

# Santos Basin Pre-Salt Cluster

How to make production development technically and economically feasible.

1-3 December 2008, NYC

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**PETROBRAS**



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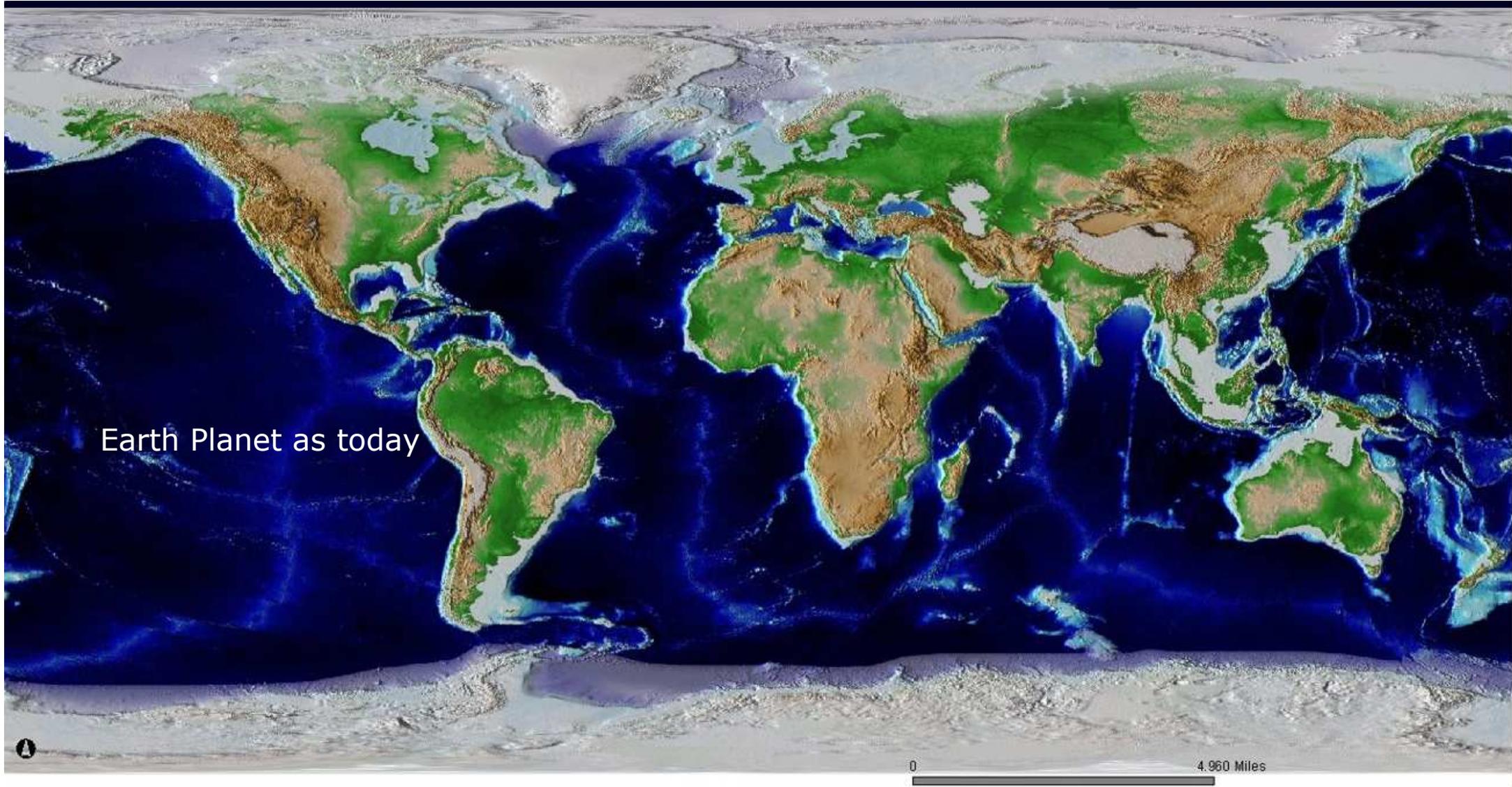
# Agenda

- **Introduction - Pre-Salt**
- **Santos Basin Pre-Salt Development Strategy**
- **Technological Challenges**
- **Economical and Logistics Challenges**
- **Commercial Strategies**
- **Conclusion**
- **Questionsn**



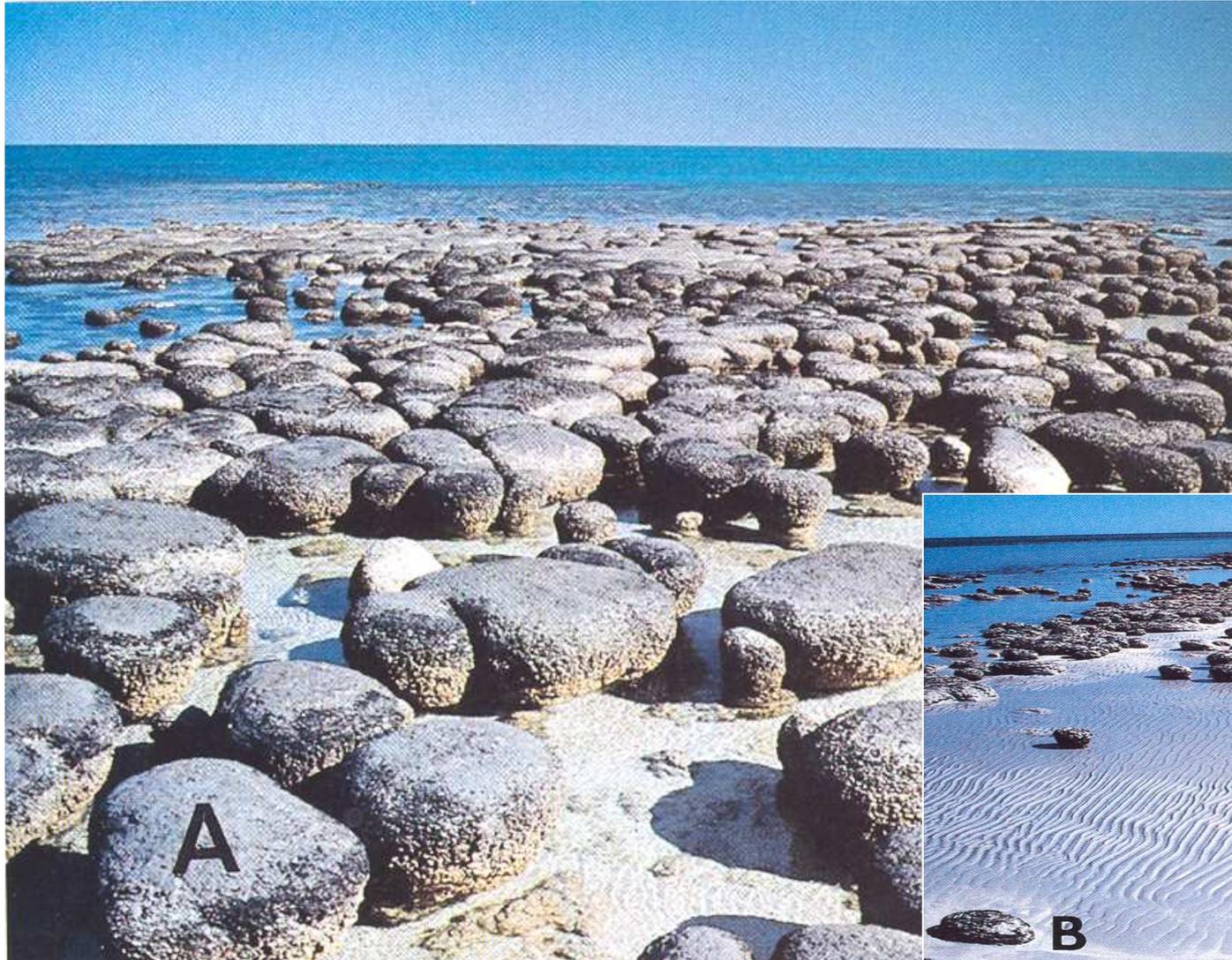


164.000.000 years ago ...





