration Overview
- Tectonostratigraphic Evolution
- Petroleum Systems
- Plays
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- Final remarks
Infrastructure and Operacional

- 3 Refineries
- 3,821 km of pipelines
- 10 Natural Gas Processing Unit (NGPU)
- Processing capacity of natural gas in the region: 18.5 million m³/day

Source: Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis, 2012
Infrastructure
and Operacional

Legend
- Highways
- Liquid Pipelines
- Gas Pipelines
- Capitals
- NGPU Ports
- R11 Blocks
- T1 Sector
- Airports
- Railways

Porto de Maceió

Source:
http://www.portodemaceio.com.br
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Exploration Overview

- **1935**: Geophysical surveys well 2AL 0001 AL (CNP)
- **1950**: 1st commercial discovery of oil (1TM 0001 AL)
- **1957**: Discovery of Carmopólis Field (SE), with 1.7 Billion bbl of oil in place (onshore)
- **1963**: Discovery of the Guaricema Field (SE) (offshore)
- **1968**:
Discovery of Pilar Field (AL) with 230 millions bbl of oil in place onshore

Petroleum Law and creation of ANP
Round 0

R2 R4 R6 R7 R10
Available Data

- **Alagoas Sub-basin**
  - 361 Exploration wells (332 onshore)

- **Sergipe Sub-basin**
  - 762 Exploration wells (484 onshore)

- 38,715 km onshore 2D lines
- 55,107 km offshore 2D lines
- 1,155 km² onshore 3D surveys
- 8,278 km² offshore 3D surveys
Wells in Sergipe Sub-basin

Wells in Alagoas Sub-basin

Number of wells

Year


Onshore wells

Offshore wells
Production and Development Fields

**Alagoas Sub-basin**

18 Fields in Production/Development

- 17 onshore
- 1 offshore

- 10 Oil Producer
- 7 Gas Producer
- 1 Gas and Oil Producer

**Sergipe Sub-basin**

37 Fields in Production/Development

- 28 onshore
- 9 offshore

- 35 Oil Producer
- 2 Gas and Oil Producer
Evolution of the Total Reserve (onshore)

- **Total Reserve Petroleum (Onshore):**
  - **Sergipe-Alagoas Basin:** 20%
  - **The other basins:** 80%

- **Total Oil Reserve**:
  - **Alagoas Sub-basin**
  - **Sergipe Sub-basin**

- **Total Gas Reserve**

Source: Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis, 2012
Accumulated Production (Oil)

Production: 5 thousand bbl/day (dec/2012)

- Siririzinho: 74 Millions bbl
- Riachuelo: 44 Millions bbl
- Camorim: 38 Millions bbl
- Guaricema: 70 Millions bbl
- Pilar: 46 Millions bbl
- Furado: 24 Millions bbl
- Carmópolis: 361 Millions bbl
- Caioba: 35.5 Millions bbl
Accumulated Production (Gas)

Production: 1,8 Million m³/day (dec/2012)

- Ananbé: 204 Thousand m³
- Furado: 4 Billions m³
- Cidade de São Miguel dos Campos: 2 Billions m³
- São Miguel dos Campos: 2,5 Billions m³
- Pilar: 9 Billions m³
- Tabuleiros dos Martins: 117 Millions m³
- Campo de Coqueiro Seco: 26 Millions m³
- Fazenda Pau Brasil: 26 Millions m³
55 Blocks were granted in bidding rounds: R2, R4, R6, R7 and R10. Currently, 12 blocks are under concession, 3 of them are onshore.

Operators onshore:
- Integral de Petróleo e Gás do Brasil S.A.
- Petrogal

Legend:
- Capital
- Development and Production Fields
- State Limits
- Sectors
- Round 11 Blocks
- Sedimentary Basin
- Basement

Exploratory Blocks:
- Green: Round 2
- Round 7
- Purple: Round 4
- Round 10
- Pink: Round 6
Location and Characterization
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Stratigraphic Evolution

Source: ANP/UFRN/FUNPEC, 2008

Campos Neto et al., 2007

Source: ANP/UFRN/FUNPEC, 2008
**Palaeozoic Sineclisis**

**Early Permian (Aracaré Fm)**
*Desert and coastal*

**Later Carboniferous (Batinga Fm)**
*Glacial*

Source: ANP/UFRN/FUNPEC, 2008
Campos Neto et al., 2007

Pre-Rift Jurassic to Eocretaceous

Berriasian (Serraria Fm) Fluvial-lacustrine

Later Jurassic (Bananeiras and Candeeiro Fms) Fluvial-deltaic/Lacustrine

Pre-Rift Unconformity (Mechanical Subsidence)
Stratigraphic Evolution

Rift
Early Cretaceous

Middle Aptian (Maceió Fm)
Deltaic and Alluvial/Sabkha.

