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BrasilRound9
Nona Rodada de Licitações

Brazil Round 9

Santos Basin

Geologist Juliana Vieira
Bid Areas Department

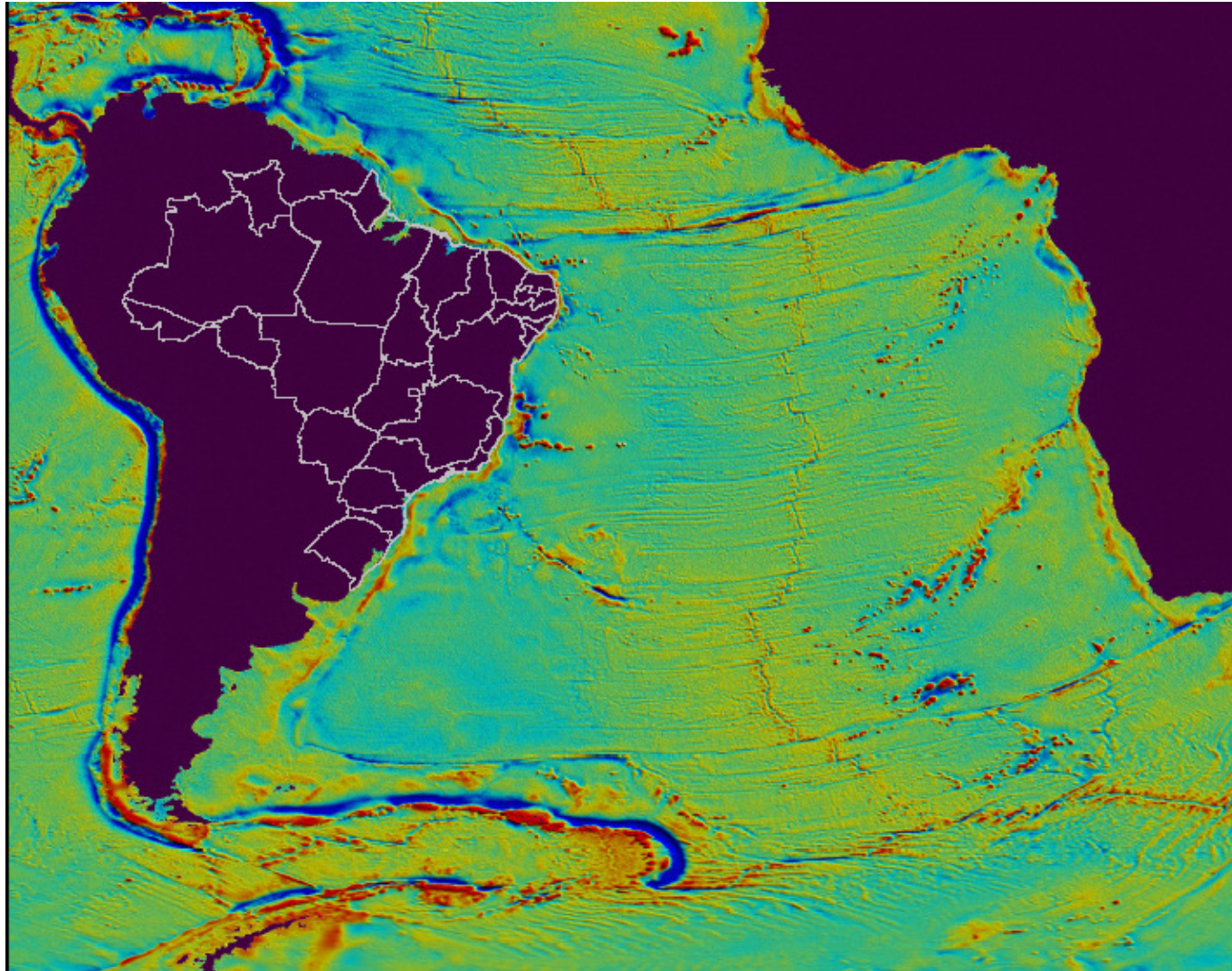


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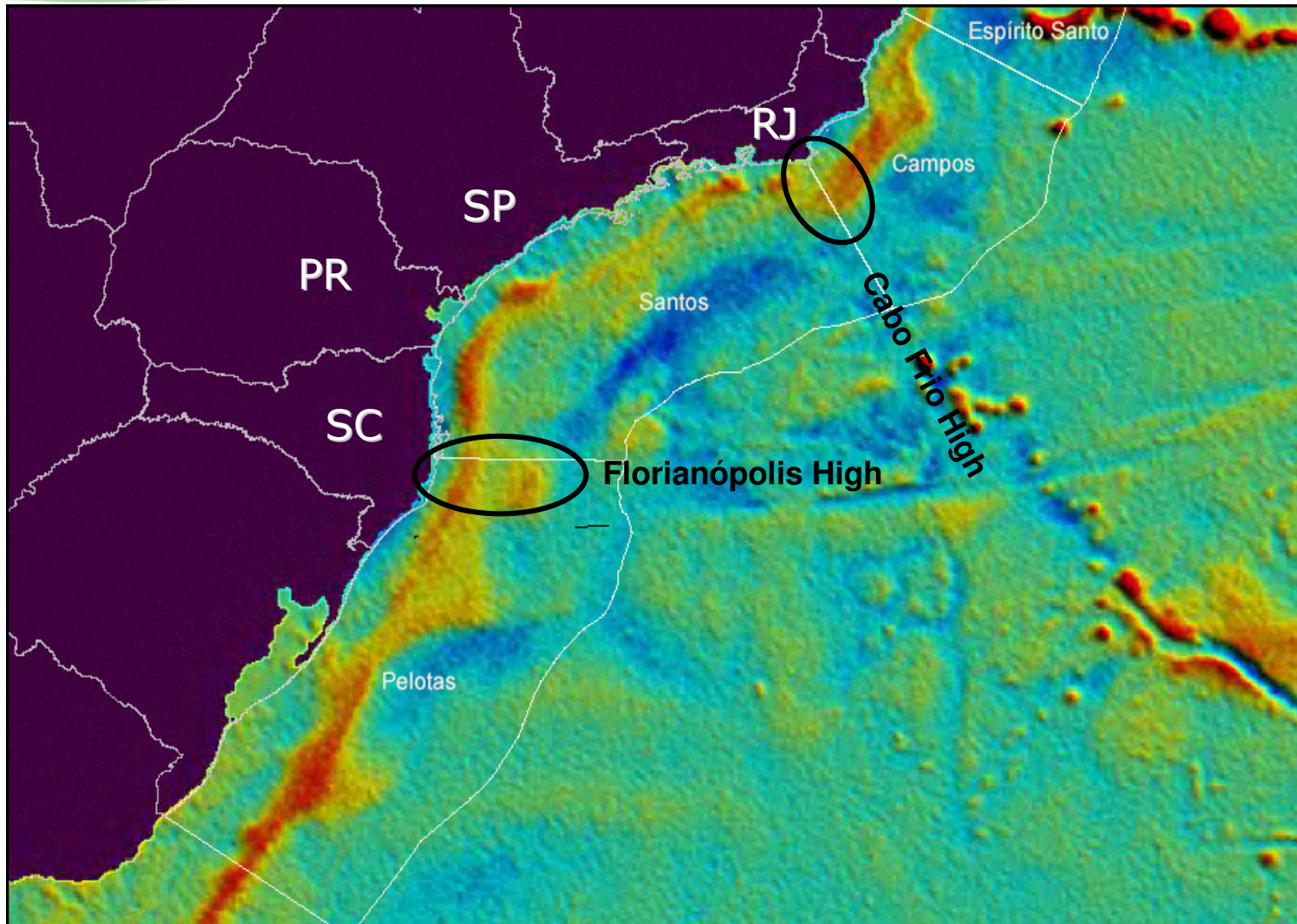


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Situation and Geologic Boundaries



Situation and Geologic Boundaries



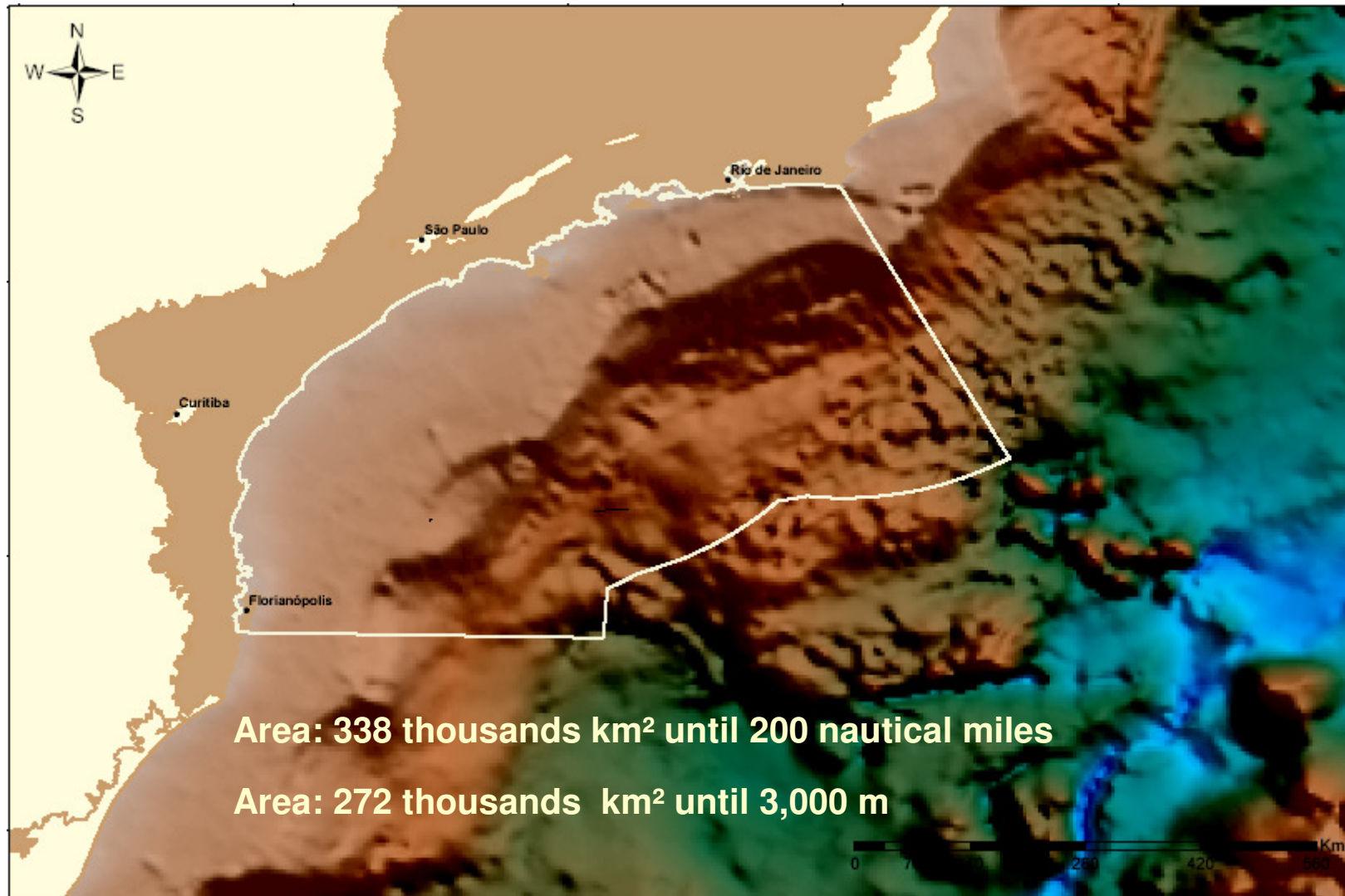


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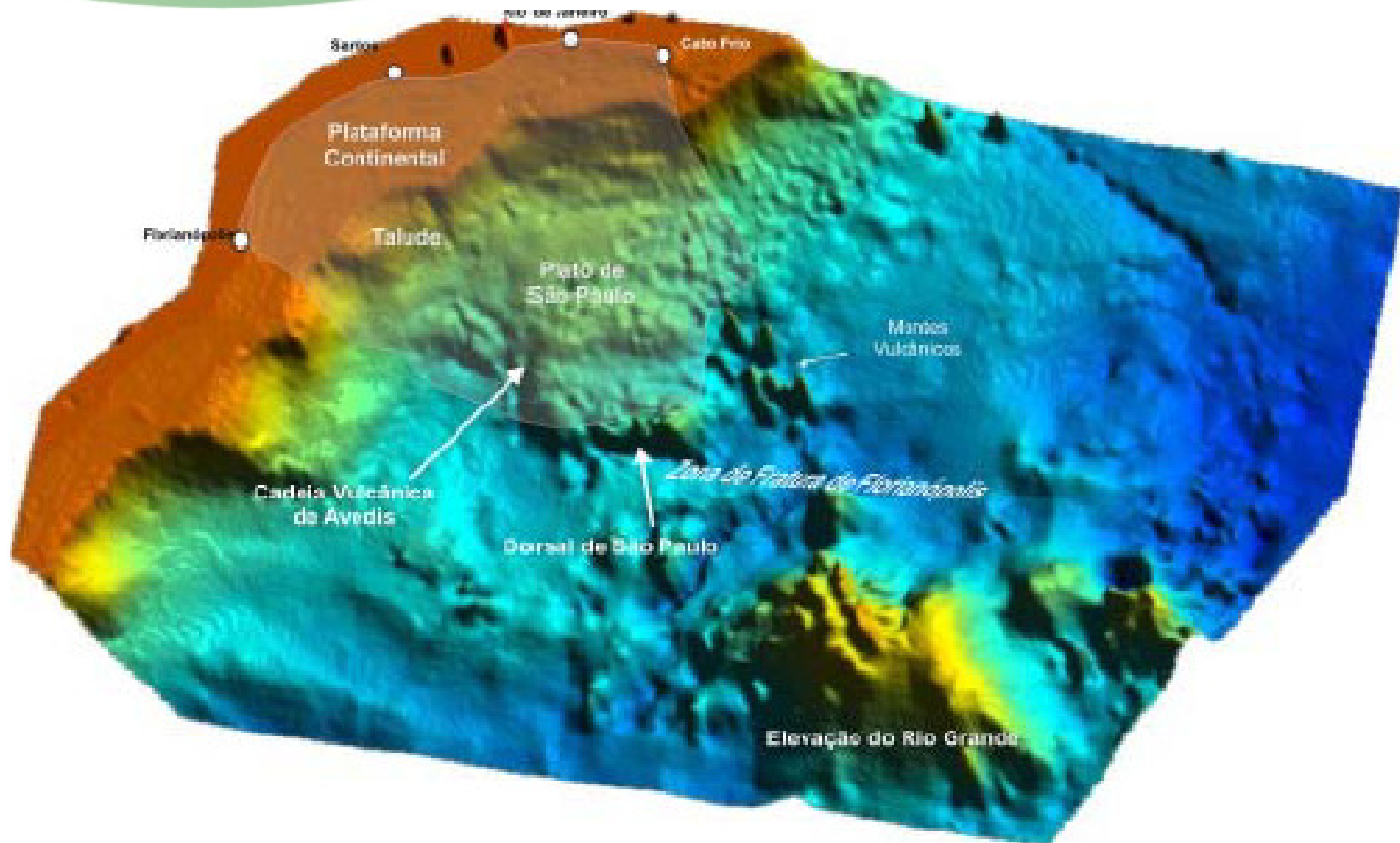


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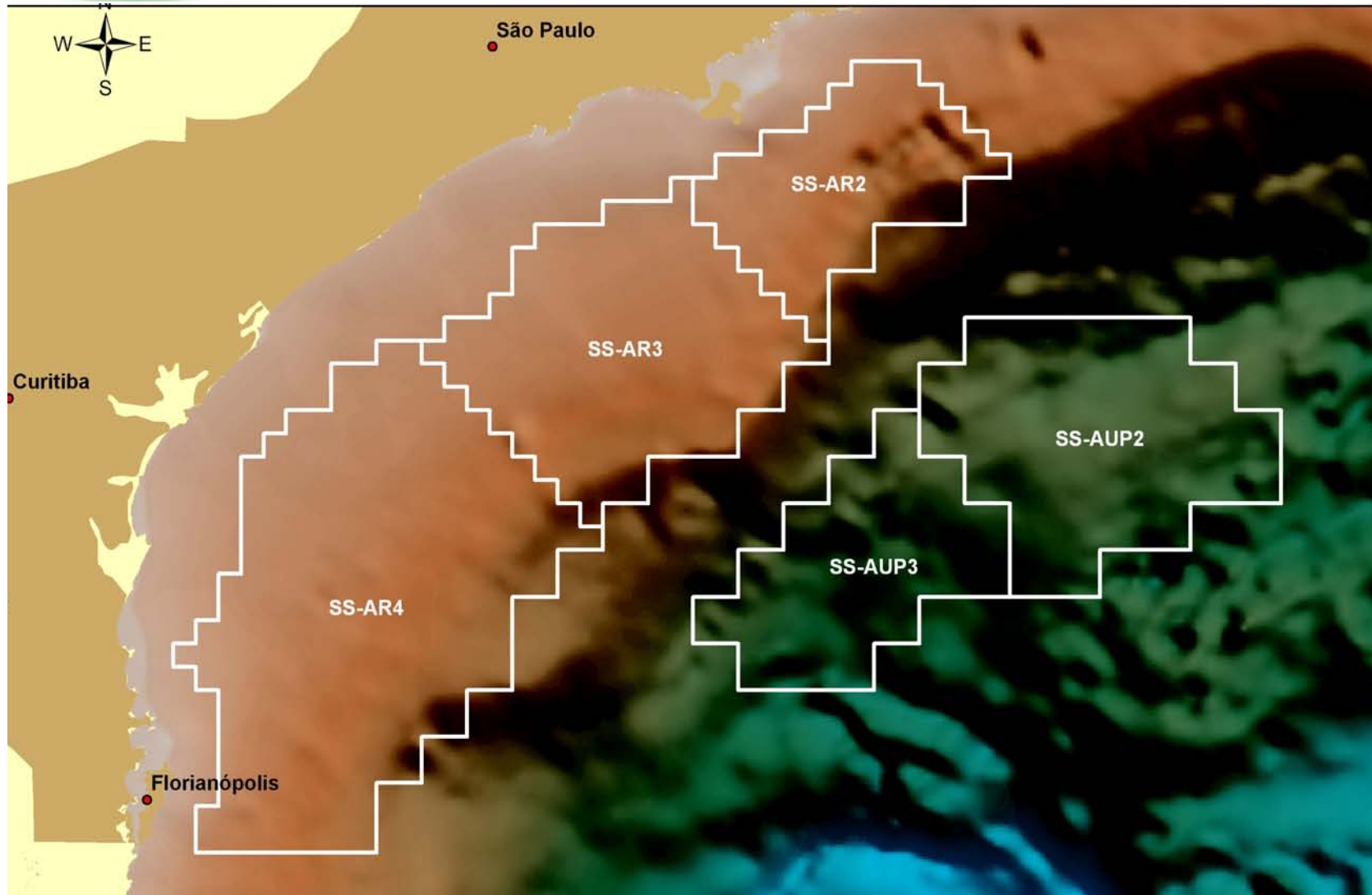
Basin Area and Bathymetry