It was like this approximately 120 million years ago



Inter tidal and Sub tidal stromatolites – Australia – recent sedimentation



# Pre-Salt – Reservoirs



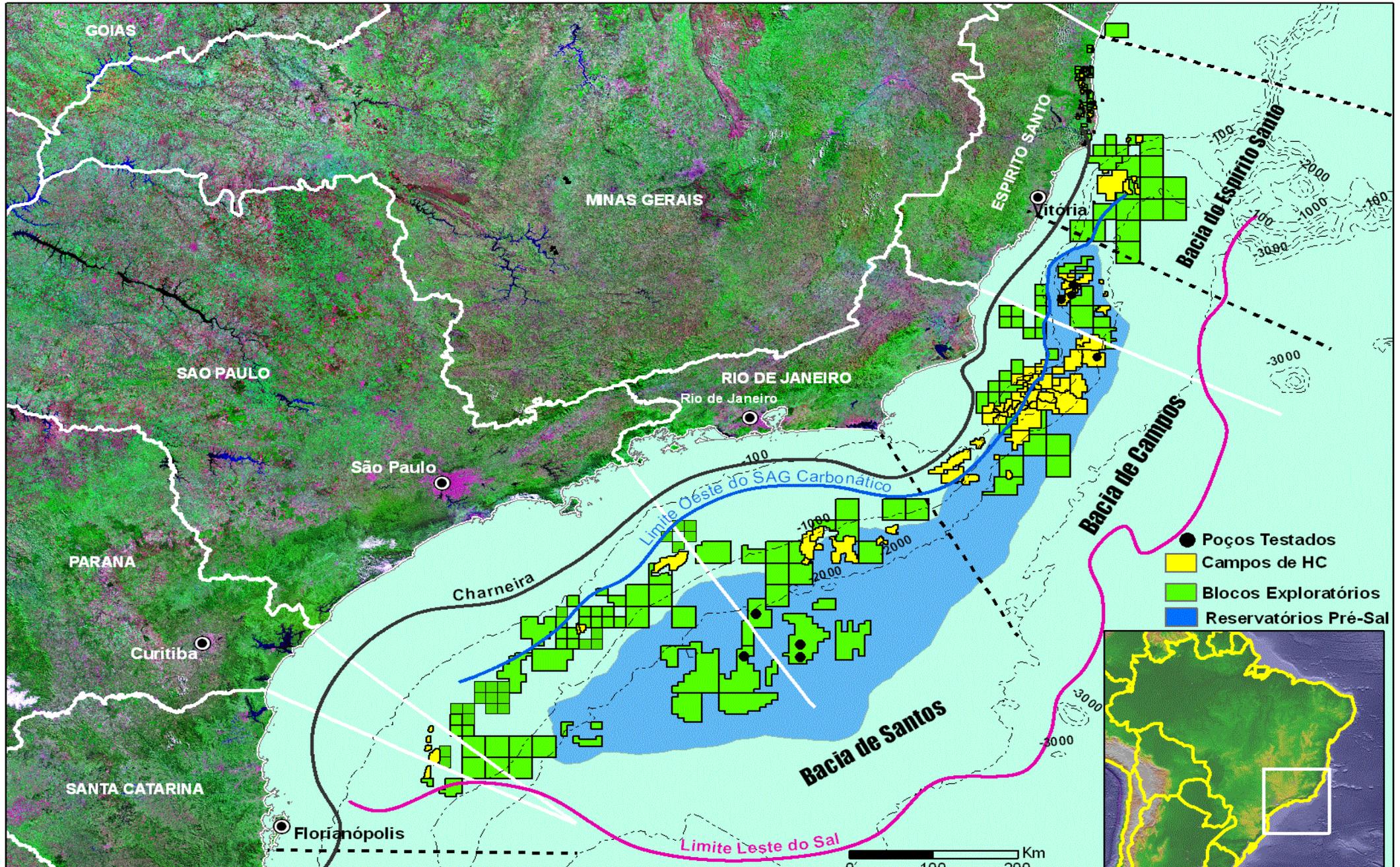
3-RJS-646 T.02 cx05/11 - 4919,85m



3-RJS-646 T.02 cx05/11 - 4920,00m

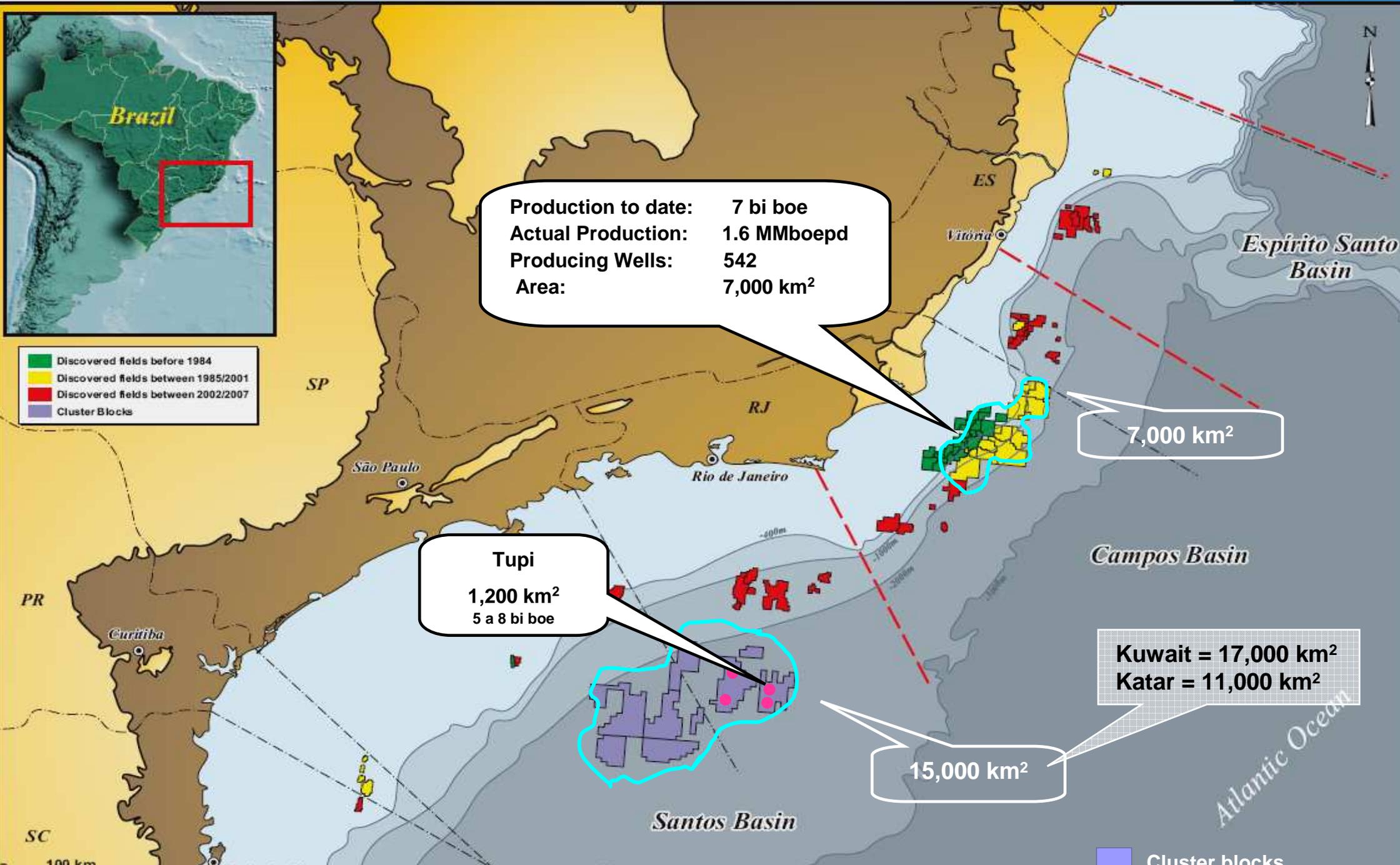


# Pre-Salt Province



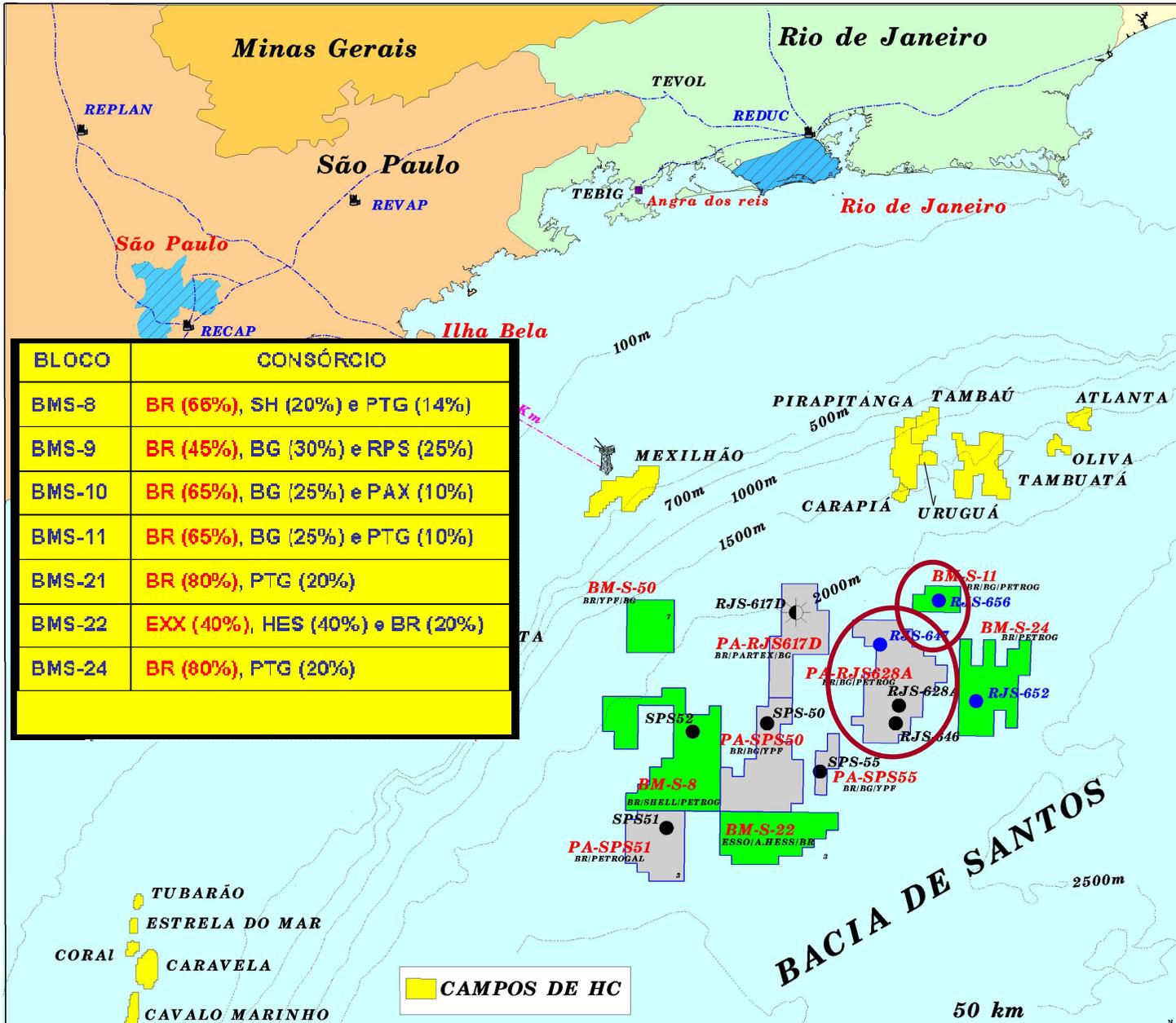


# Santos Basin Pre-Salt Cluster





# Some Location Details



Evaluation Plans approved by ANP

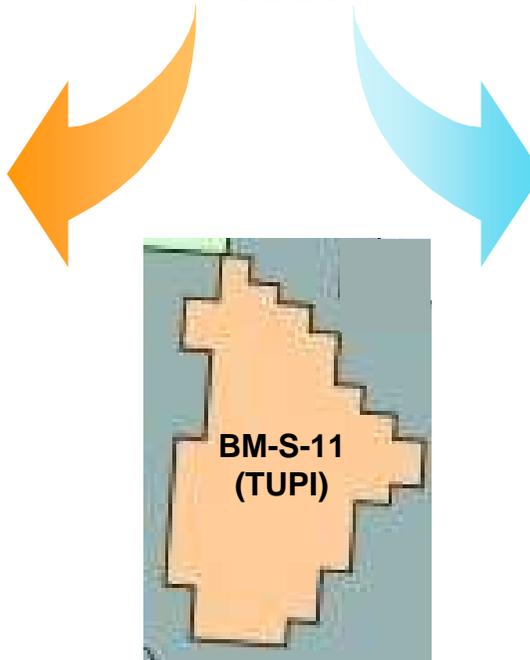
- Parati – 1-RJS-617
- Tupi – 1-RJS-628
- Carioca – 1-SPS-50
- Caramba – 1-SPS-51
- Guará – 1-SPS-55

Evaluation Plans being prepared/under negotiation

