The State of the Art of the Brazilian Pre-Salt Exploration

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ACE 101: Bridging Fundamentals and Innovation
Outline

1. Brazil’s Current State
2. The Pre-Salt Play
3. 2017 to 2019 Pre-Salt Licensing Rounds: Giant Leads
4. Final Remarks
Brazil’s Current State

Sedimentary Area: 7.5 million km²

Area under concession
~ 280,000 km²

335 Blocks
431 fields

Production
(Mar, 2018)
Oil 2.56 million barrels/d
Natural Gas 107 million m³/d

Proven Reserves
(Dez, 2017)
Oil 12.8 billion barrels
Natural Gas 367 billion m³

10th largest oil producer in the world
and the largest in Latin America
Oil Production in Brazil

**1998**
- Production (Dec, 1998)
  - 970 thousand bbl/d
  - 30 million m³/d

**2018**
- Production (Mar, 2018)
  - 2.56 million bbl/d
  - 107 million m³/d

**Oil Export (2000)**
- 18.68 bbl/d

**Crude Oil Export (Feb, 2018)**
- 0.9 million bbl/d
Brazil’s Prospectivity

Pre-Salt
- High quality Carbonate Reservoirs underneath the salt layer
- High well productivity more than 30,000 bpd in the beginning of production
- Potential for giant or supergiant field discoveries

Conventional Offshore
- Eastern and Equatorial Margin
  - Potential for oil discoveries from the Upper Cretaceous to Paleogene turbidite reservoirs

Onshore
- Mature Basins (Remaining Potential)
- New Frontier Basins
  - Solimões Basin: Potential for light oil accumulations
  - Paleozoic and Proterozoic basins: gas prone
Oil Production in Brazil

Million barrels of oil/day

- Total Oil
- Post-Salt
- Pre-Salt
- Onshore
Proven Reserves

December, 2017

Oil
12.8 Billion bbl

Gas
367 Billion m³

15 Billion boe

Oil Proven Reserves

- Pre-Salt: 5%
- Conventional Offshore: 39%
- Onshore: 56%

Gas Proven Reserves

- Pre-Salt: 18%
- Conventional Offshore: 29%
- Onshore: 53%

Pre-Salt: 56%
Conventional Offshore: 37%
Onshore: 7%
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The Pre-Salt Play

Aptian

SINBPA/Petrobras
Scotese
The Pre-salt Play

Depositional Model

Platforms

Buildup

- Transgressive limestone
- Micritic limestone (mudstone - wakestone)
- Mud flat dolomite
- Argillaceous limestone & marl
- Siltstone
- Sandstone
- Conglomerate
- Basement
- Intraclast-spherulite (-packtone - grainstone)
- Wackestone - packstone with spherulites
- Argillaceous limestone & marl with spherulites
- Lime packestone - grainstone with mollusk shells
- Lime packestone - grainstone with mollusk shells
- Shale (commonly organic-rich)
- Shrubby microbial boundstone
- Domal to branching microbial (chert boundstone)

Source: Edited of Saller et all, 2016.
The Pre-salt Play

Petroleum System

Itapema – Itapema/Barra Velha

Aptian
Barremian
Hauterivian
Valanginian

Stratigraphic chart: Moreira et al., 2007
The Pre-salt Play

Buzios Field – Facies Example

2-ANP-0001-RJS

Core

Top of Coquina

Oil/water contact

Final Depth = 5,942.0 metros
The Pre-salt Play

Buzios Field – Facies Example

Schrubs

8.85 meters

2.0 cm

SHR1

3 mm

1 - 2 cm
The Pre-salt Play

Buzios Field – Facies Example

Spherulite

8.85 meters

CLU + estevensite? (ritimite)
Si
Sph
Sph + microlamination
Laminated CLU
Silica nodule
The Pre-salt Play

Buzios Field – Facies Example

Laminated Calcilutite

Si

Si

8.85 meters

2.0 cm
The Pre-salt Play

Buzios Field – Facies Example

Calcarenite

8.85 meters

CRE
The Pre-salt Play

Mero Field – Facies Example

**Core 1**
- Depth: 5,548/5,566 m

**Core 2**
- Depth: 5,613/5,631 m

**2-ANP-0002A-RJS**
- Base of salt: 327.0 m
- Oil/water contact

**Final Depth** = 6,029.3 metros
The Pre-salt Play

Mero Field – Facies Example

Core 1

Core 2

Calcarenite
The Pre-salt Play

Mero Field – Facies Example

Core 1

Core 2

Laminated calcilutite

3.0 cm
The Pre-salt Play

Mero Field – Facies Example

Core 1

Core 2

Crenulated lamination calcilutite

3.0 cm
The Pre-salt Play

Mero Field – Facies Example

Core 1

Core 2

Calcirudite
The Pre-Salt comprises huge accumulations underneath the salt layers;