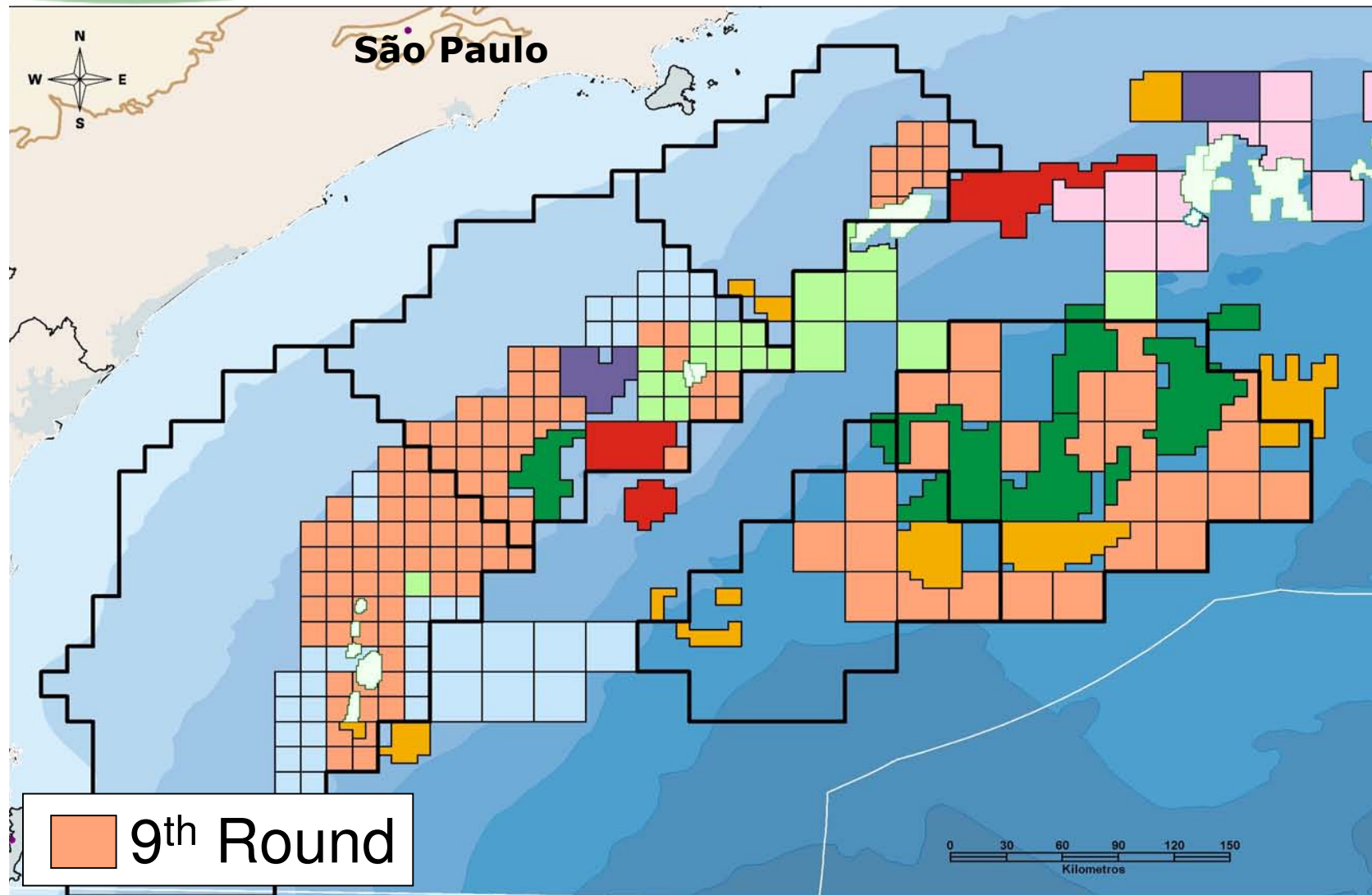
Physiography



Situation of Round 9 Sectors

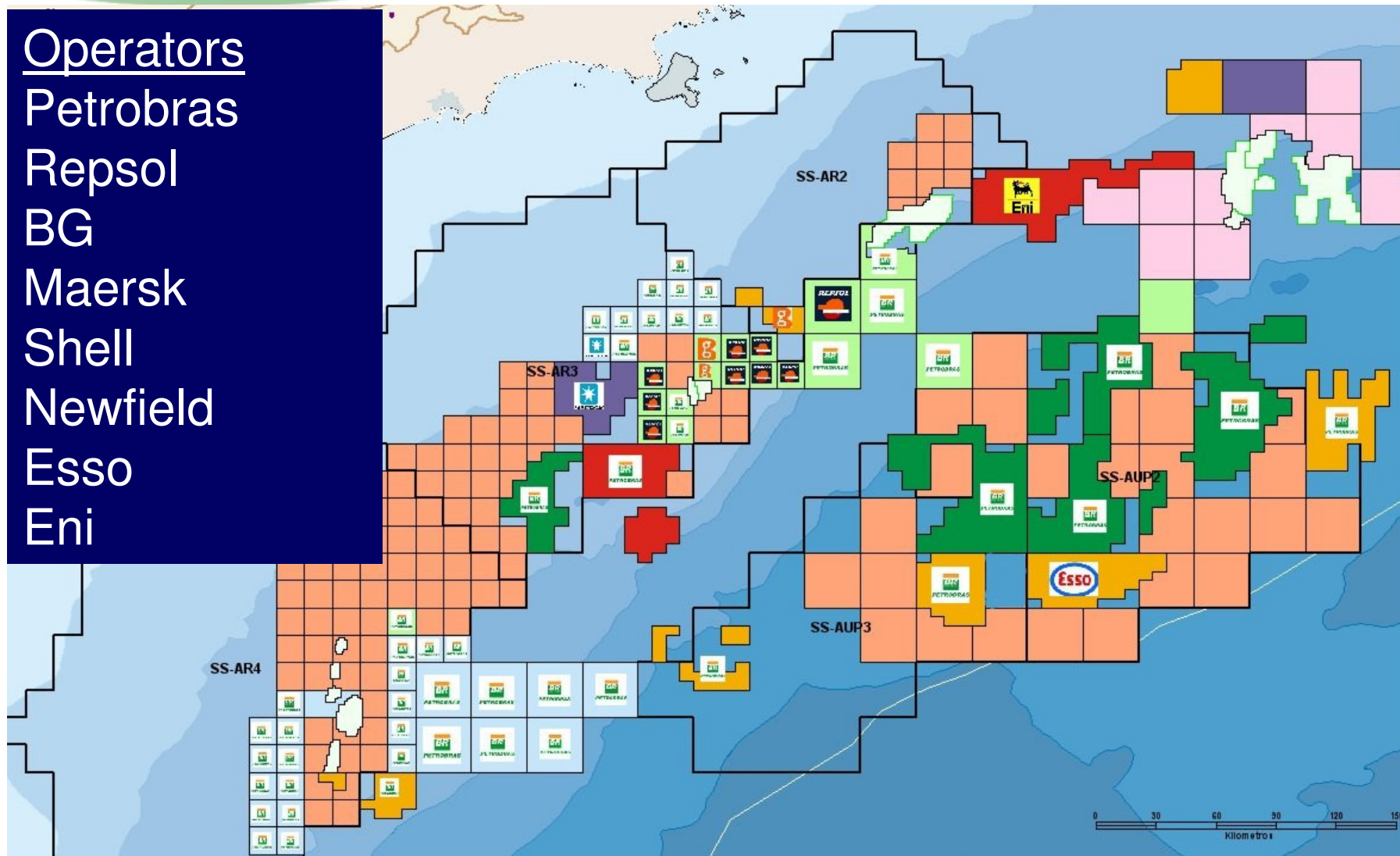


Situation of Round 9 Sectors

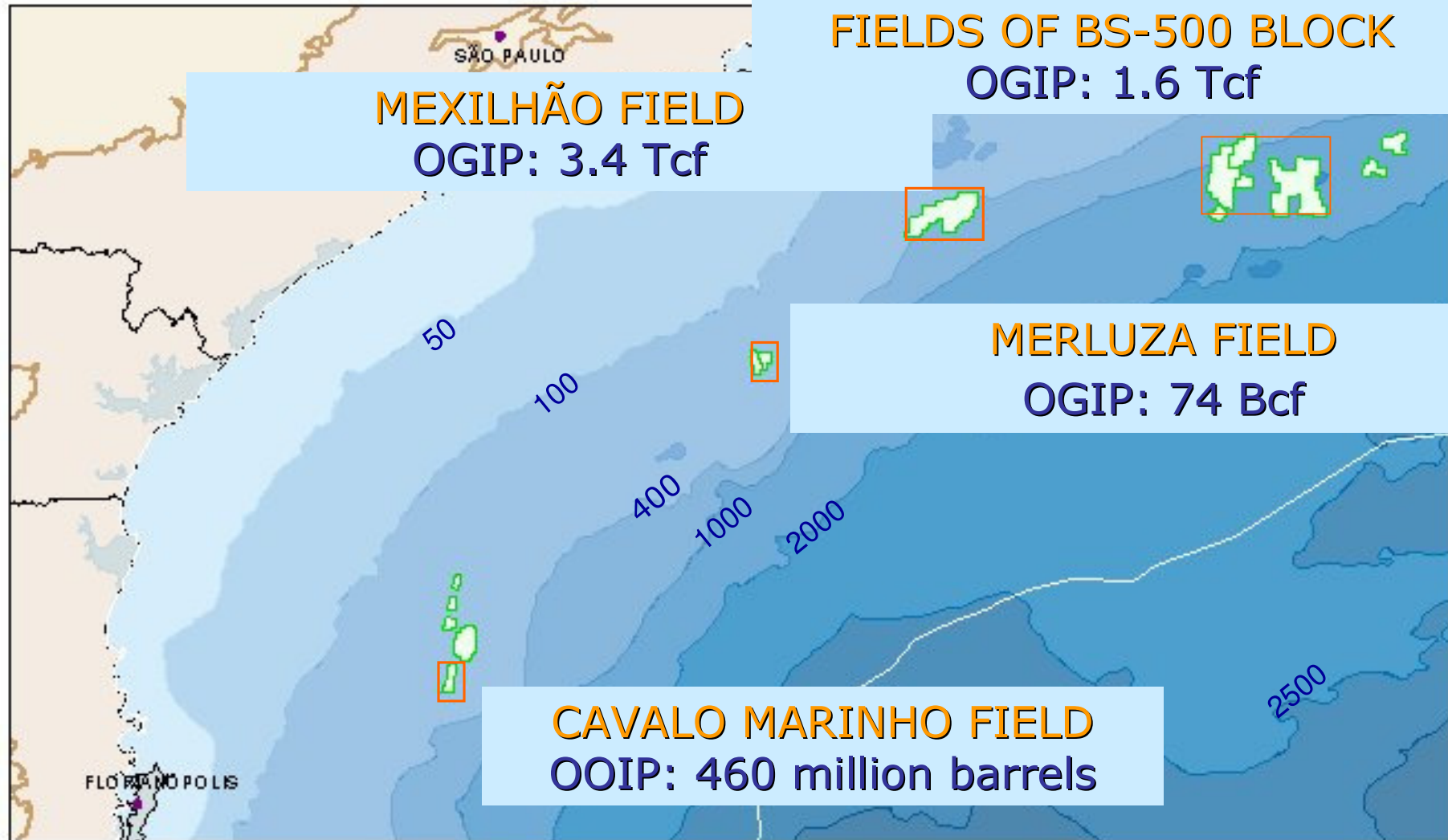


Operator Companies










Operators
Petrobras
Repsol
BG
Maersk
Shell
Newfield
Esso
Eni

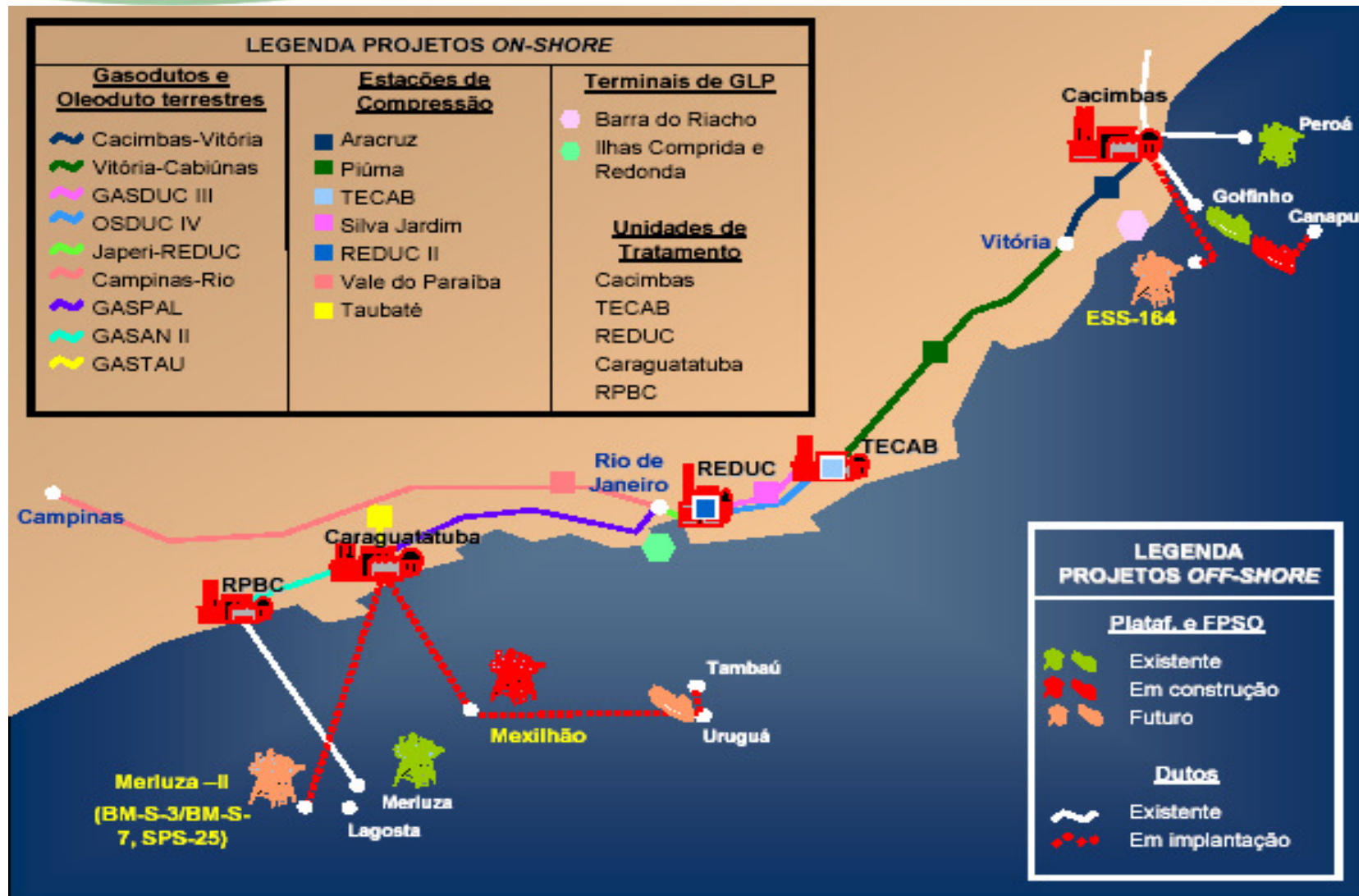


Oil & Gas Fields

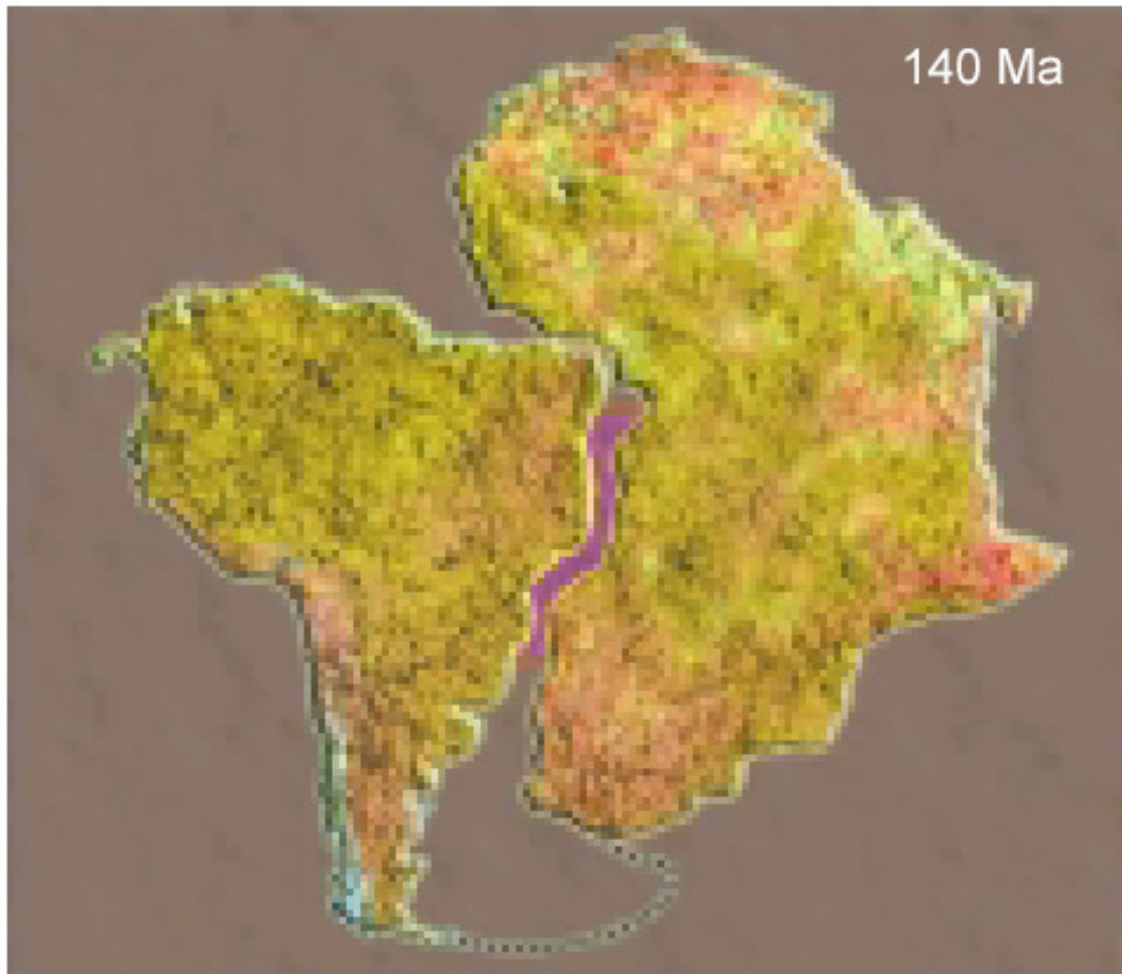


New Fields

FIELD NAME	DATE		MAIN PRODUCER HORIZONS	OOIP/OGIP
CAVALO MARINHO	Ago-03		Fm, Guarujá (Early albian)	460 MM bbl
LAGOSTA	Set-04		Mb, Ilha Bela - Fm, Itajaí-Açu (Upper Cretaceous)	173 Bcf
URUGUÁ	Dez-05		Mb, Ilha Bela - Fm, Itajaí-Açu (Upper Cretaceous)	1 Tcf
TAMBAÚ	Dez-05		Fm, Itanhaém (Late albian)	1.6 Tcf
ATLANTA	Fev-07		Fm, Marambaia (Tertiary)	-
OLIVA	Fev-07		Fm, Marambaia (Tertiary)	754 MM bbl
TAMBUATÁ	Fev-07		Mb, Ilha Bela - Fm, Itajaí-Açu (Upper Cretaceous)	1.6 B bbl
CARAPIÁ	Fev-07		Mb, Ilha Bela - Fm, Itajaí-Açu (Upper Cretaceous)	65 MM bbl