- Bem-Te-Vi – 1-SPS-52
- Júpiter – 1-RJS-652
- Iara – 1-RJS-656

## Tupi Area

- Petrobras (65%), BG (25%), Petrogal (10%)
- Heterogeneous layered carbonates – microbiolates with variable reservoir quality
- Water Depth about 2,200 m
- Salt layers with thickness – up to 2,000 m
- Well tests indicate potential flow rates of 15-20 k bopd
- API: 28-30°

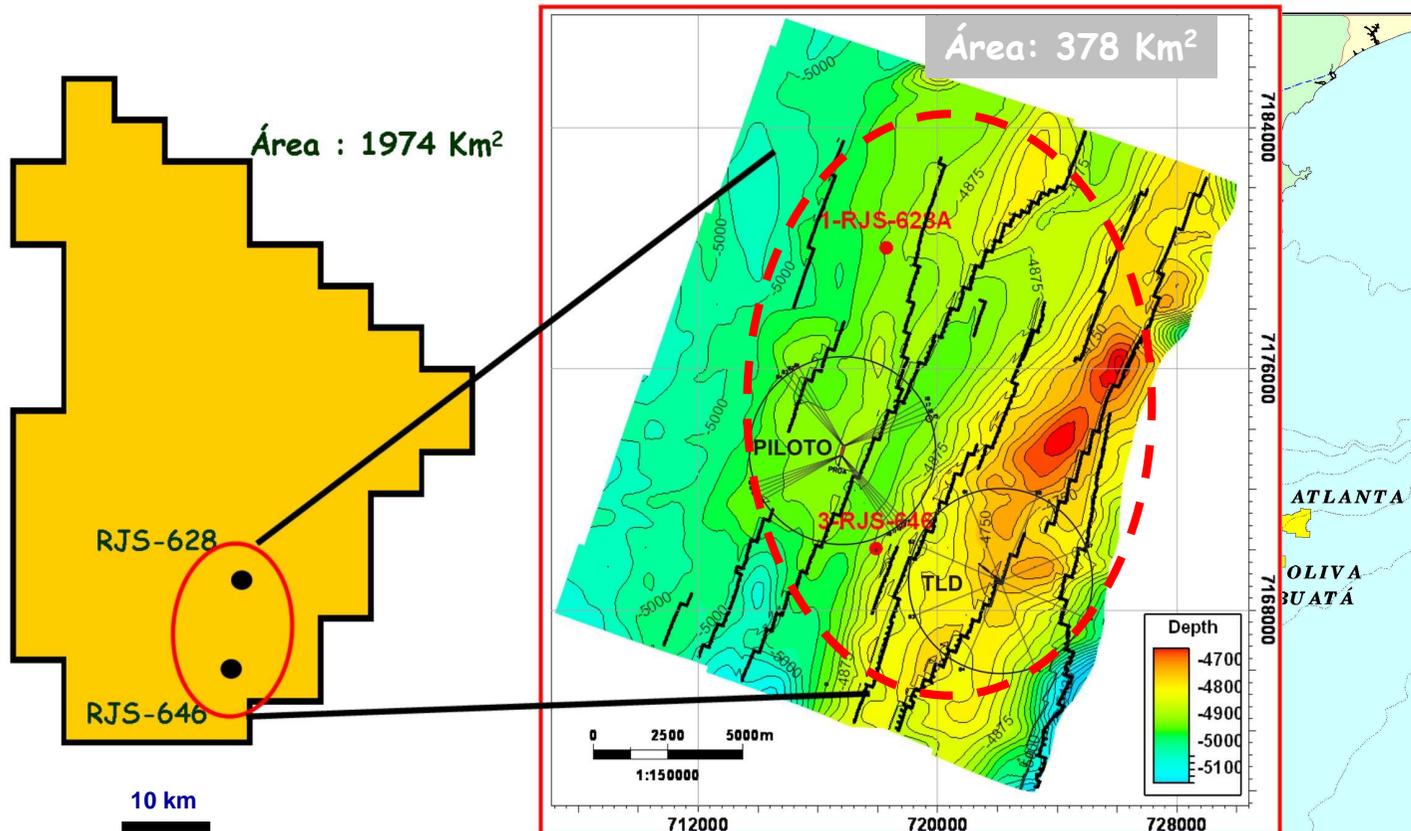


- Oil viscosity around 1 cP
- GOR around 230 m<sup>3</sup>/m<sup>3</sup>
- Initial pressure 580 kgf/cm<sup>2</sup>
- Low TAN (Total Acid Number)
- CO<sub>2</sub> in the associated gas (Tupi: 8 - 12%)
- Concern with flow assurance due to wax deposition in pipes