Light Oil with excellent quality accumulations and high commercial values;

1) Great prospectivity, potential for giant and supergiant oil fields;

2) High wells productivity related to high quality carbonate reservoirs and extensive and thick production zones.
Pre-salt Production

~1.4 million barrels of oil/day

The Pre-Salt production comes from 83 wells:

58 in Santos Basin
25 in Campos Basin
The Pre-salt Play Production

~1.4 million barrels of oil/day

- **Pampo** (2 wells)
  - Oil: 64 bbl/d
  - Gas: 1 M m³/d

- **Mero** (1 well)
  - Oil: 25.6 M bbl/d
  - Gas: 1.7 MM m³/d

- **Sururu**
  - Oil: 16.8 M bbl/d
  - Gas: 512 M m³/d

- **Lula** (44 wells)
  - Oil: 831.9 M bbl/d
  - Gas: 34.8 MM m³/d

- **Lapa** (2 wells)
  - Oil: 38.3 M bbl/d
  - Gas: 1.07 MM m³/d

- **Sapinhoa** (12 wells)
  - Oil: 255.4 M bbl/d
  - Gas: 10.2 MM m³/d

- **Baleia Franca** (2 wells)
  - Oil: 35 M bbl/d
  - Gas: 1.4 MM m³/d

- **Baleia Azul** (4 wells)
  - Oil: 33.9 M bbl/d
  - Gas: 1.2 MM m³/d

- **Jubarte** (8 wells)
  - Oil: 118.5 M bbl/d
  - Gas: 3.9 MM m³/d

- **Marlim Leste** (5 wells)
  - Oil: 27.7 M bbl/d
  - Gas: 520 M m³/d

- **Barracuda/Caratinga**
  - Oil: 8.1 M bbl/d
  - Gas: 127 M m³/d

- **Marlim/Voador**
  - Oil: 4.7 M bbl/d
  - Gas: 141 M m³/d

- **Sururu**
  - Oil: 16.8 M bbl/d
  - Gas: 512 M m³/d

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Mar/2018
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Bidding Rounds Schedule

4th PSC Bidding Round
2018 (06.07.18)

5th PSC Bidding Round
2018 (09.28.18)

6th PSC Bidding Round
2019 (1st S)

2019 (3rd Q)

3rd Q
4th Pre-salt Bidding Round

Public session for submission of bids:
Jun the 7th, 2018

4 blocks in Pre-Salt play

Potential for huge oil discoveries

Unrisked oil in place volume (P50)
~14 billion barrels
Unrisked in place oil volume (P50)
7.8 billion barrels
Unrisked in place oil volume (P50)
7.8 billion barrels
This auction will include 4 blocks: Saturno, Titã, Pau-Brasil and Sudoeste de Tartaruga Verde

Unrisked oil in place volume (P50) surpasses 17 billion barrels

Public session for submission of bids:
September the 28th, 2018
Base of Salt
Depth Structural Map

25 km
5th Pre-salt Bidding Round

Saturno
Titã
Dione

Arbitrary Line

Top of Salt (Aptian/Albian)
Base of Salt (Aptian)
Base of Sag (Aptian)

Sea Bottom
Fault
Basement

Survey: 0264_BM_SANTOS_FASE_VII_B – Courtesy of CGG
Dione Prospect

5th Pre-salt Bidding Round

Survey 0268_BM_SANTOS_FASE_VII_B – Courtesy of CGG: Arbitrary Line (Fast Track)
3 blocks in Pre-Salt play including giant leads
Aram Block

Crossline 4802

Top of Salt (Aptian/Albian)  Basement  Fault

3,000  5,000  7,000  9,000
Depth (m)

Survey: R0014_BS_1_SOUTH_PSDM – Courtesy of PGS

Prominent Basement High
Four-way Closure
Amplitude Anomalies

Area: 1,500 km²

6th Pre-salt Bidding Round

PRE-SALT
Brazil 6
PRODUCTION SHARE

anp
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The Pre-salt play is comprised of highly productive Aptian carbonate reservoirs in structural traps sealed by thick salt layers; Currently, there are 12 fields producing from the Pre-salt layers in Brazil. The Pre-salt play is responsible for more than half of the Brazilian oil production; Estimated unrisked in place volume surpasses 30 billion barrels of oil for the 4th and 5th Pre-Salt Licensing Rounds.
National Agency of Petroleum, Natural Gas and Biofuels

ANP

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