PIRAPITANGA	Fev-07		Fm, Florianópolis (Middle Albian)	2.5 Tcf

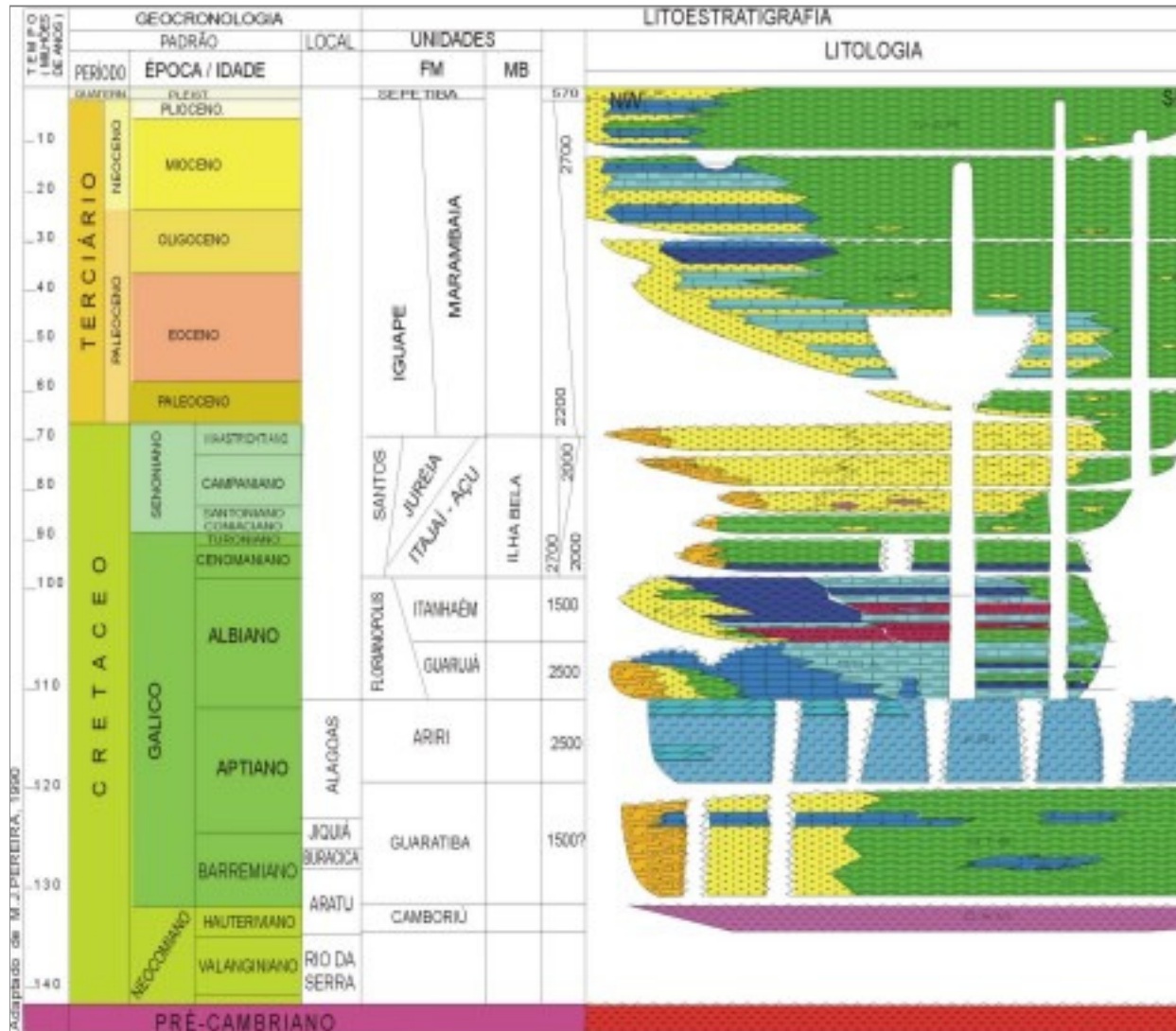


Tectonostratigraphy Evolution



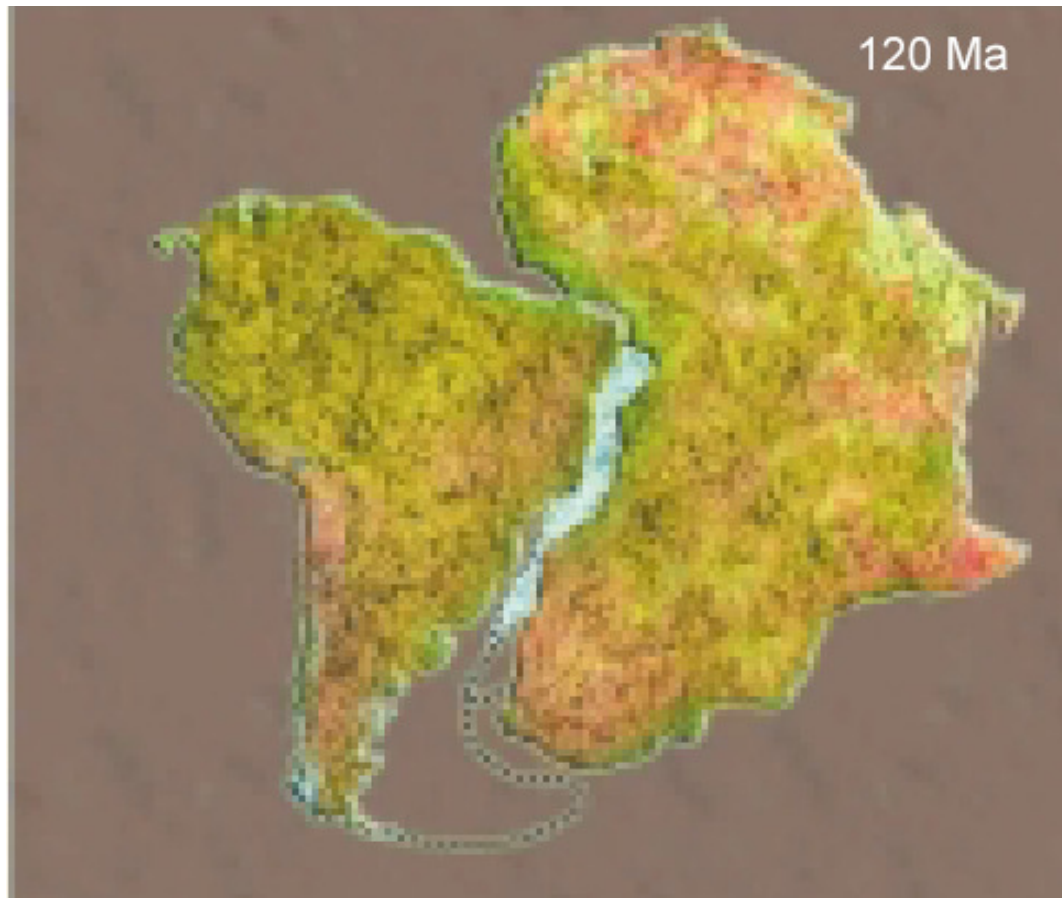
- ✓ Neocomian – break up of Gondwana (rifting phase)
- ✓ Mechanic subsidence
- ✓ Siliciclastic deposits

Tectonostratigraphy Evolution



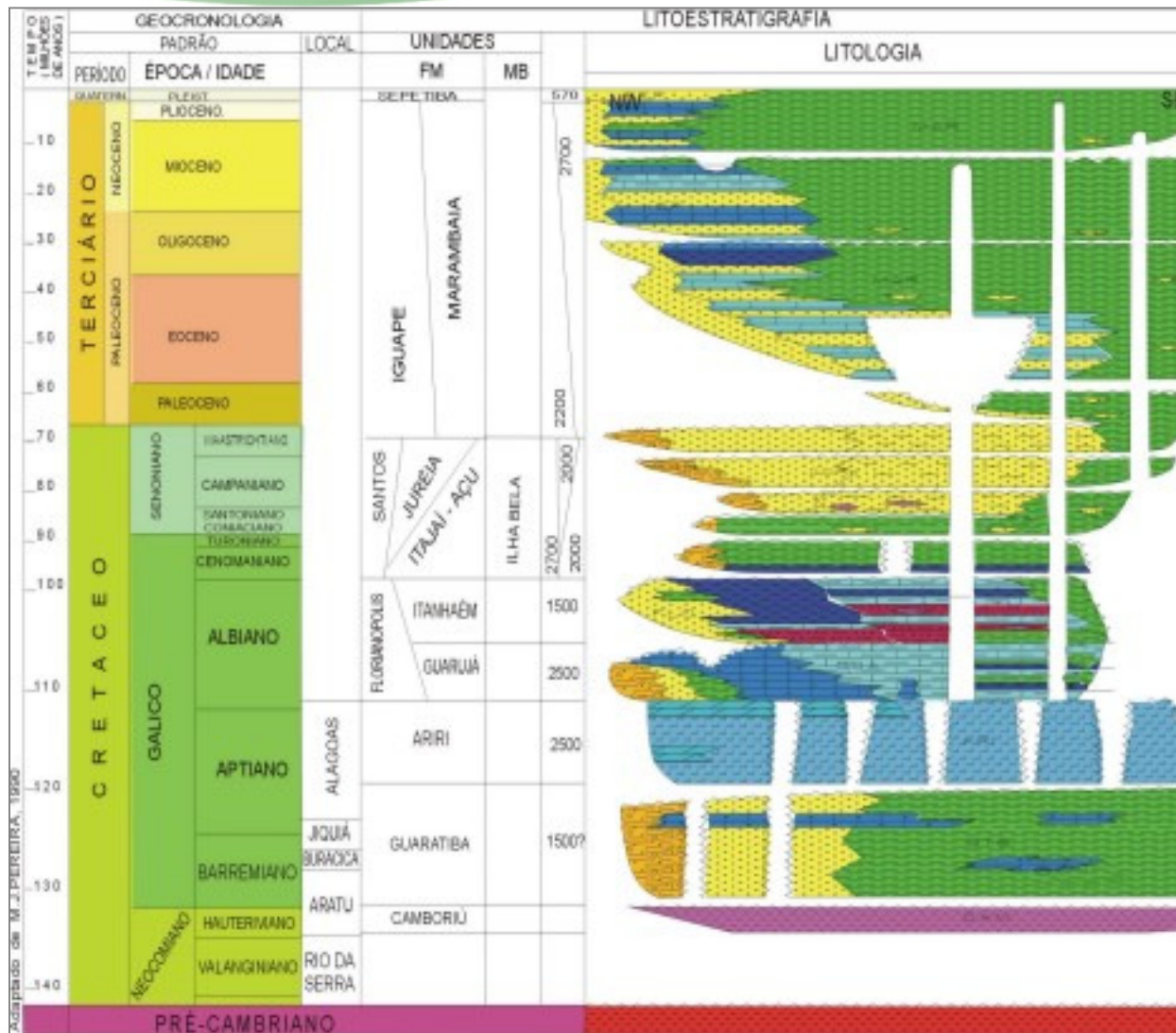
- Rift
- Neocomian (Atlantic rift)
- basalts (Camboriú Fm)
- Barremian/Late Aptian (Guaratiba Fm)

Tectonostratigraphy Evolution



- ✓ Aptian Age – Gulf Phase
(shallow and elongated)
- ✓ Thermal Subsidence
- ✓ Carbonate and
Evaporite Deposits

Tectonostratigraphy Evolution



- Transitional
- Aptian Carbonates (Sag Phase)
- Evaporites of Early Aptian (Ariri Fm)

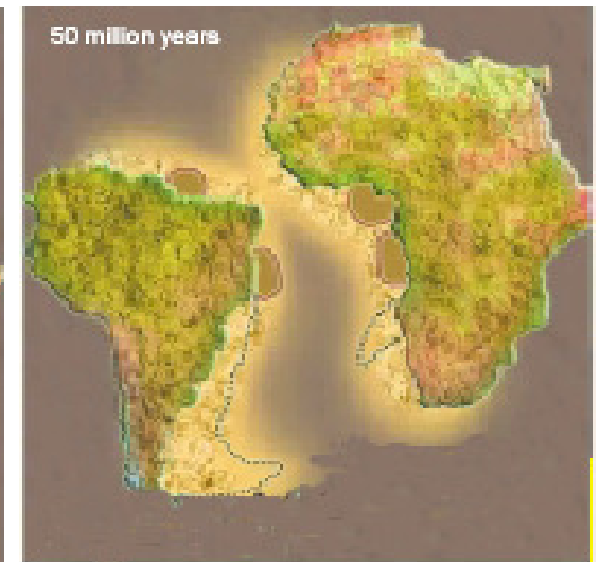
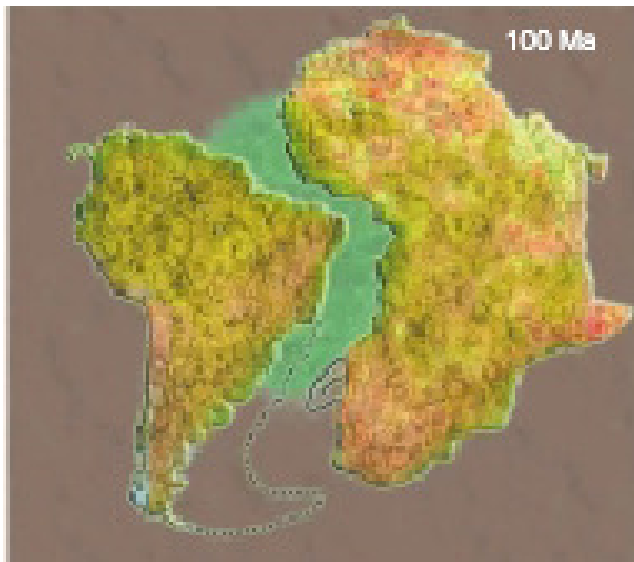


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Tectonostratigraphy Evolution