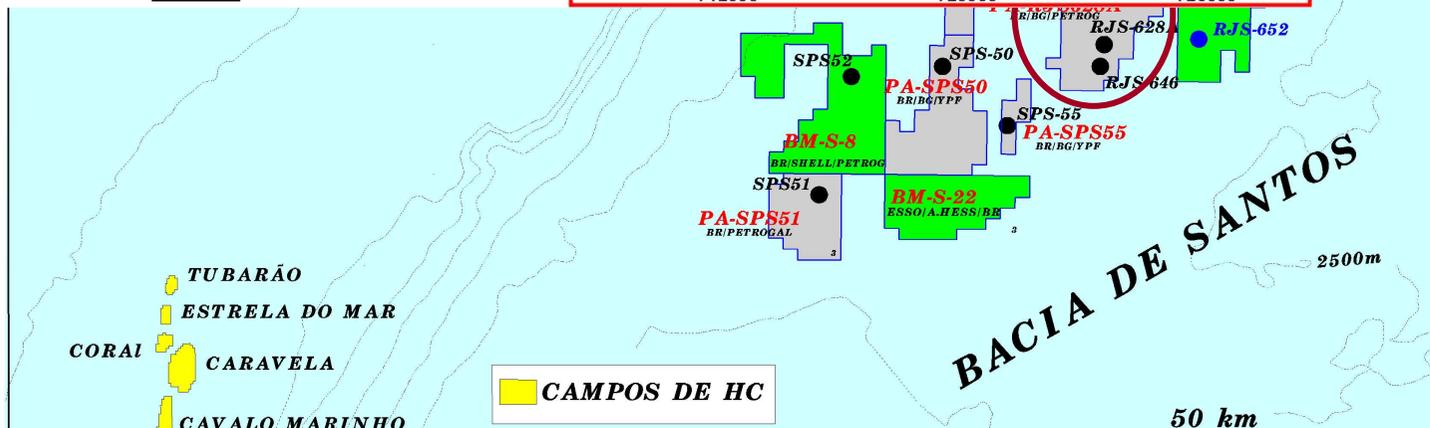
# General Data - Tupi Area

## PA do RJS-628



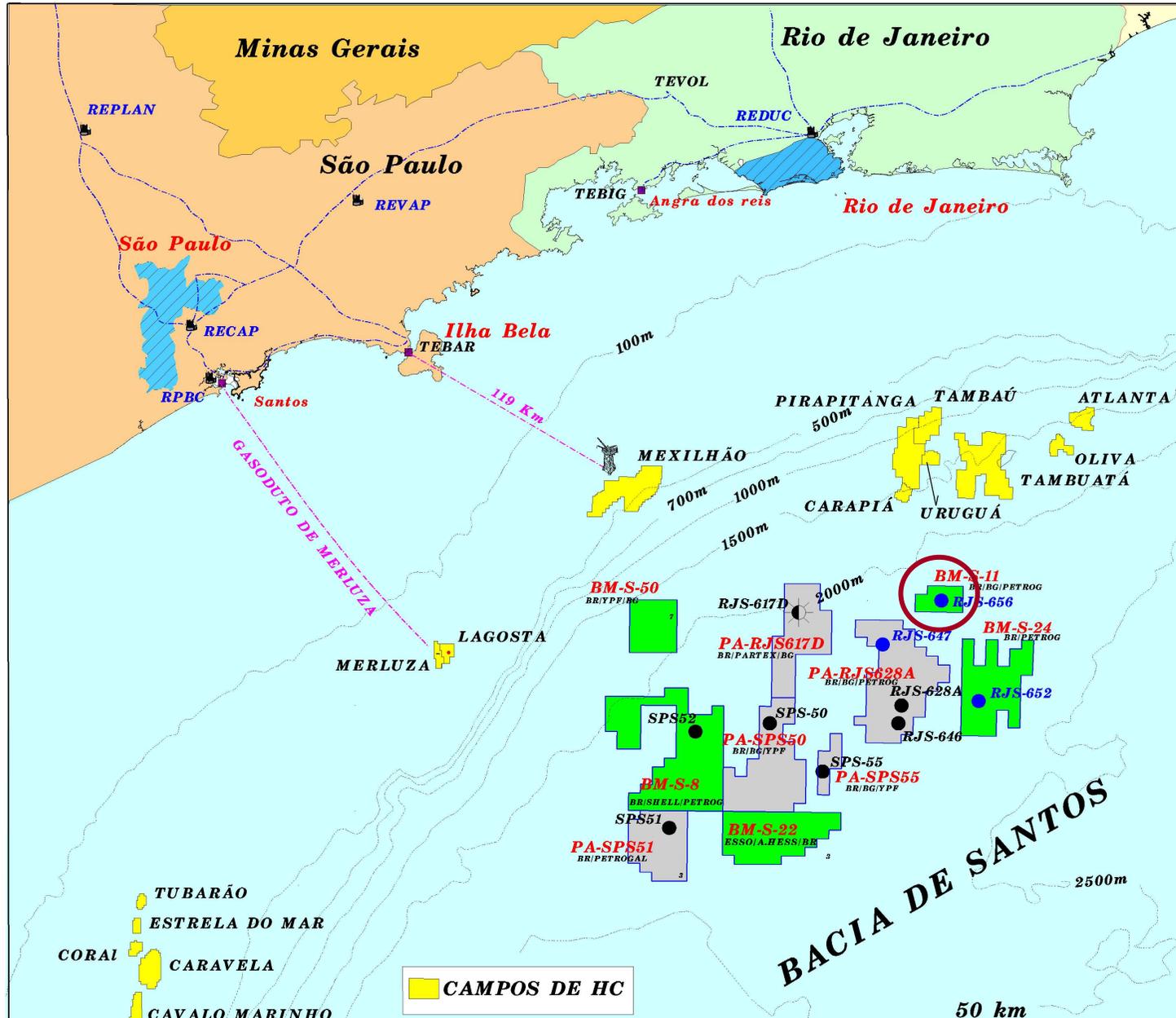
## Tupi Area

- Selected Area for the Pilot: 115 km<sup>2</sup>
- Area of the Appraisal Plan: 1974 km<sup>2</sup>
- The main reservoir in the Pre-Salt is known as the SAG reservoir.
- Two other carbonate reservoirs are found in the area (RIFT, COQUINAS).
- The preliminary estimates for the recoverable volume for the whole Tupi area are between 5 and 8 billion bbl





# General Data - Iara

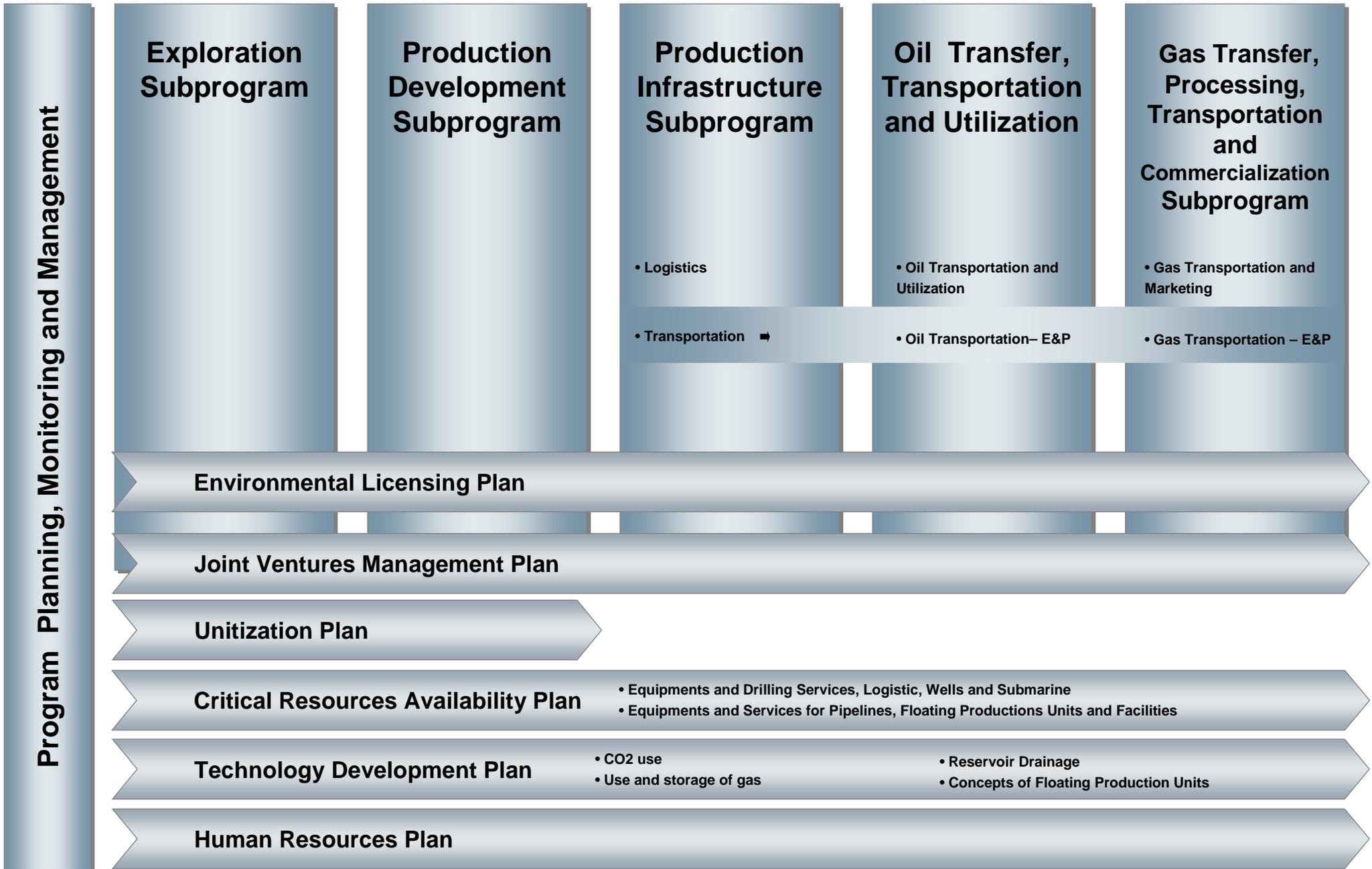


Iara Area

- Petrobras (65%), BG (25%), Petrogal (10%)
- Area of the Appraisal Plan: 300 km<sup>2</sup>
- The preliminary estimates for the recoverable volume for Iara area are between 3 and 4 billion bbl
- Water Depth about 2,230 m
- Reservoir Depth about 6,080 m
- API: 26-30°