Early Aptian (Fm. Poção e Coqueiro Seco)
Fluvial, alluvial and lacustrine

Neocomian to Barremian
(Feliz Deserto, Penedo and Barra do Itiúba Fm)
Fluvial-deltaic and lacustrine

Pre Neo-Alagoas Unconformity (South Atlantic opening)

Source: ANP/UFRN/FUNPEC, 2008

Campos Neto et al., 2007

Sergipe Sub-basin
Alagoas Sub-basin
Campos Neto et al., 2007

Stratigraphic Evolution

Post-Rift

Albian to Coniacian

Sergipe Group

Riachuelo and Cotinguiba Fm

Pre-Calumbi Unconformity
Drift

Santonian to Recent

Piaçabuçu Group

Marituba, Mosqueiro and Calumbi Fm
Structural Maps

Gravimetric Map
Residual Bouguer Anomaly (mGal)

Source: ANP/UFRN/FUNPEC, 2008
Structural Maps

Magnetic Map Analitic Sinal (nT/m)

Source: ANP/UFRN/FUNPEC, 2008
Structural Maps

Magnetic Map Tilt (Radians)

Source: ANP/UFRN/FUNPEC, 2008
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Petroleum Systems

- Barra do Itiúba/Coqueiro Seco – Coqueiro Seco (.).

- Maceió (.)

Fonte: ANP/UFRN/FUNPEC, 2008
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<th>Generation</th>
<th>Alagoas Sub-basin</th>
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**Neocomian to Barremian**
- Barra de Itiúba and Coqueiro Seco Fm
- Shales of freshwater to brackish water
- TOC ~ 3%, high potential generator and Kerogen Type I and II

**Middle to Early Aptian**
- Maceió Fm
- TOC ~ 5%, high potential oil and gas generator

Campos Neto et al., 2007
Petroleum Systems
Reservoir Rock

Reservoirs

Alagoas Sub-basin

Aptian to Barremian
Maceió, Penedo and
Coqueiro Seco Fm
Sinrift Sandstones
Ø = 10% to 25%

Jurassic
to Neocomian
Pre-Rift Sandstone
Serraria Fm
Good permoporosity

Campos Neto et al., 2007
Petroleum Systems
Seal Rock

Reservoirs

Alagoas Sub-basin

Seals

Aptian to Barremian Sinrift Sandstones

Jurassic to Neocomian Pre-Rift Sandstone

Shales of Barra do Itiúba and Coqueiro Seco Fm

Shales of Feliz Deserto and Barra do Itiúba Fm

Campos Neto et al., 2007
Petroleum Systems
Traps and Migration

Traps
- Domic features
- Horsts
- Basculation in the basement
- Normal faults NE

Migration
- Carrier layers
- Permeable faults
- Lateral migration

Source: ANP/UFRN/FUNPEC, 2008
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Plays

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<td>Aptian Sandstones</td>
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Barremian Play
Sandstones and carbonates
Coqueiro Seco Fm and Morro do Chaves Mb

Aptian Play
Sandstones
Maceió Fm

Neocomian Play
Sandstones
Barra do Itiúba Fm

Late Jurassic Play
Sandstones
Serraria Fm

Source: ANP/UFRN/FUNPEC, 2008
Barremian Sandstones

SUB-BACIA DE ALAGOAS
Seção 027-1464

Rifte
Pre-rifte
Embasamento

São Miguel dos Campos Field

Source: ANP/UFRN/FUNPEC, 2008
Barremian Sandstones and carbonates

**Geological Section of the Pilar Field**

-Anticline

- > 700 Reservoirs (gas and oil)

- Intensive faults → Rift Tectonic
Aptian Sandstones

1FGT 0001 AL

Fazenda Guindaste

Line 0027-0358

Faults
Aptian tops
Barremian tops
Basement
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Blocks on offer

- SEAL-T1 Sector – Alagoas Sub-basin
- 25 Blocks
- Total Area ~ 733 km²
- Block Area ~ 30 km²
Oil and gas shows throughout the length of the well

Fazenda Guindaste Field has already produced gas in sandstones of Maceió Fm
266 km of 2D seismic surveys

11 wells

Petroleum System Studies of Sergipe-Alagoas Basin - ANP/UFRN 2008

Gravimetry
Exploration Opportunities

Magnetic Map Tilt (Radians)

Fonte: ANP/UFRN/FUNPEC, 2008
Exploration Opportunities

SEAL-T1-72

Line 0027-0359

- Faults
- Aptian top
- Barremian top
- Basement
Exploration Opportunities

Fazenda Guindaste Field

Line 0027-0678

- Faults
- Aptian top
- Barremian top
- Basement
Exploration Opportunities

Line 0027-0562

- Faults
- Aptian top
- Barremian top
- Basement
Exploration Opportunities

Identification of Faults and Seals:

- SEAL-T1-44
- SEAL-T1-50
- SEAL-T1-51

Line 0027-0564

- Faults
- Barremian top
- Aptian top
- Basement
Speculative Resources (Gas)

Area on offer
733 km²

21 discoveries
Risk 1 : 7
1 well per 114 km²
1 well per 5 km²
Drill 147 wells
VGIP 2 Billions m³
97 Millions m³ per discovery*

Reference Period
2002 to 2012

*Logarithmic Mean
## Contractual Aspects

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Final Remarks

- Mature basin
- Active production of oil and gas in the northeast of Brazil
- Blocks offered and acquired by bidders in several rounds
- 20% of the onshore reserves of the country
- Infrastructure for the oil industry
- Efficient petroleum system and diversity of plays
- Adequate opportunities for small and medium-sized companies
- Reprocessing and non seismic methods are suggested
National Agency of Petroleum, Natural Gas and Biofuels

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