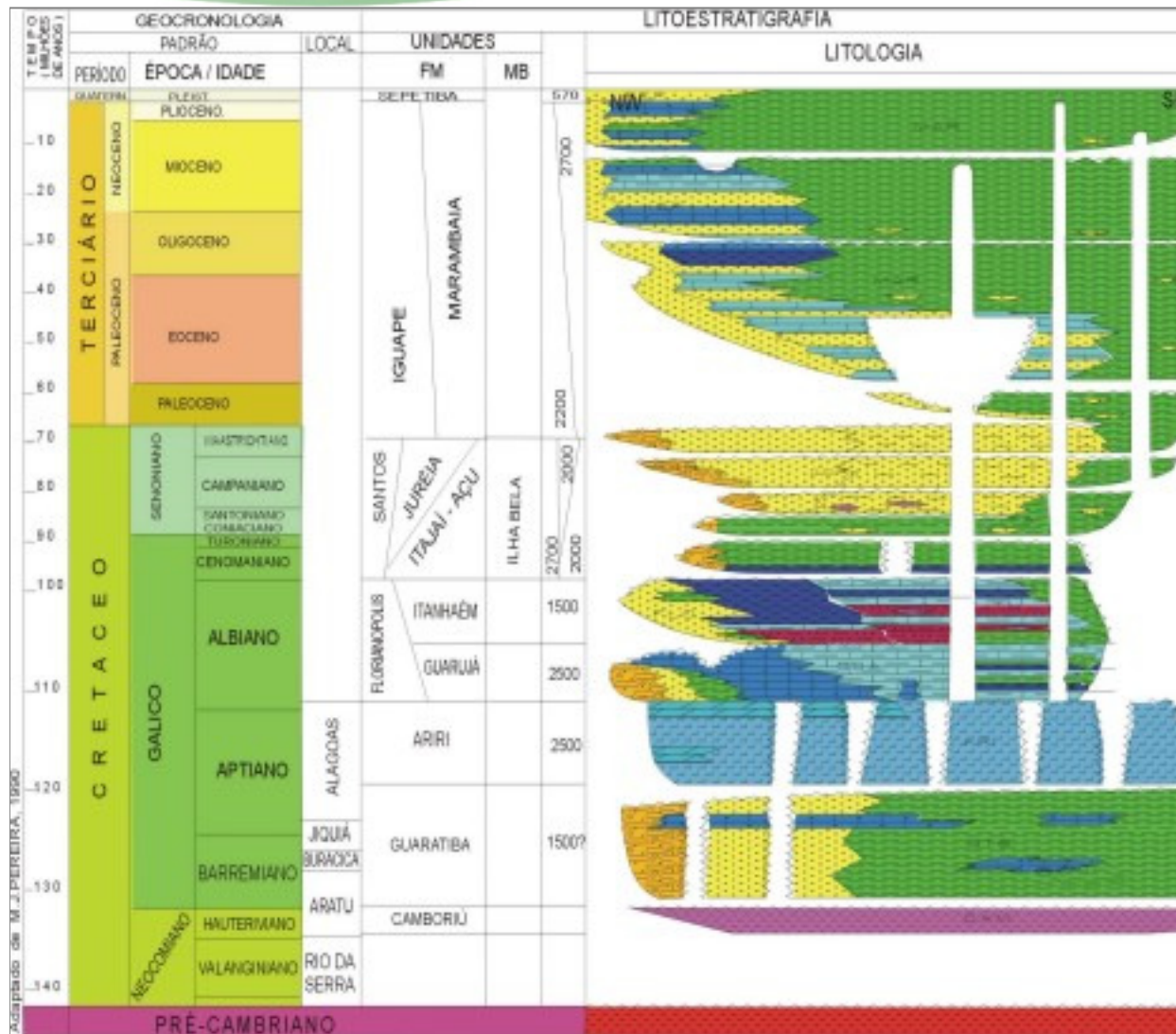


✓ Drift Phase – Marine Megasequence:

Transgressive Megasequence (Albian/Turanian) – carbonate platform and shales

Regressive Megasequence (Santonian/Tertiary) – siliciclastic deposits

Tectonostratigraphy Evolution



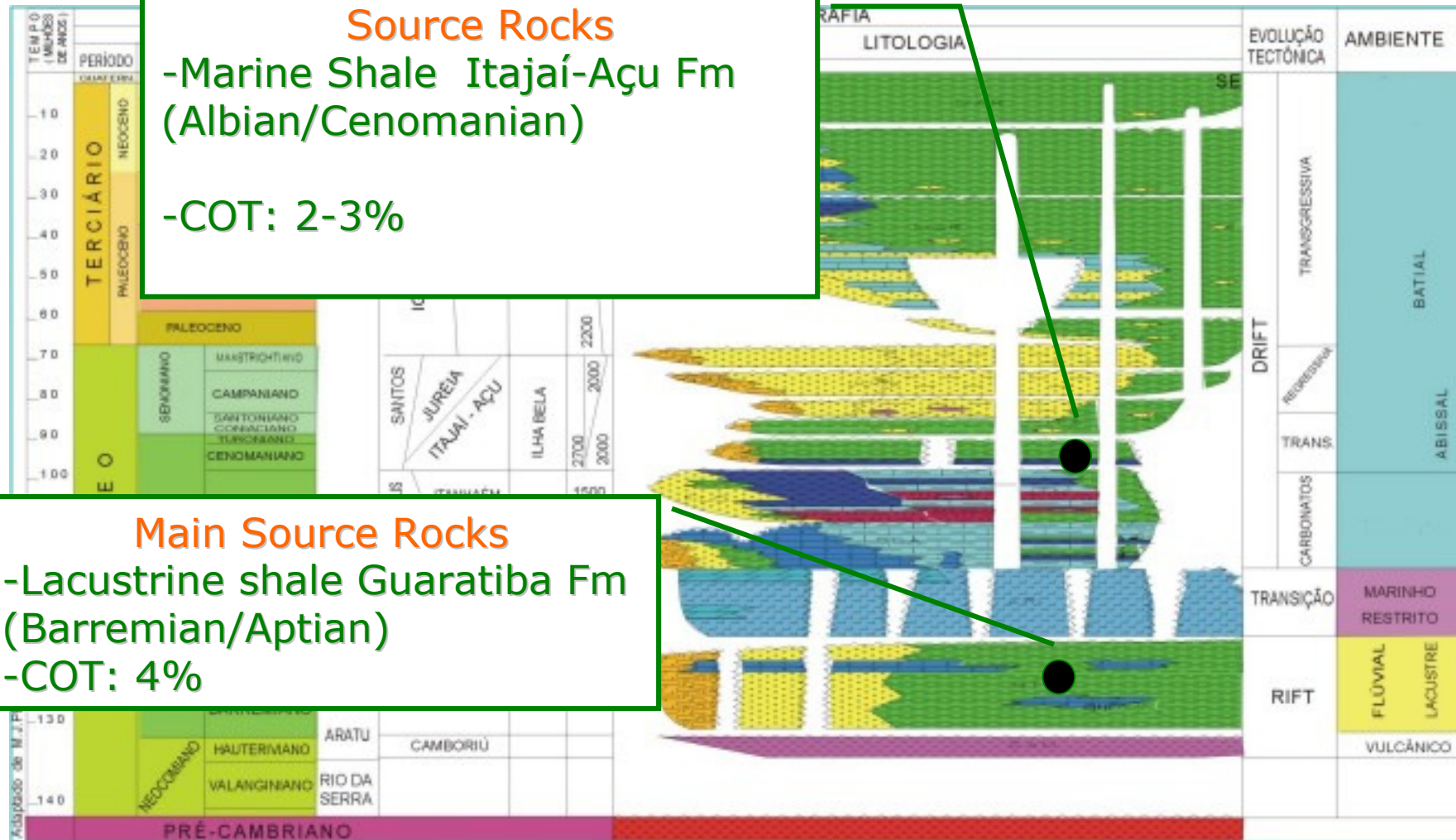
- Drift

- Regressive Phase
- Tertiary (Marambaia Fm)

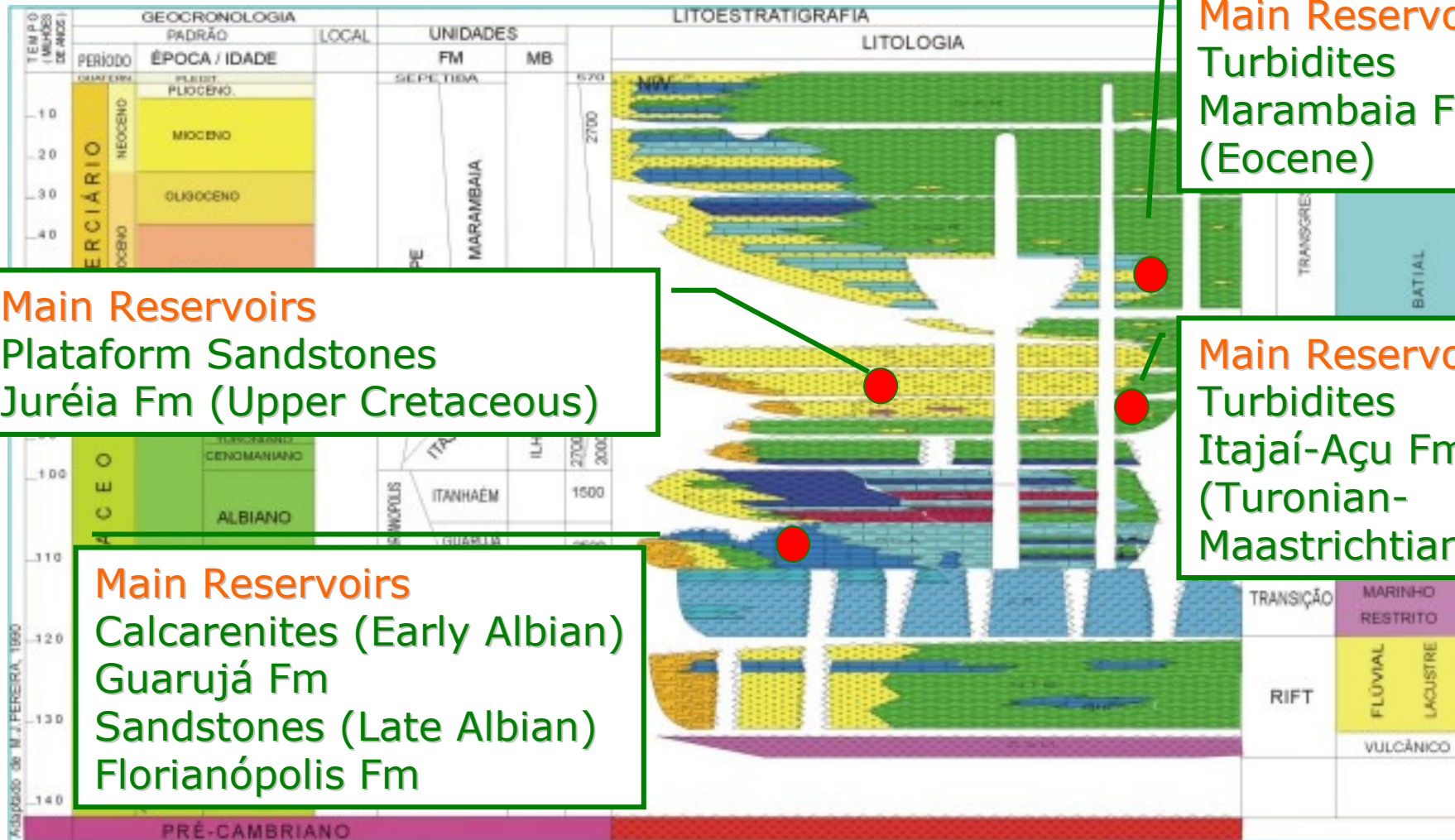
- Late Cretaceous (Juréia Fm and Ilha Bela Mb)

- Transgressive Phase
- Cenomanian/Turonian (Itajaí-Açu Fm)

- Early Albian (Guarujá Fm)



Petroleum System



Main Reservoirs
Plataform Sandstones
Juréia Fm (Upper Cretaceous)

Main Reservoirs
Turbidites
Marambaia Fm
(Eocene)

Main Reservoirs
Turbidites
Itajaí-Açu Fm
(Turonian-Maastrichtian)

Main Reservoirs
Calcarenites (Early Albian)
Guarujá Fm
Sandstones (Late Albian)
Florianópolis Fm

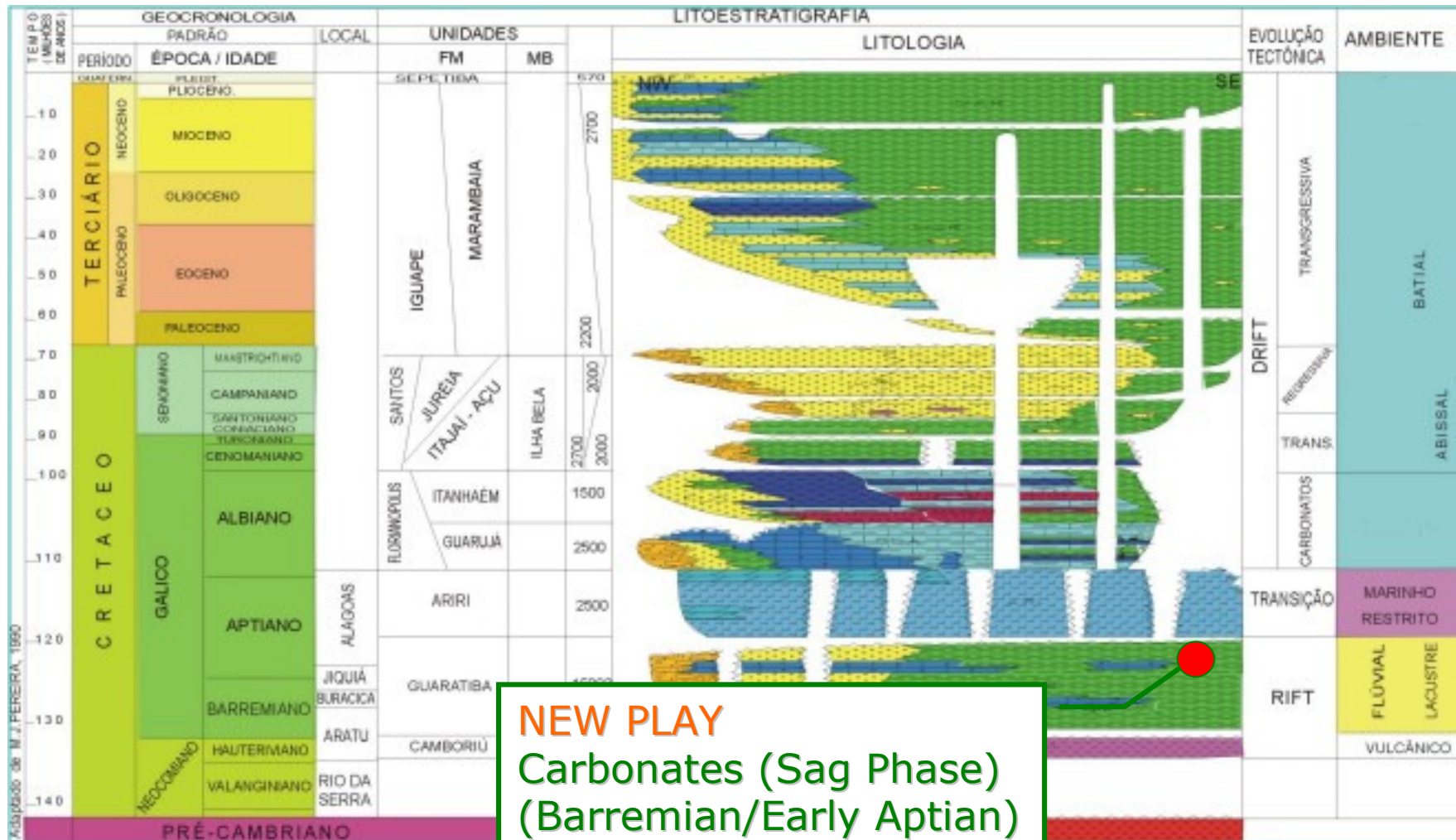


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Petroleum System



NEW PLAY
 Carbonates (Sag Phase)
 (Barremian/Early Aptian)
 Guaratiba Fm



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Petroleum System

- **Generation/Maturation**
- **Rift Sequence**
 - Beginning of the generation window : Albian
 - Generation peak: Cenomanian
- **Drift Sequence**
 - Beginning of the oil generation window : Maastrichtian
 - Generation peak : Oligocene
 - Conditioned to structural lows formed by halokinesis



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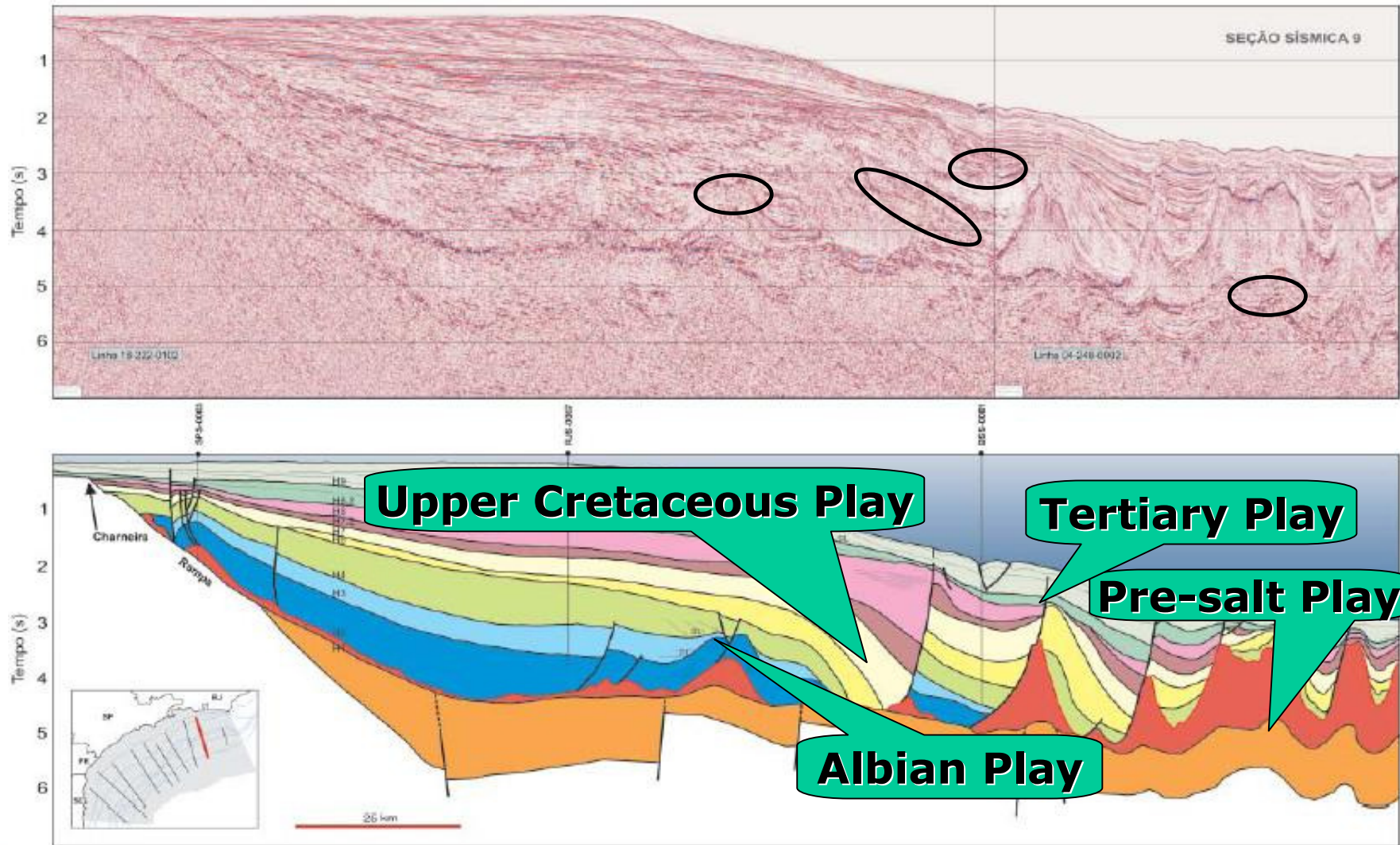