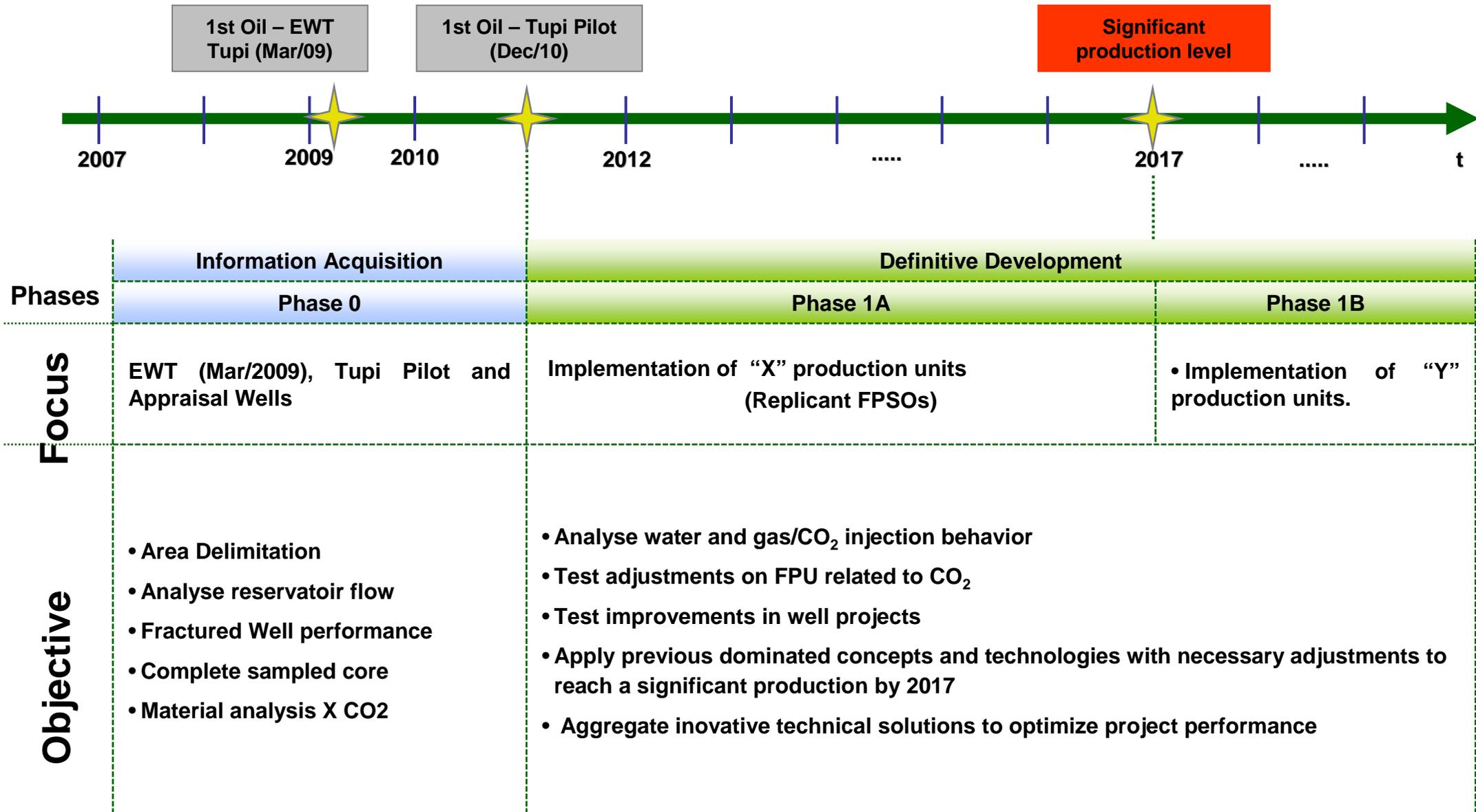


# Pre-Salt Integrated Development Plan (PLANSAL)





# Development Strategy (Ex: Tupi)





# Development Strategy by Phases



Phase 0: Information Acquisition: Appraisal Wells + EWT Tupi + 7 EWTs in other areas + Tupi & 2 Anticipated Pilots

Phase 1 – Definitive Development

Phase 1a – 8 FPSOs + Gas Transp.1a + Oil Transp.1a + Infra + Oil Utilization1a + Gas Commercialization 1a

Phase 1b – “N” FPU’s + Gas Transp.1b + Oil Transp.1b + Oil Utilization1b + Gas Commercialization



# Production Design

1st Oil:

March/2009

- 2 Well Production: 3-RJS-646 and P1
- Expected Flow: 14.000 bpd
- Test Duration: 15 months



FPSO BW Cidade de São Vicente

LDA: 2200m

DRILL  
WELL P1



PHASE 2  
WELL P1  
6 MONTHS

6" PRODUCTION  
4" SERVICE  
EHU

LINE  
RELOCATION

6" PRODUCTION  
4" SERVICE  
EHU

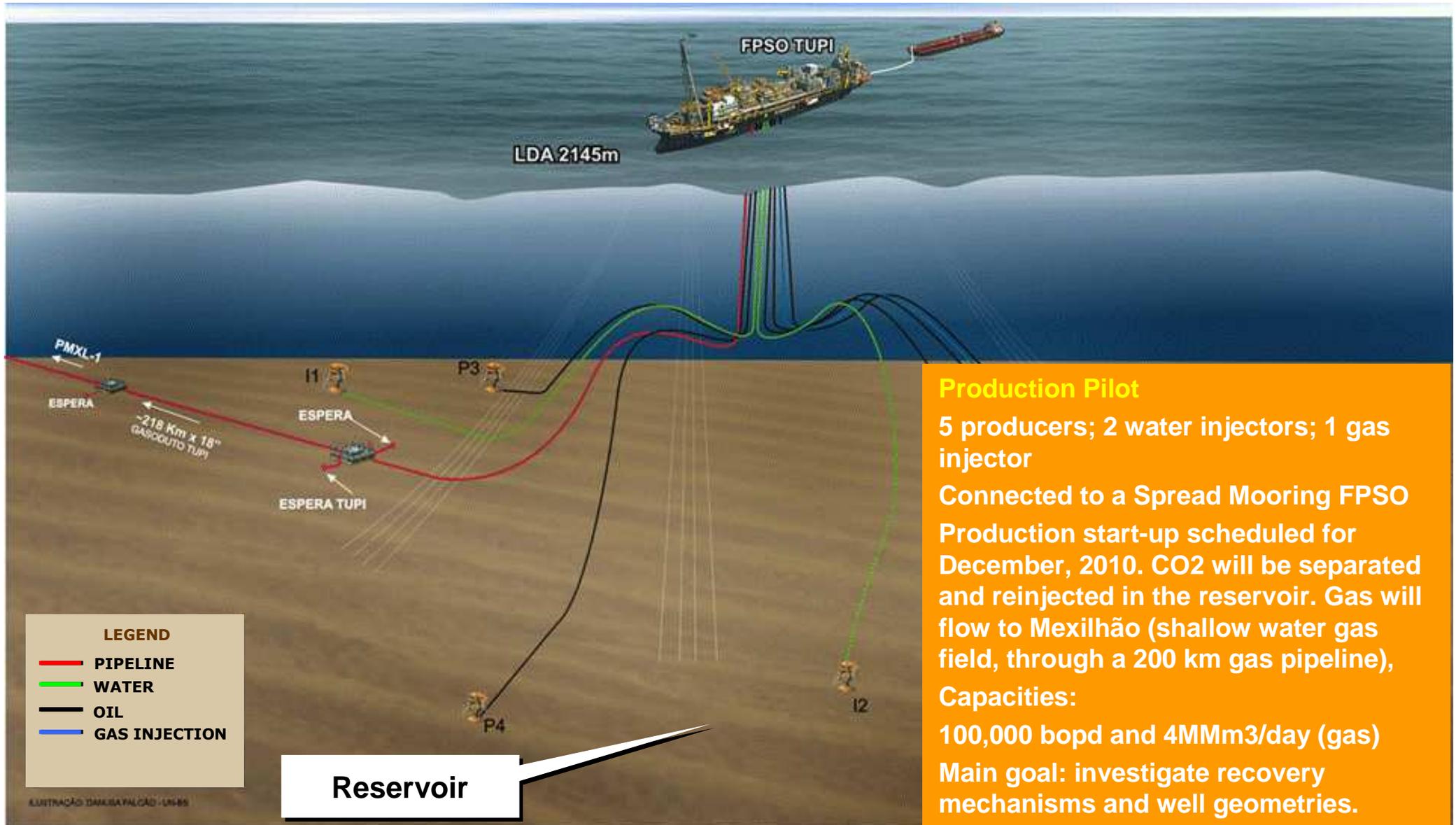
PHASE 3  
WELL 3-RJS-646  
3 MONTHS



PHASE 1  
WELL 3-RJS-646  
6 MONTHS

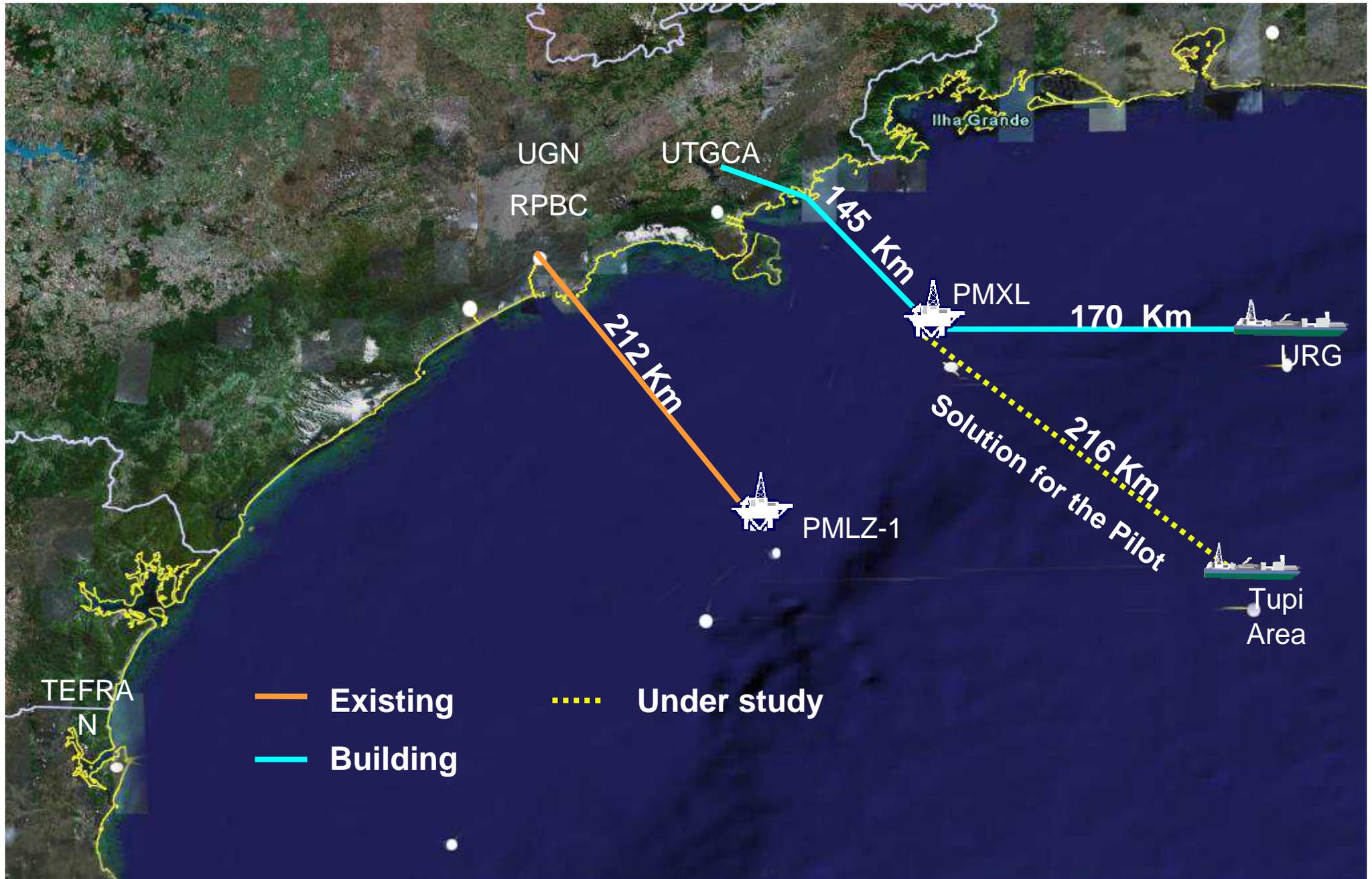


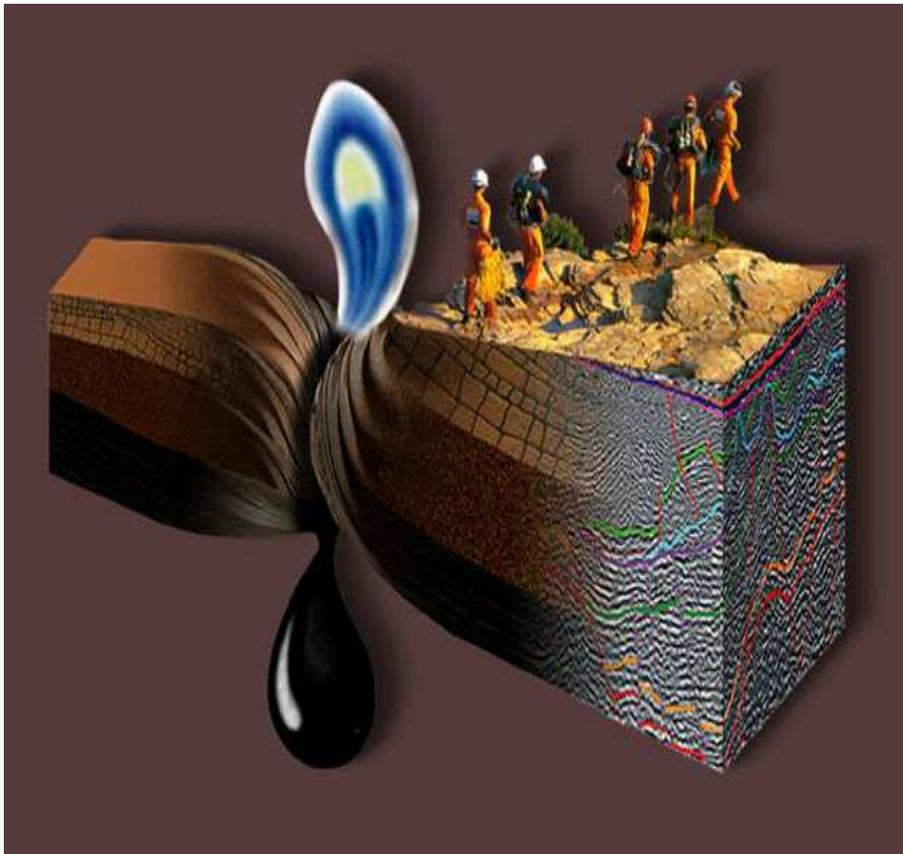
# Pilot Project Scope





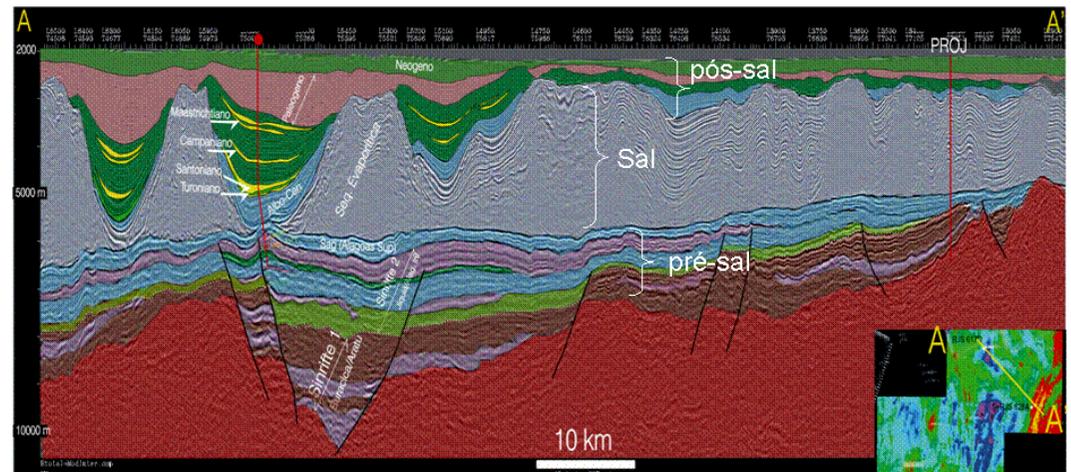
# Gas exportation for the Tupi Pilot

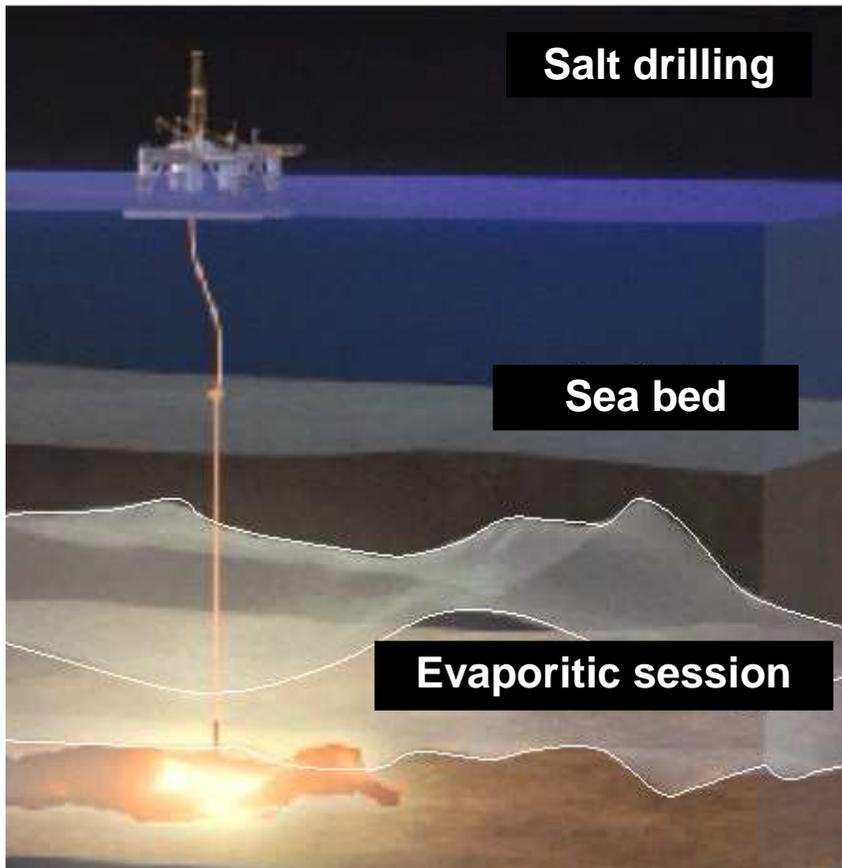




## Reservoir Characterization and Engineering

- Facies definition from seismic data.
- Internal reservoir characterization, with focus on the main heterogeneities.
- Secondary recovery: technical feasibility of water and gas injection.
- Geomechanics of the surrounding rocks with depletion.





## Well Drilling and Completion

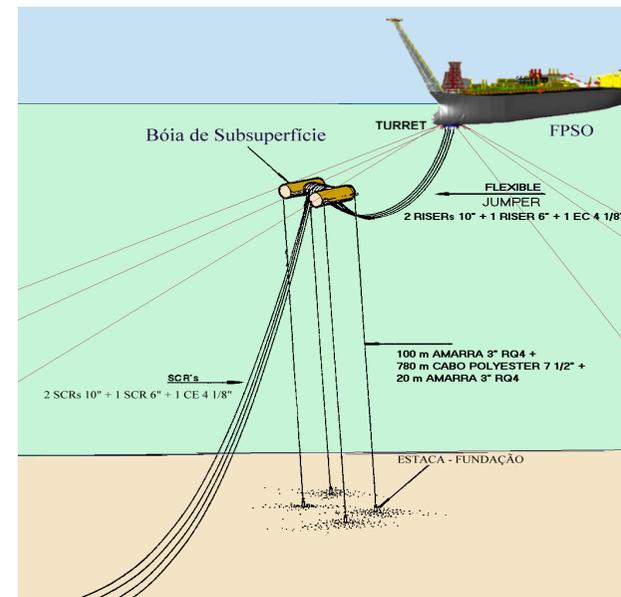
- Deviation of the wells into the salt zone.
- Hydraulic fracture in horizontal wells.
- Wellbore materials, resistant to high CO<sub>2</sub> content.
- Slow penetration in the reservoir.
- Extended Reach Wells.