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Nona Rodada de Licitações

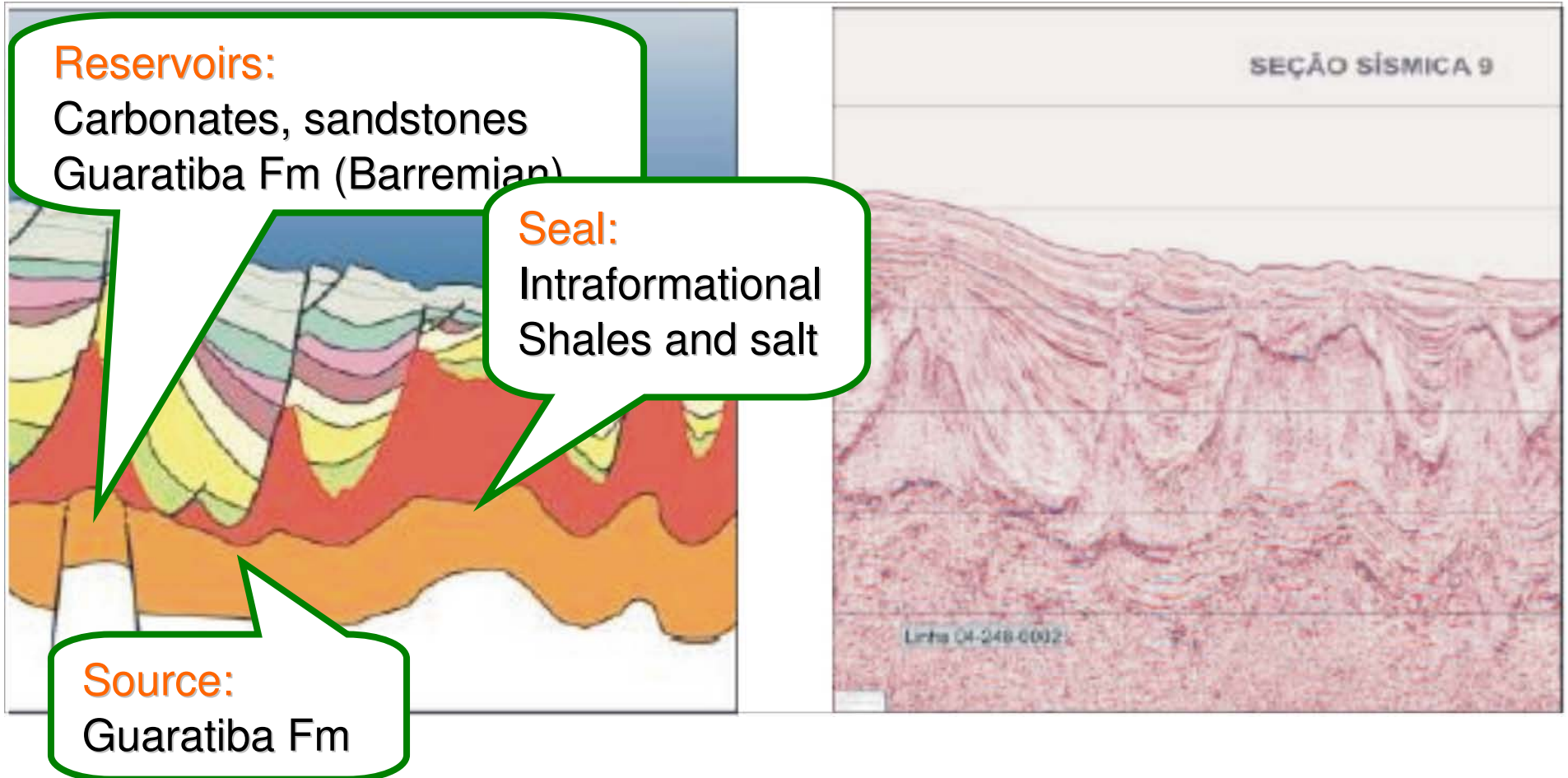
Petroleum System

- **Migration**
 - Listric faults associated to salt tectonics, unconformity surfaces and salt dome walls,
 - Autochthonous conditions of migration (Pre-salt section)
- **Traps**
 - Structural/stratigraphic control as salt tectonics effects in post-rift section
 - Pre-salt section prevail on structural traps
- **Cap Rocks**
 - Calcilutites, marls, shales and evaporites

Main Plays



Pre-Salt Play



Pre-Salt Potential (Example)

BM-S-11 Block (Petrobras)

Discovery Well = 1-BRSA-369A-RJS

Date = October 2006

Water Depth = 2,126 m

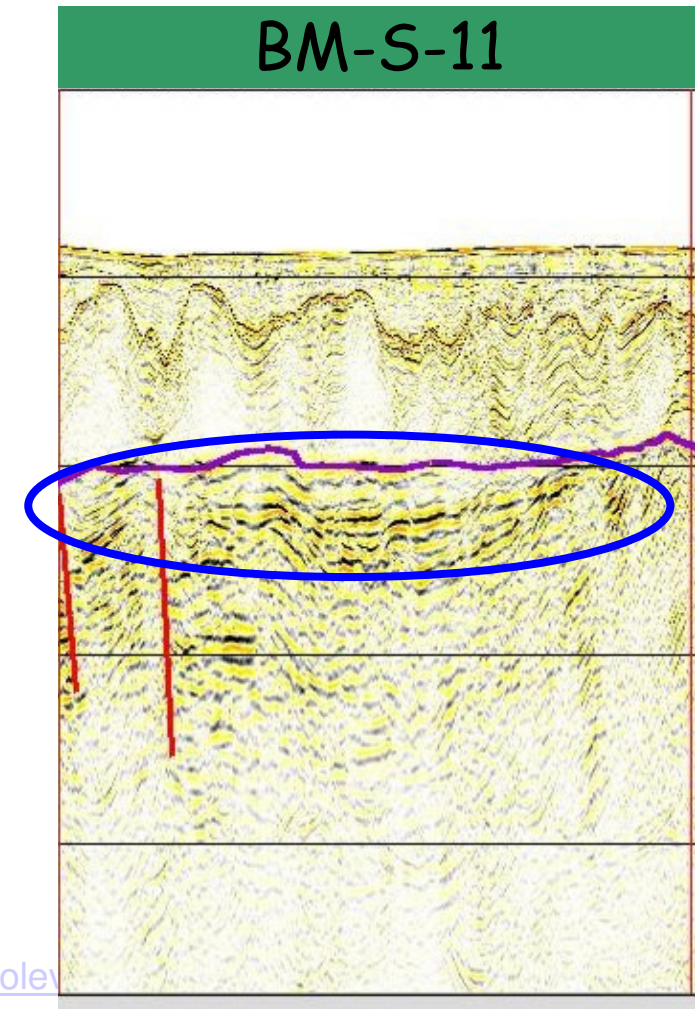
Distance of coast = 250 km

Reservoir Depth = ~ 5,150 m

Fluid Type: Oil 30° API

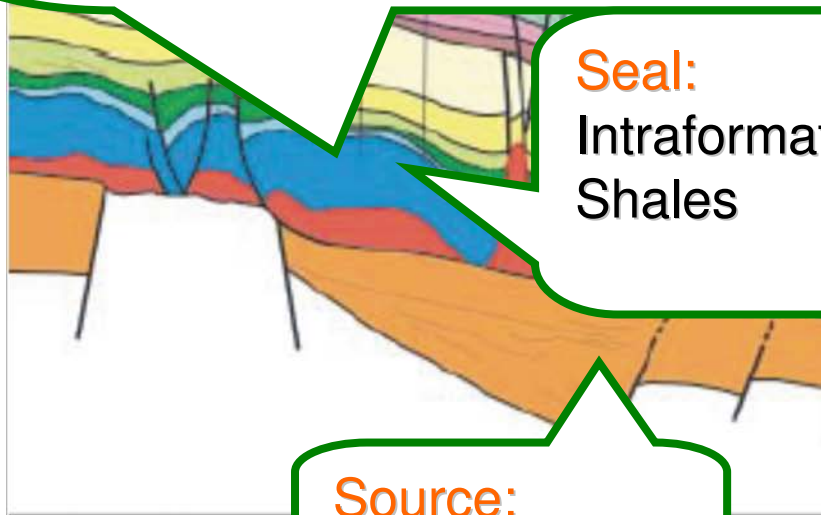
Test = 4,900 barrels oil/day
150,000 m³ gas/day

http://www.acionista.com.br/home/petrobras/041006_descoberta_oleolev
http://www.bg-group.com/media/archive_2006/100406-sx.htm



Reservoirs:

Sandstones of Florianópolis Fm,
Calcarenites of Guarujá Fm (Early Albian)
and turbidites of Itanhaém Fm (Late
Albian)

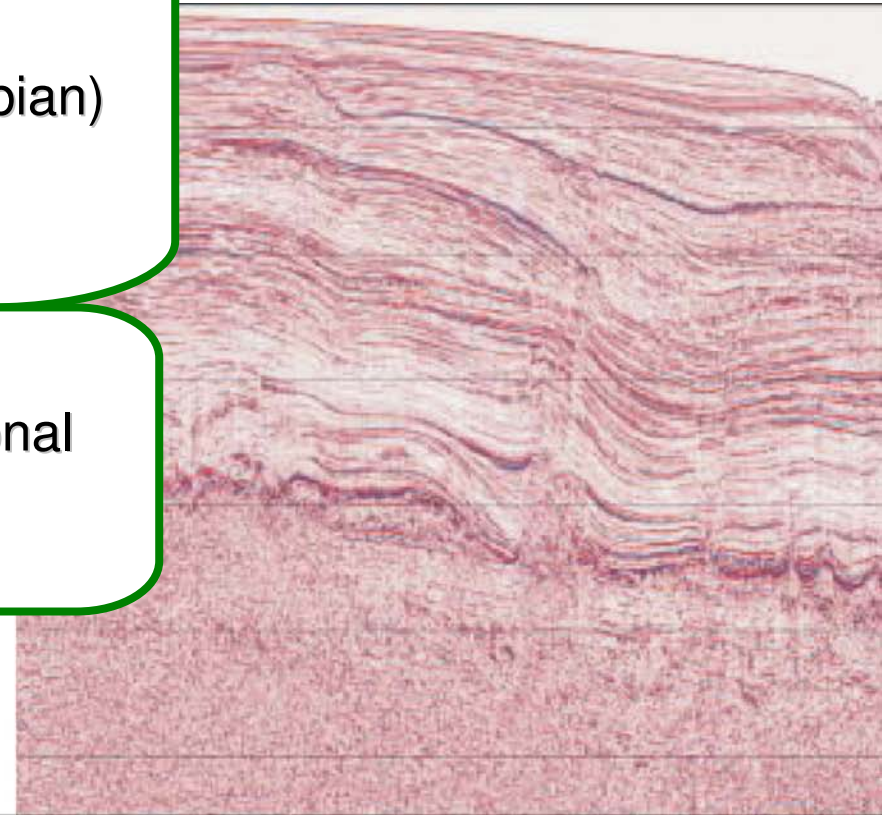


Seal:

Intraformational
Shales

Source:

Guaratiba Fm

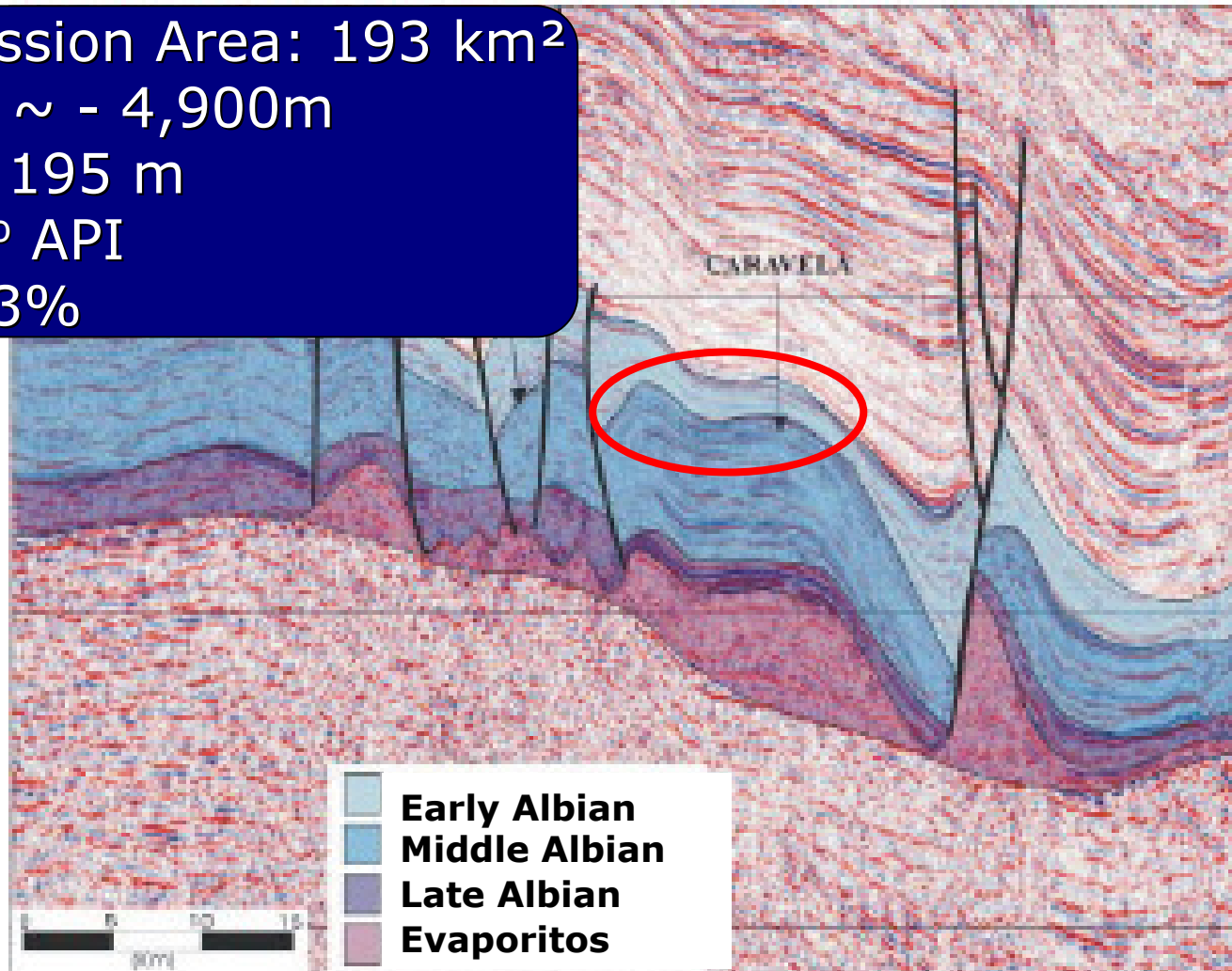


Caravela Oil Field

Carbonate Reservoir

Albian Play

Concession Area: 193 km²
Depth ~ - 4,900m
WD = 195 m
Oil 40° API
Ø = 13%

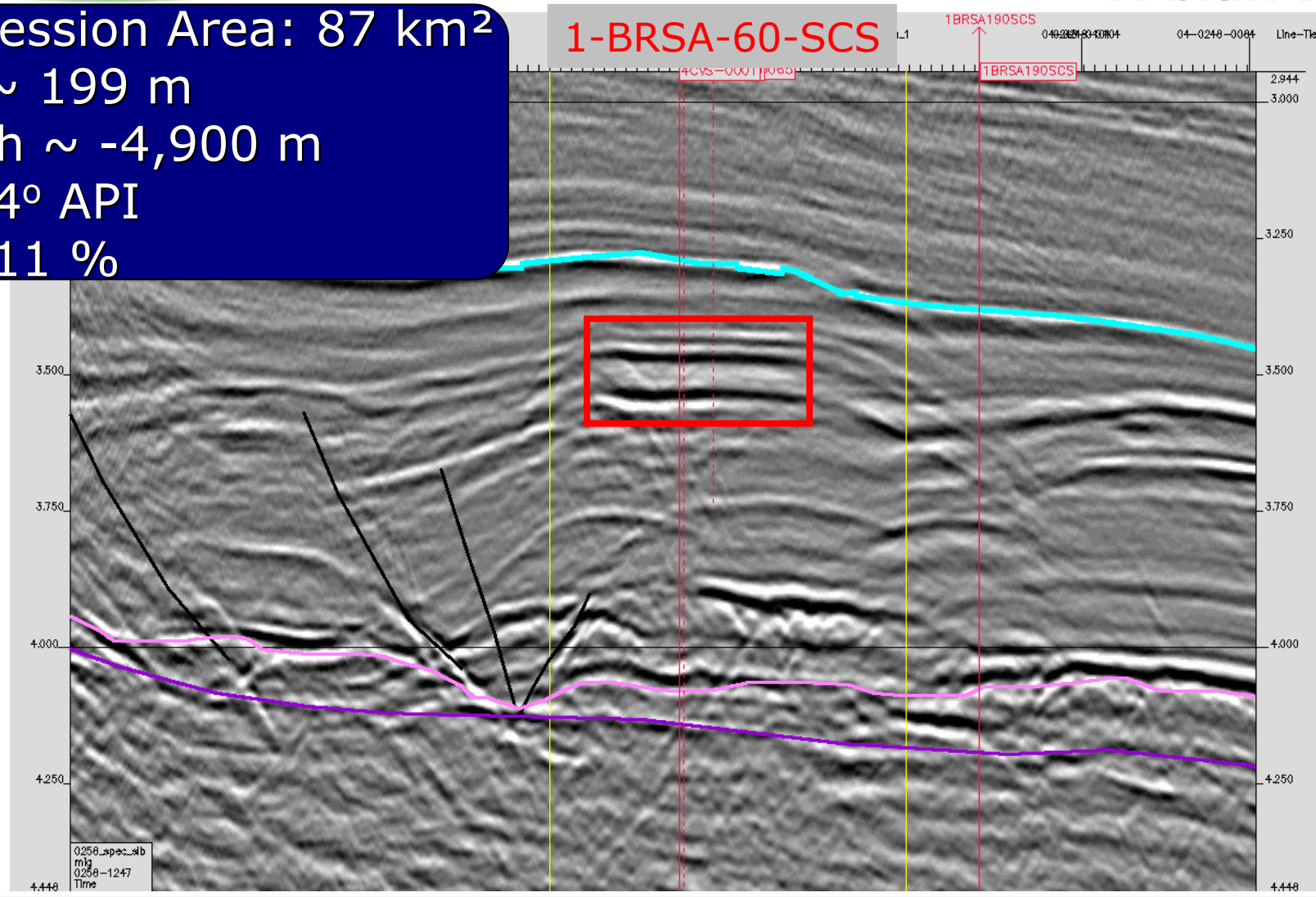


Cavalo Marinho Oil Field

Carbonate Reservoir

Albian Play

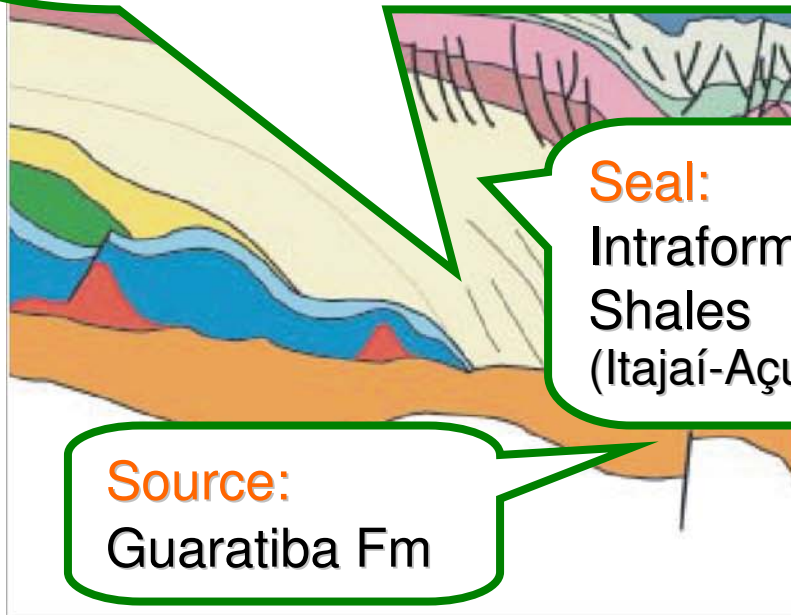
Concession Area: 87 km²
WD ~ 199 m
Depth ~ -4,900 m
Oil 44° API
Ø = 11 %



Upper Cretaceous Play

Reservoir:

Turbidites of Ilha Bela Mb (Itajaí-Açu Fm) and platform sandstones of Juréia Fm (Turonian/Maastrichtian)

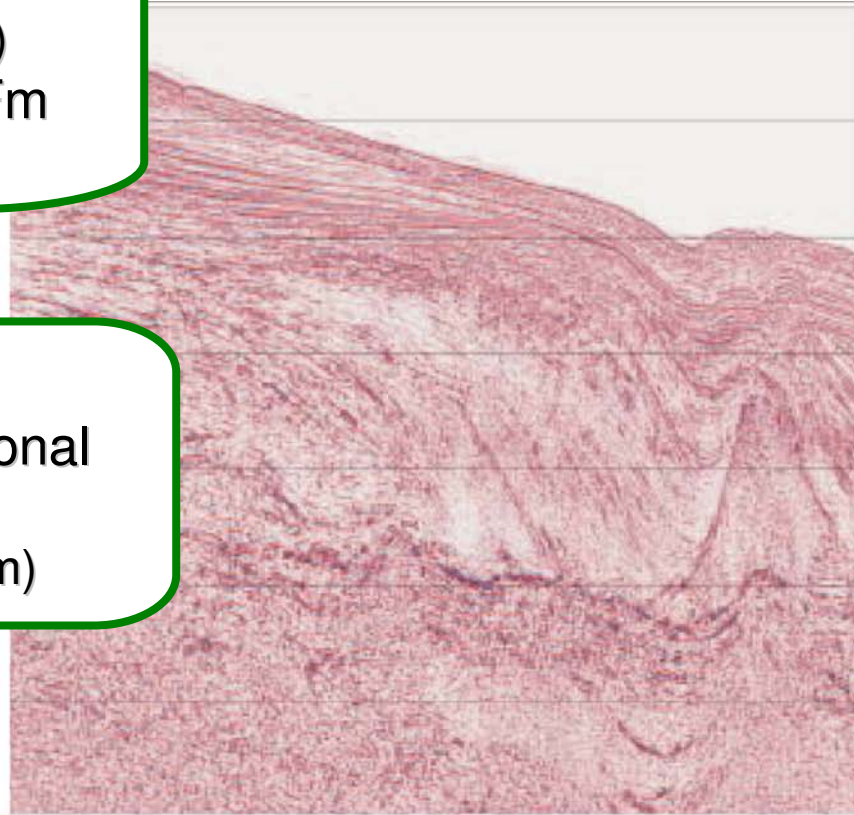


Seal:

Intraformational Shales (Itajaí-Açu Fm)

Source:

Guaratiba Fm



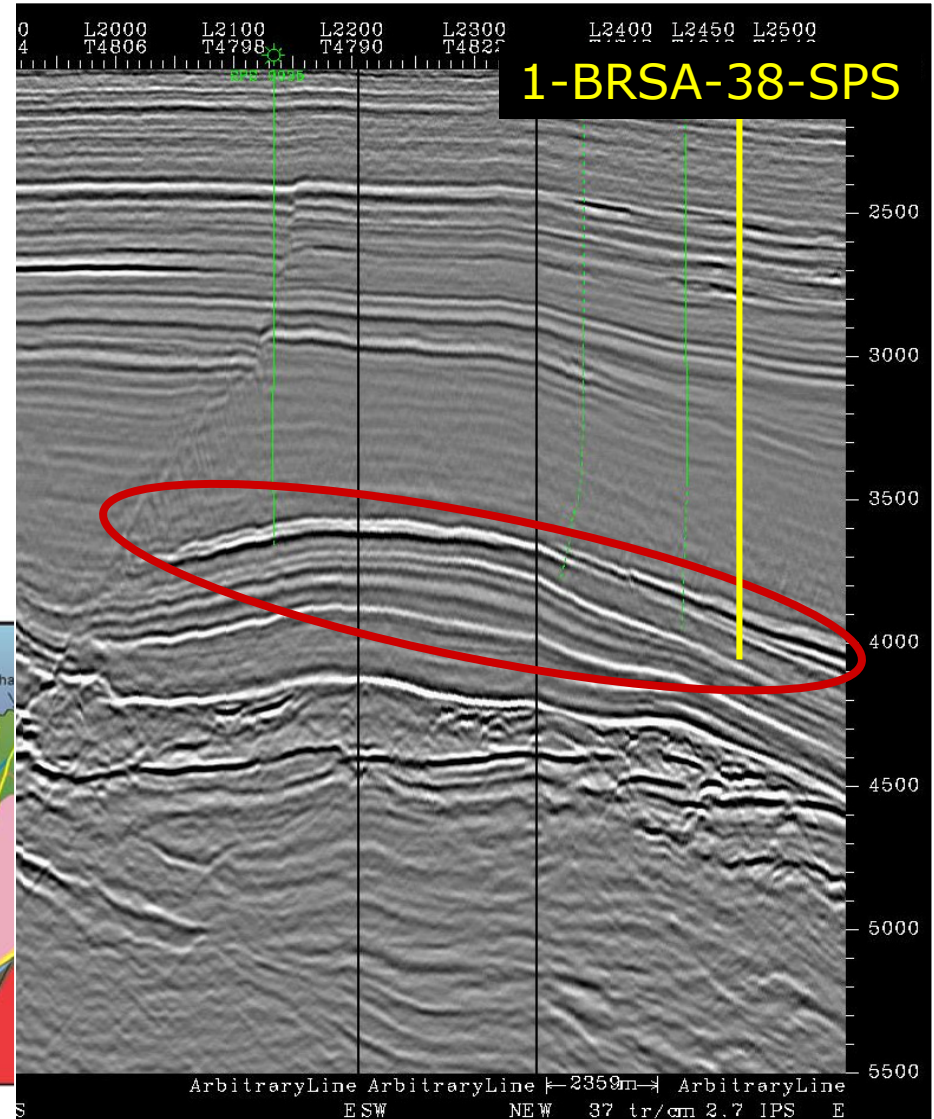
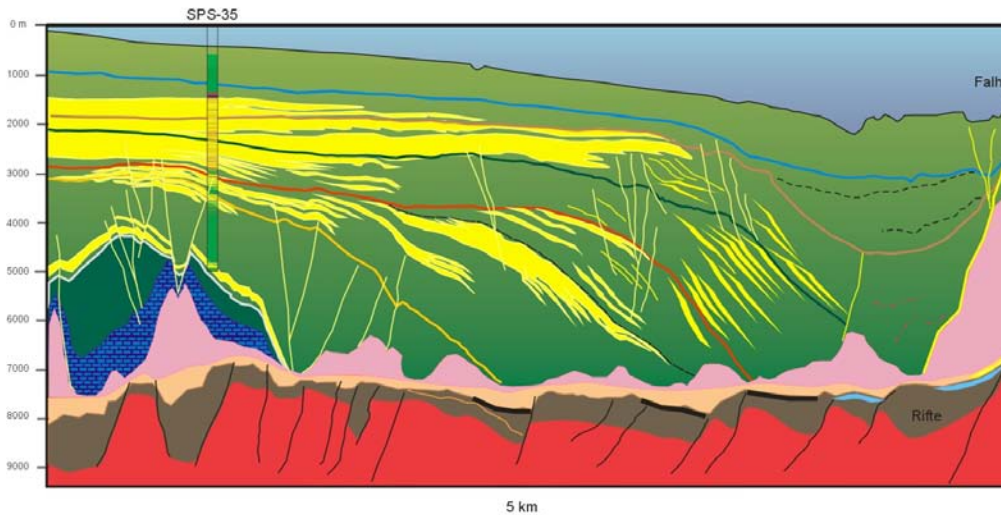


Mexilhão Gas Field

Sandstone Reservoir

Upper Cretaceous Play

Concession Area: 546 km²
WD ~ 500 m
Depth ~ -4,400 m
Ø = 13-19 %
k = 0,5 – 5 mD



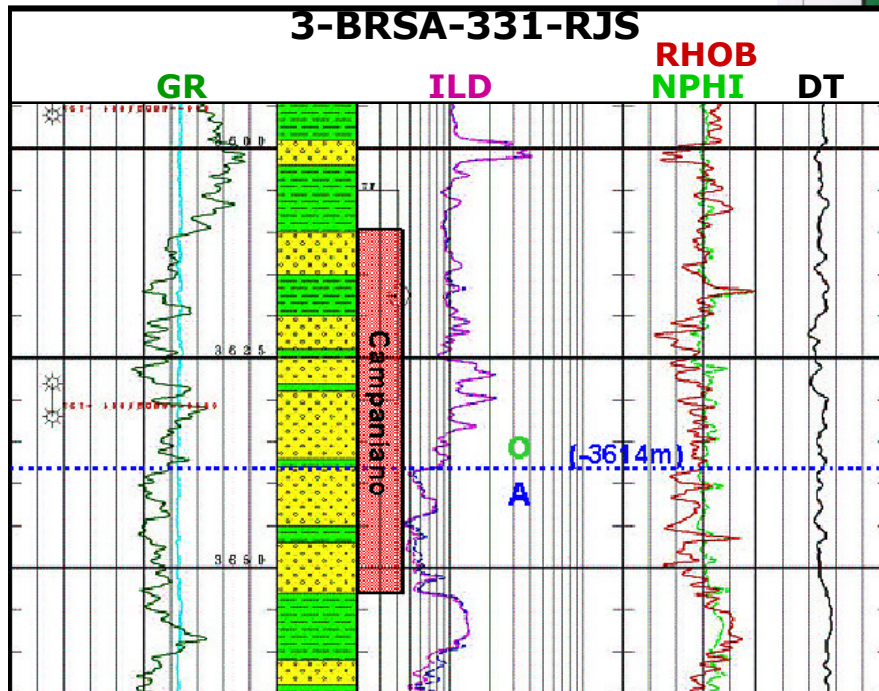
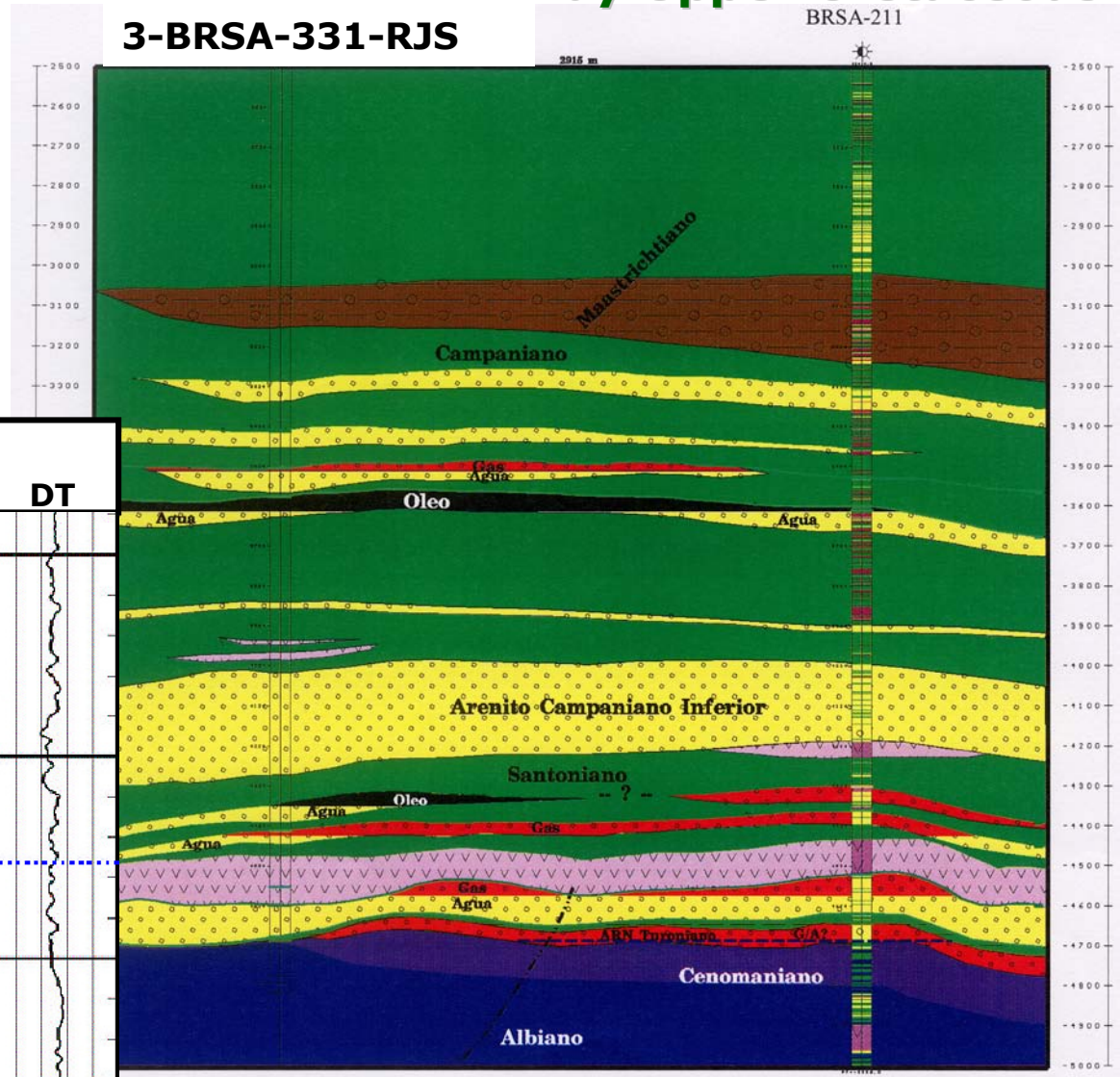
Source: Petrobras