## Subsea Engineering

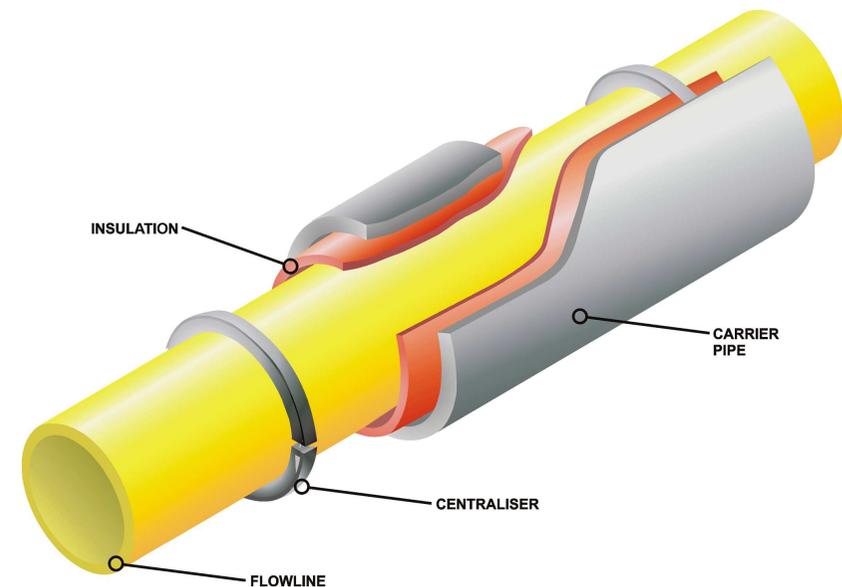
- Qualification of risers for water depth of 2,200 m, with CO<sub>2</sub> and high pressure.
- Scenario for riser towers, SCRs with lazy wave and other technologies.
- Qualification of thermal insulated flowlines for water depths of 2,200 m.
- Flowlines for high pressure gas injection





## Flow Assurance and Artificial Lift

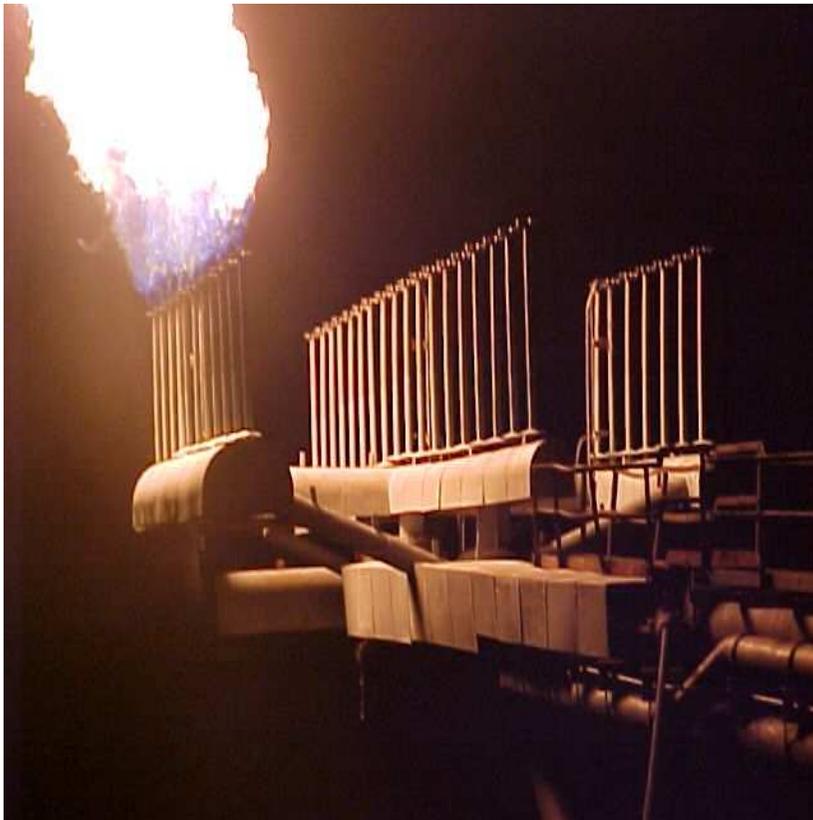
- Preventing hydrate formation
- Wax deposition in long pipelines.
- Scaling control
- Temperature management along the lines



## Floating Production Units

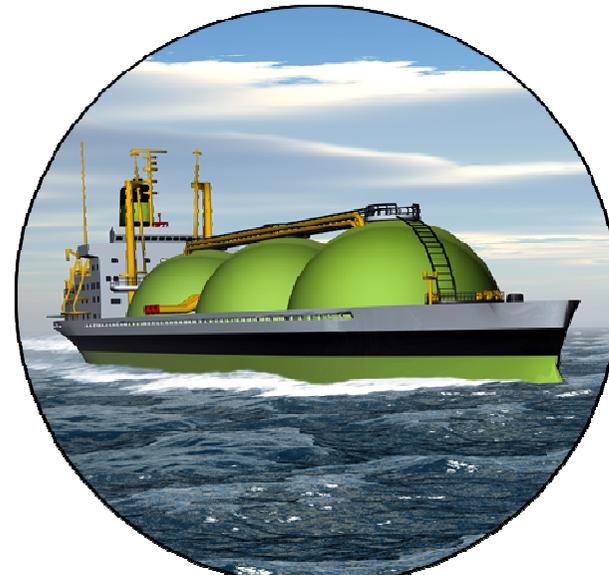
- Mooring in water depths of 2,200 m
- Interaction with the riser's system
- Scenario for platforms with direct access to the wells (SPAR, FPDSO).





## Logistics for the Associated Gas

- More suitable materials for equipment dealing with high CO<sub>2</sub> concentration gas streams.
- Gas pipeline larger than 18" in water depth of 2,200 m.
- Long distance to shore (300 km).
- Scenario for new technologies offshore: LNG, CNG, GTL, GTW, etc.





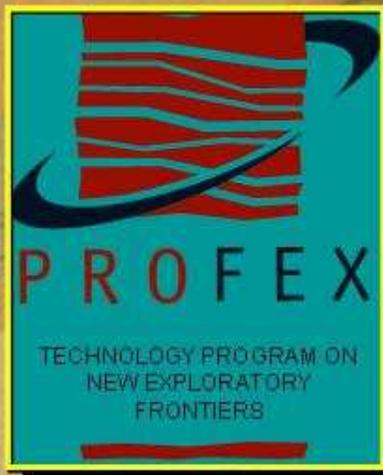
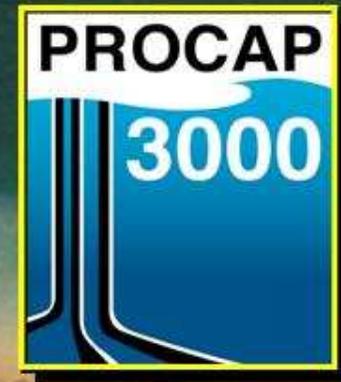
## Environment Protection

- Cuttings collection
- Use of zero discharge systems
- Produced water re-injection
- Massive use of green drilling fluids
- HSE management



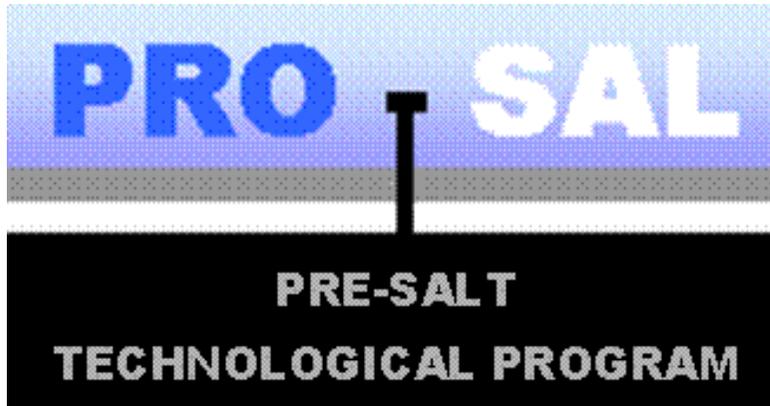


# Petrobras Technological Corporate Programs

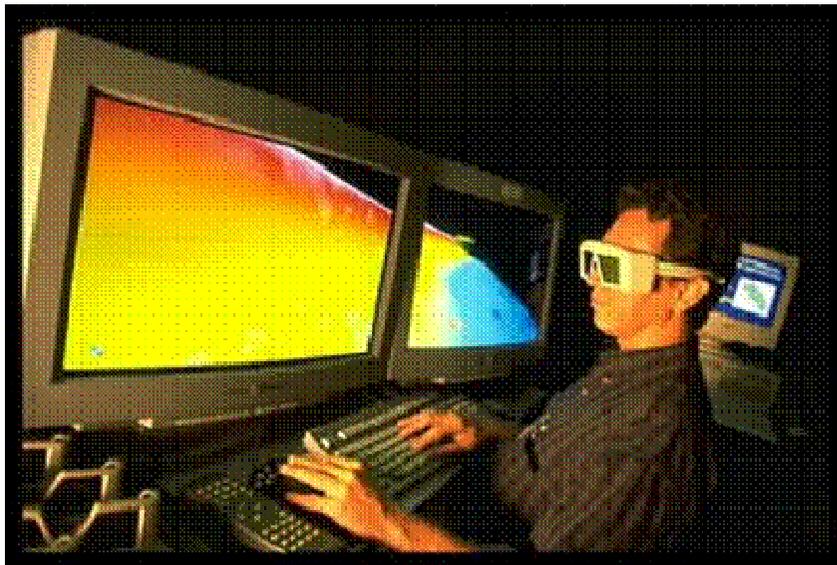




# PRO-SAL - Pre-Salt Technological Program



**CENPES – Petrobras R&D Center**



**137 Laboratories and 30 Pilot Plants**

## **Objective:**

Develop and disseminate technologies to incorporate reserves and to develop the production of the recent discoveries in the pre-salt section.

## **Projects' Portfolio:**

### **Well construction for the pre-salt section**

(drilling fluids, cement resistance, stimulation techniques, geomechanical model, liner drilling, well control in the salt zone, multilaterals).

**Geosciences** (chemical stratigraphy, core-log-test integration, geomechanical model and fracture distribution, pre-salt imaging, seismic attributes)

**Reservoir Engineering:** Recovery optimization



# Petrobras global strategy

- ❖ **Fast track projects culture: Golfinho, PLANGAS, 1st DP FPSO, ...**
  - ❖ DP FPSO for the Extended Well Test already under conversion
  - ❖ Tupi Pilot FPSO has already been chartered, by the Tupi Consortium.

- ❖ **Wide standardization program:**

- ❖ Drilling, completion and subsea hardware (trees, lines, ...)
- ❖ FPU design → hull and production plant whenever possible;

- ❖ **High Local Content policy**

- ❖ **Key suppliers policy**

- ❖ Long term contracts with Service Companies.
- ❖ “Batch orders” for long lead items.
- ❖ Current negotiations for rigs, vessels, ...

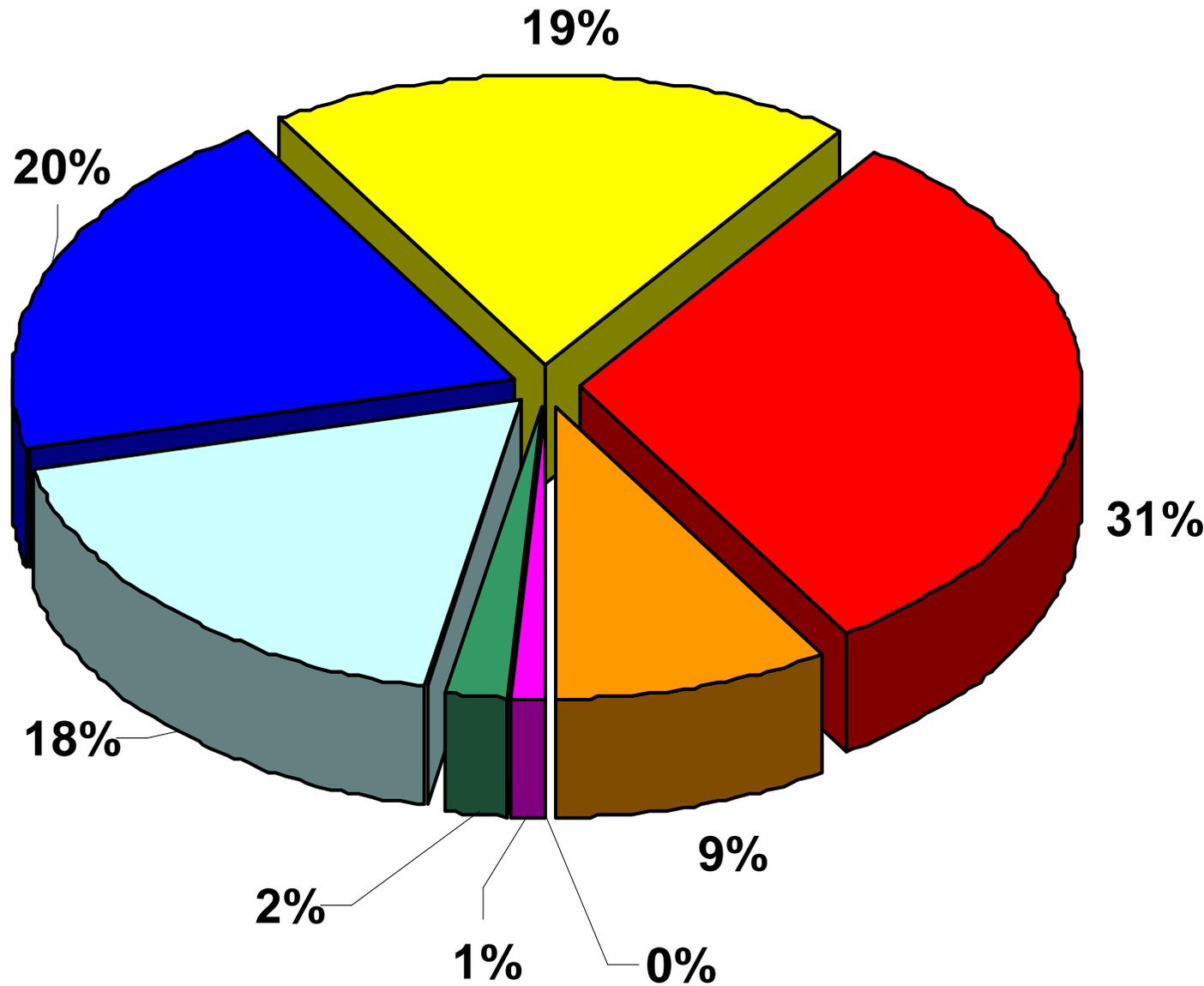


- ❖ **Alternative solutions for gas transportation (LNG, CNG, GTW,...)**



## CAPEX TYPICAL DISTRIBUTION

- Residual Value
- Processing Plants
- Exportation
- Gathering
- FPU
- Completion
- Drilling
- Abandonment



## ❖ Production Platforms:

### ❖ High Local Content

- ❖ Use of new infrastructure for hulls

- ❖ Modules manufactured in existing sites or prepared at low investment;

### ❖ Competitiveness in cost and schedule

- ❖ Sequence of 8 standard FPSO units;

- ❖ Standard FPSO hulls construction made by experienced companies;

- ❖ Standardization of FPSO's Top sides whenever possible;



Infrastructure for  
Production Platforms  
Rio Grande City – RS.



## ❖ Subsea Rigid Pipelines:

- ❖ Ultra deep water
  - ❖ Brazilian industry is investing to supply high strength steel pipe;
- ❖ **Few number of suitable pipeline lay down vessels in the Market;**
  - ❖ EPCI Contracting Philosophy and anticipate slot acquisition;
  - ❖ Construction of new vessel in Joint venture with experienced operator;

## ❖ Drilling rigs

- ❖ On going contract strategy
  - ❖ 25 drilling rigs under construction to be received by 2012;
  - ❖ Analysing extra units in global market;
- ❖ **New rigs demand after 2013 and on**
  - ❖ High Local Content;
  - ❖ Competitive basis with international market;
  - ❖ Evaluating brazilian infra-structure installed capacity;





# Other Contract Strategy

## ❖ Logistics

- ❖ 146 Vessels (PSV, AHTS, LH) and Helicopters:
- ❖ Operation in pool regime;
- ❖ Bids allowing the construction in Brazil;

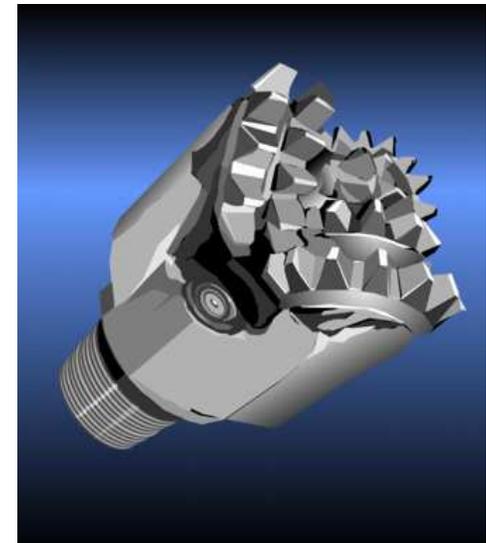


## ❖ Subsea Equipment and Vessels (PLSV)::

- ❖ Long Term Contracts, with minimum consumption guarantee;
- ❖ Incentives that encourage investments in expansion or newcomers;
- ❖ Standard products and traditional suppliers;

## ❖ Well Equipments and Services:

- ❖ Scale effect for rising competition;
- ❖ Traditional suppliers will be invited to tender
- ❖ Long Term Contracts (minimum consumption guarantee);
- ❖ Incentives that encourage investments in expansion or newcomers





# Conclusion

- ❖ Petrobras has the worldwide recognized deepwater experience to address technical and commercial challenges for Pre-salt appraisal and development.
- ❖ A new paradigm will be established for conceptual design applied to Santos Basin Pre-salt cluster production development and logistical support.
- ❖ Tremendous opportunities for already installed and newcomers in Brazilian suppliers and service companies due to the scale provide by upstream portfolio.
- ❖ Pre-salt will start production in 2009, with a steep ramp-up on the following years;
- ❖ Pre-Salt will be a significant contribution to Petrobras production throughout next decade;
- ❖ The next revision of our Strategic Plan will detail our future plans.





Thank you!



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**Questions and Answers**

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