Uruguá Oil/Gas Field

Sandstone Reservoir Play Upper Cretaceous

Concession Area: 64 km²
Depth: - 3,600 m
Oil 32,5° API
Ø = 26 %
WD = 1,391 m

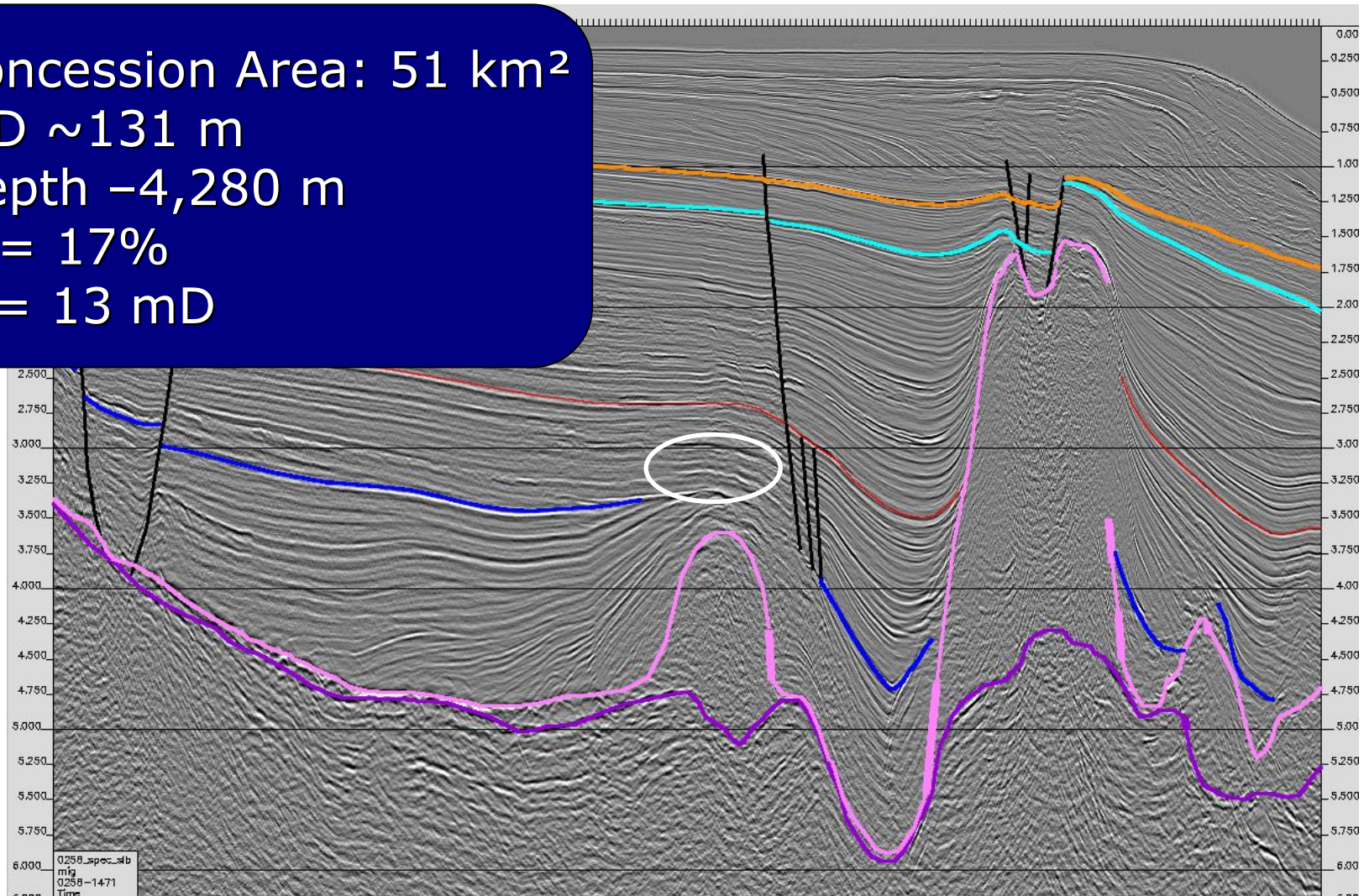


Source: Petrobras

Merluza Gas Field

Sandstone Reservoir Play Upper Cretaceous

Concession Area: 51 km²
WD ~131 m
Depth -4,280 m
 $\emptyset = 17\%$
K = 13 mD



Tertiary Play

Reservoirs:

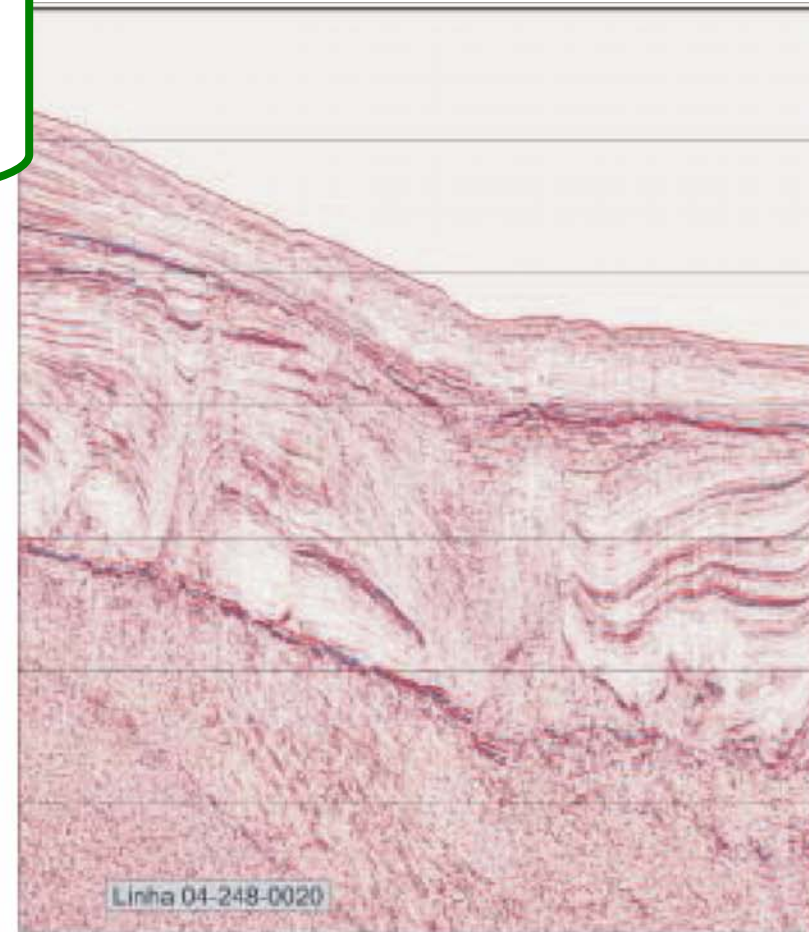
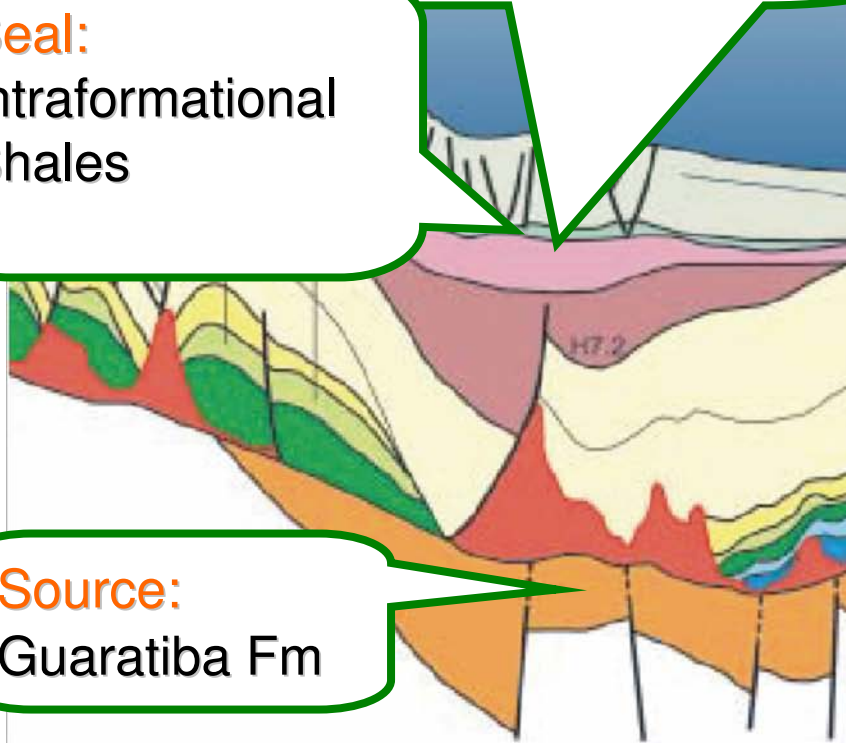
Turbidites of
Marambaia Fm (Eocene)

Seal:

Intraformational
Shales

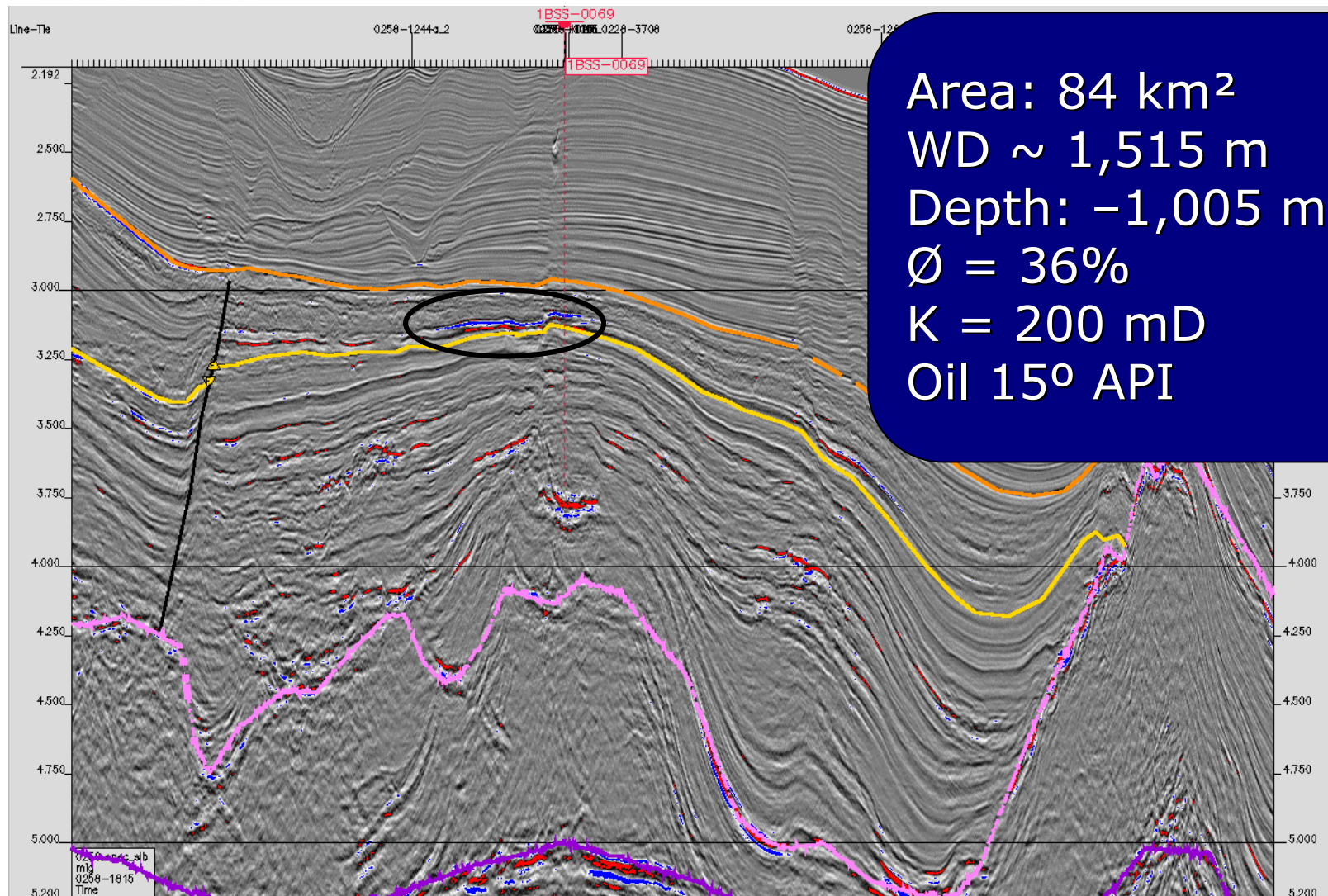
Source:

Guaratiba Fm

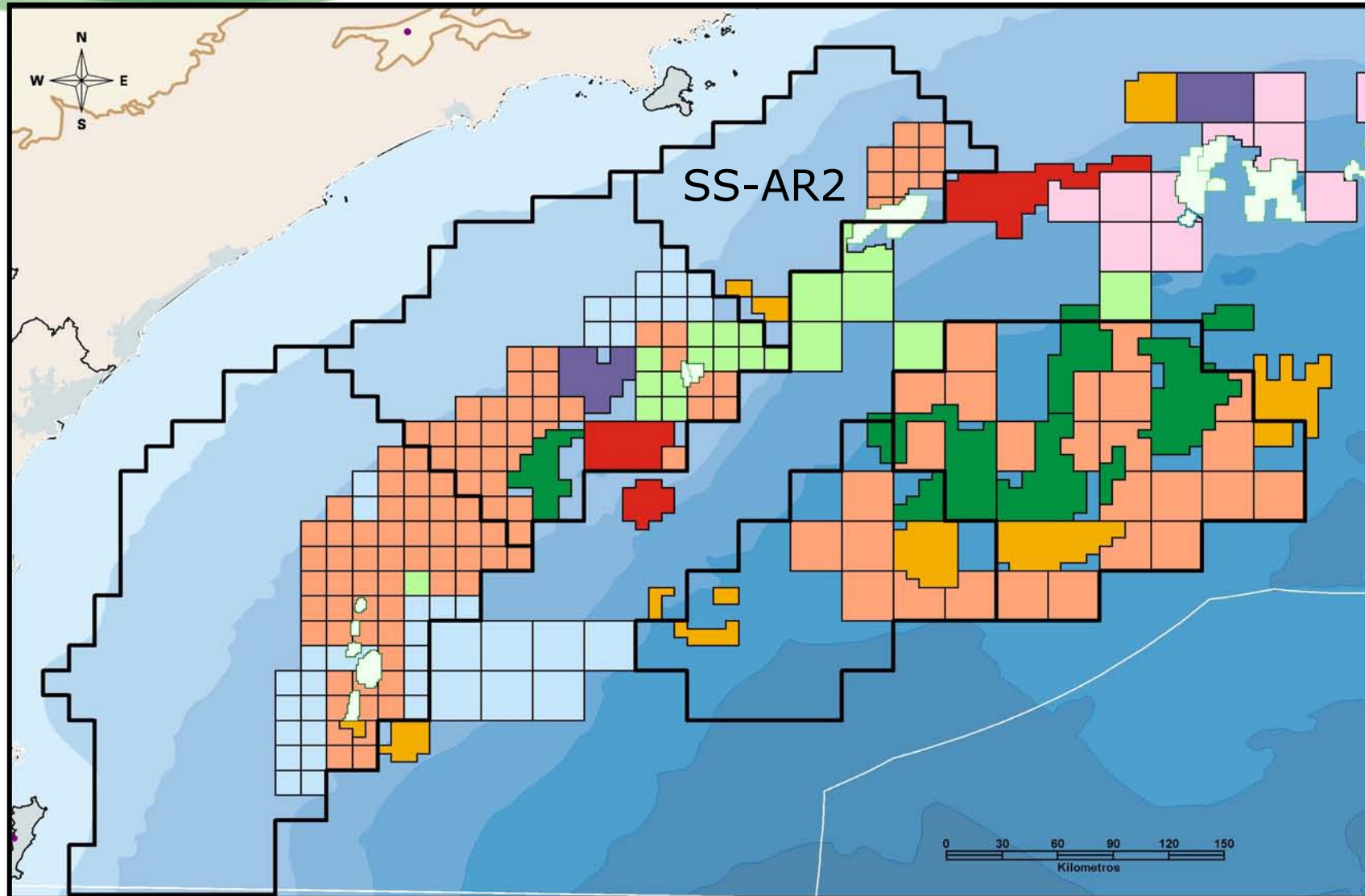


Oliva Field

Sandstone Reservoir Play Tertiary

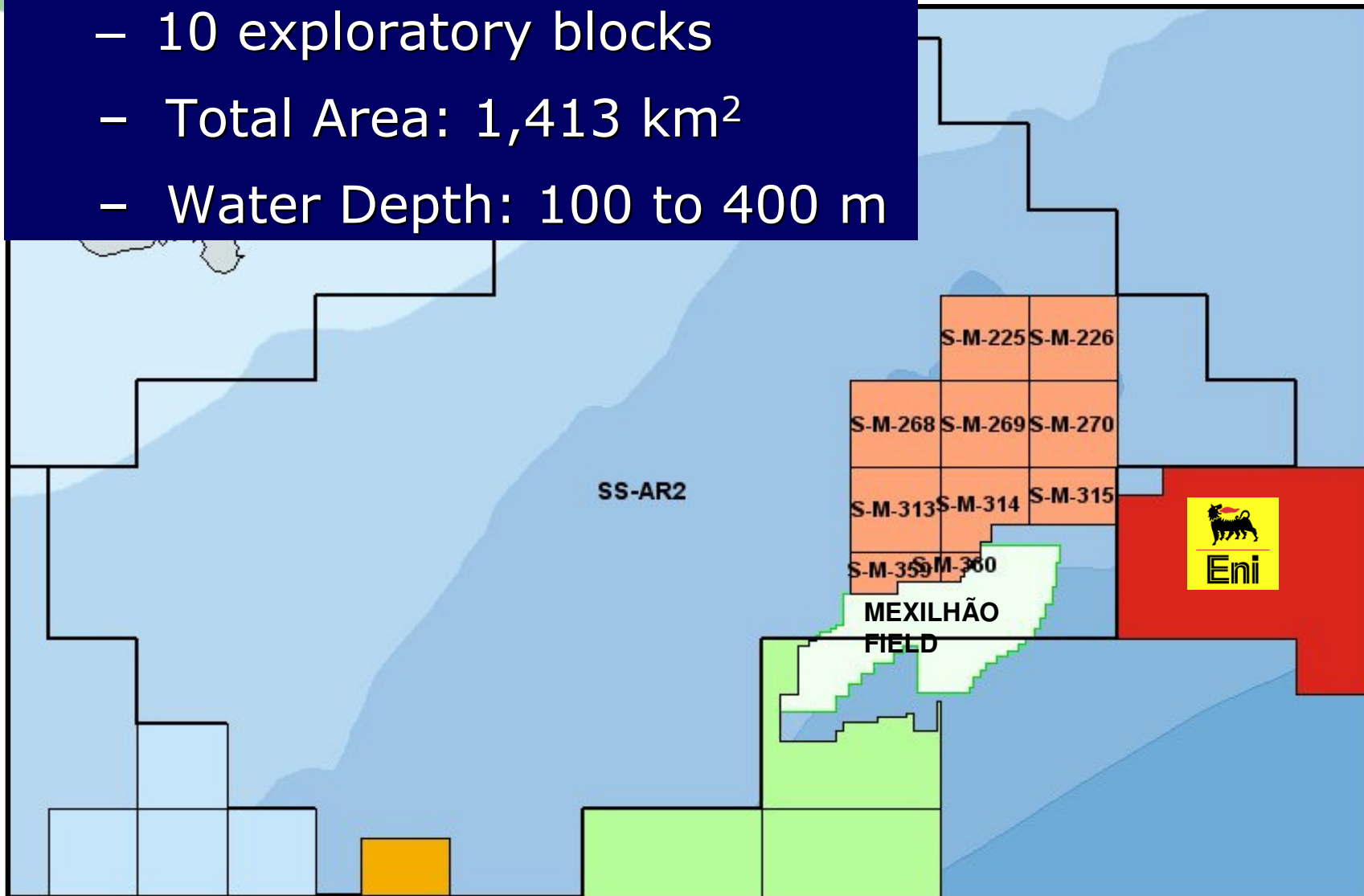


Sector SS-AR2 Blocks Offered

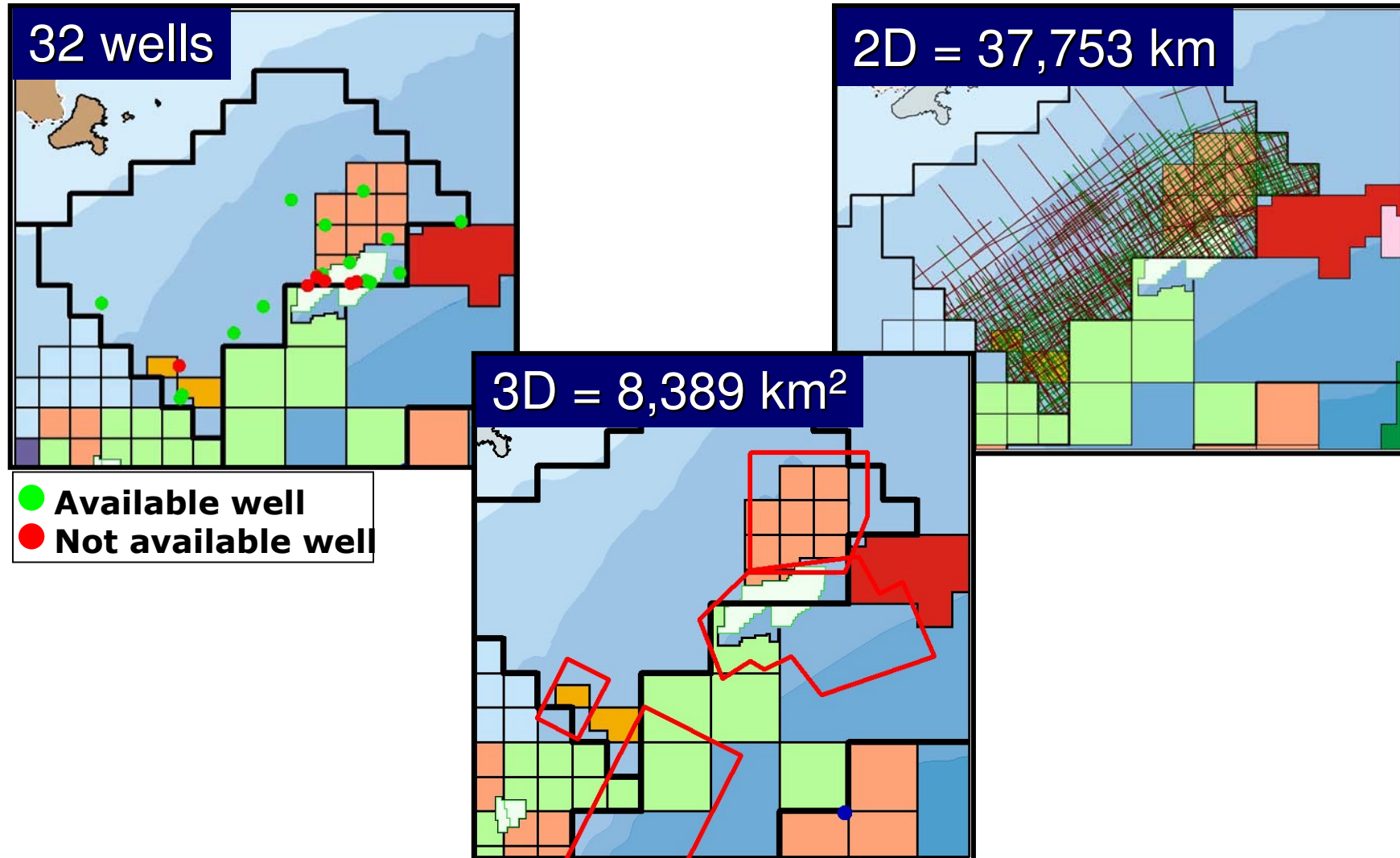


Sector SS-AR2 Blocks Offered

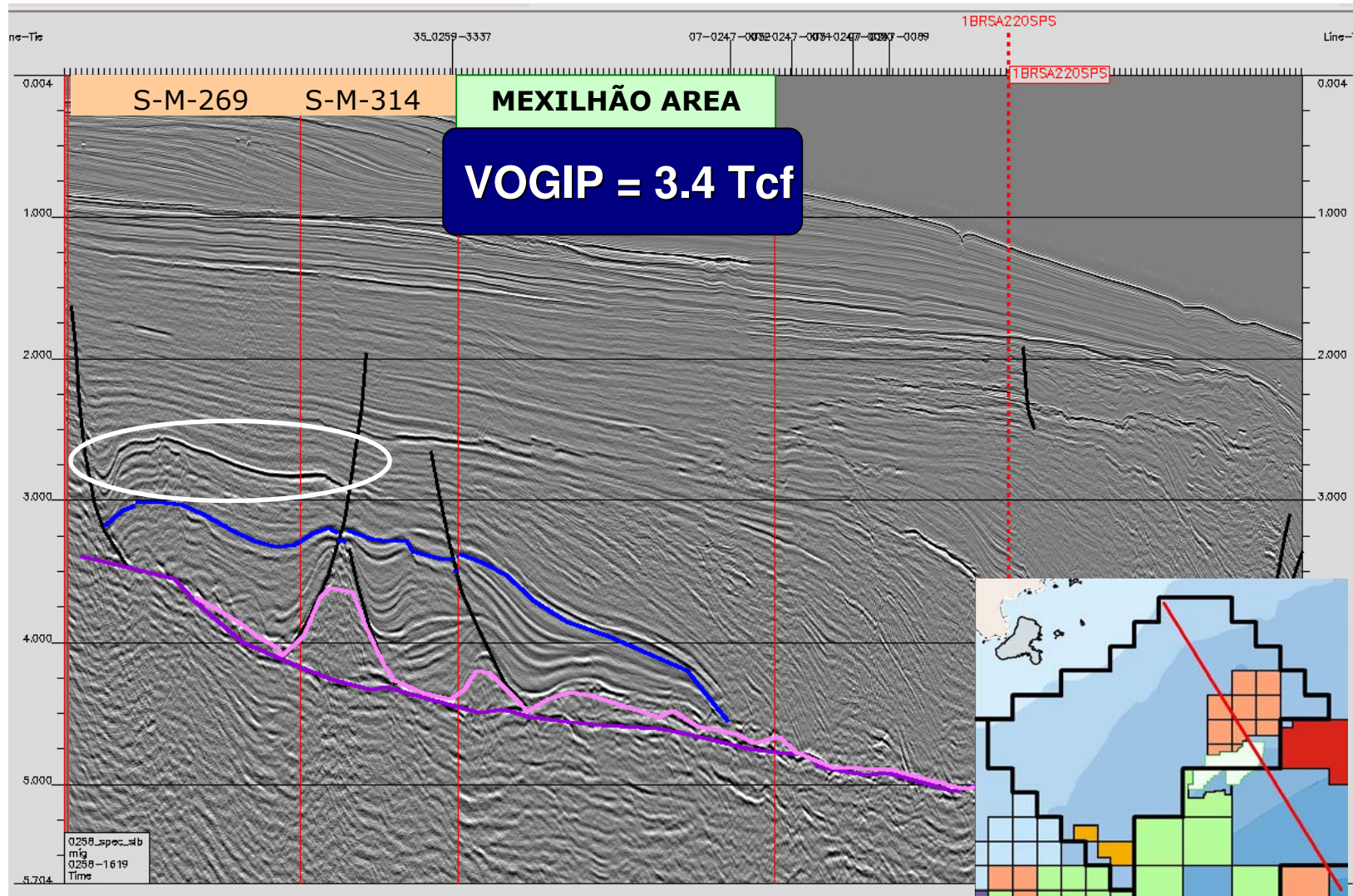
- 10 exploratory blocks
- Total Area: 1,413 km²
- Water Depth: 100 to 400 m



Exploratory Activities



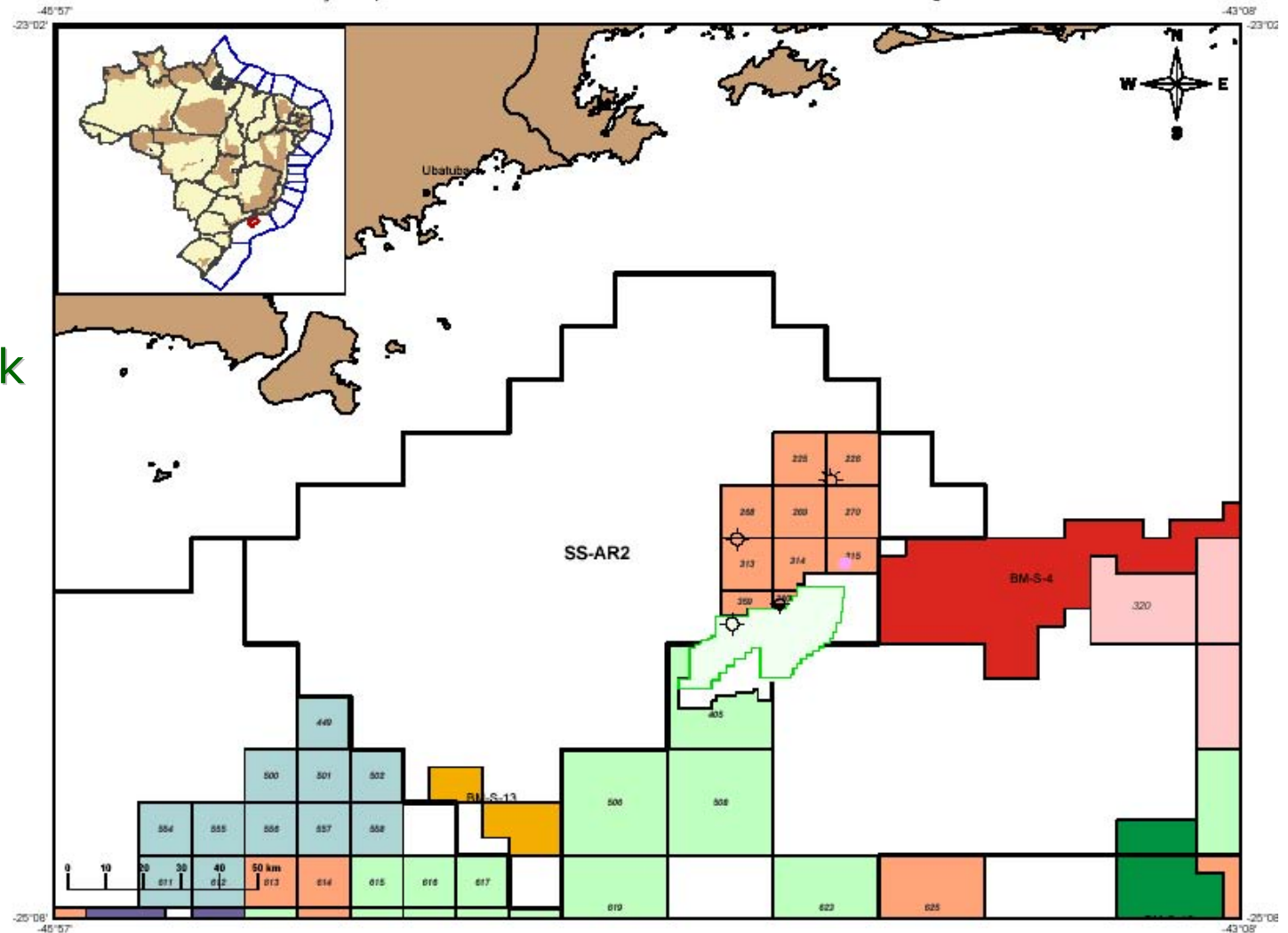
Upper Cretaceous Exploratory Opportunities



Courtesy Schlumberger-Western Geco

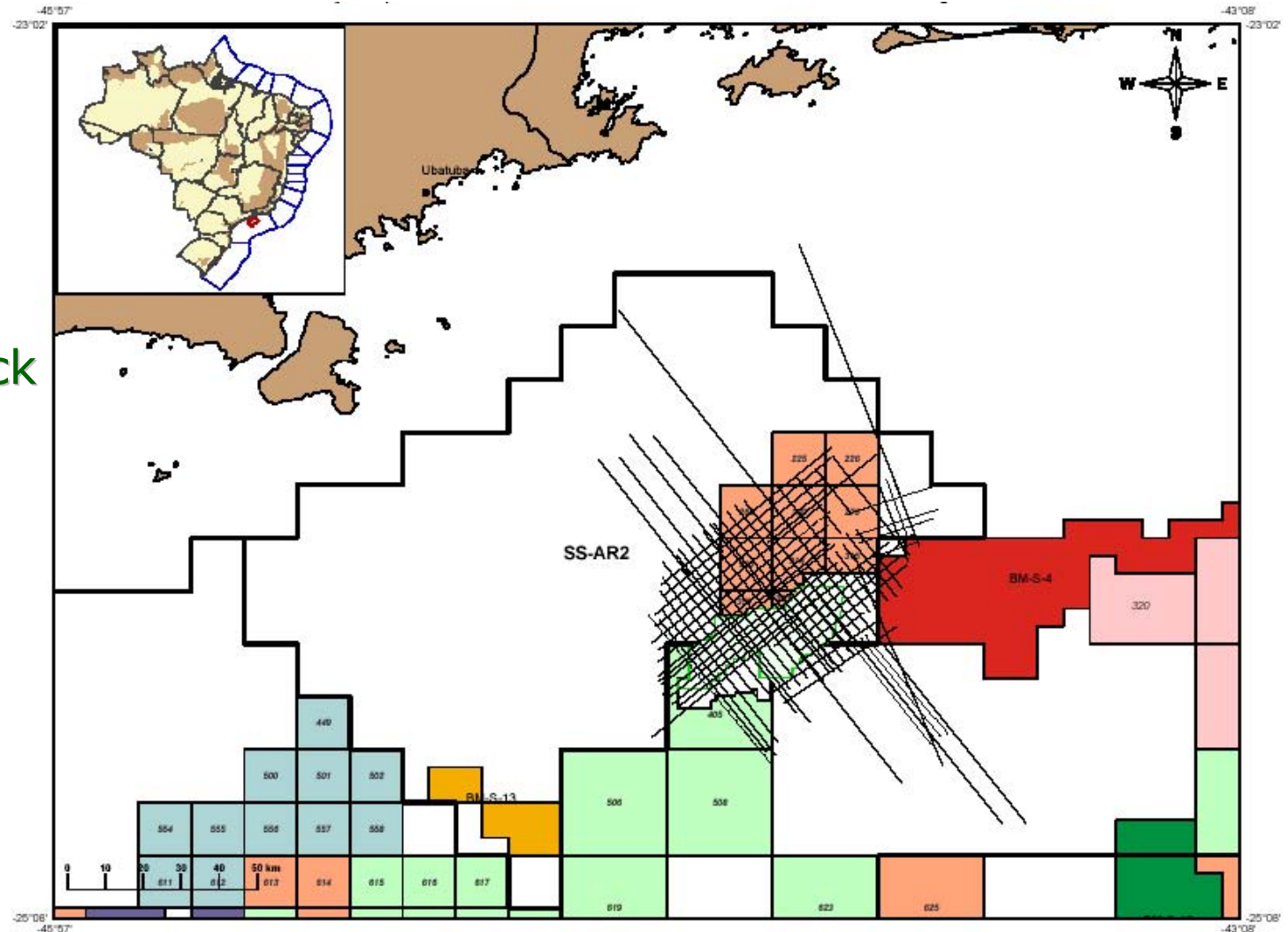
- **SS-AR2**

- Wells: 5
- Seismic:
3,963 km
2D pos-stack



- **SS-AR2**

- Wells: 5
- Seismic:
3,963 km
2D pos-stack





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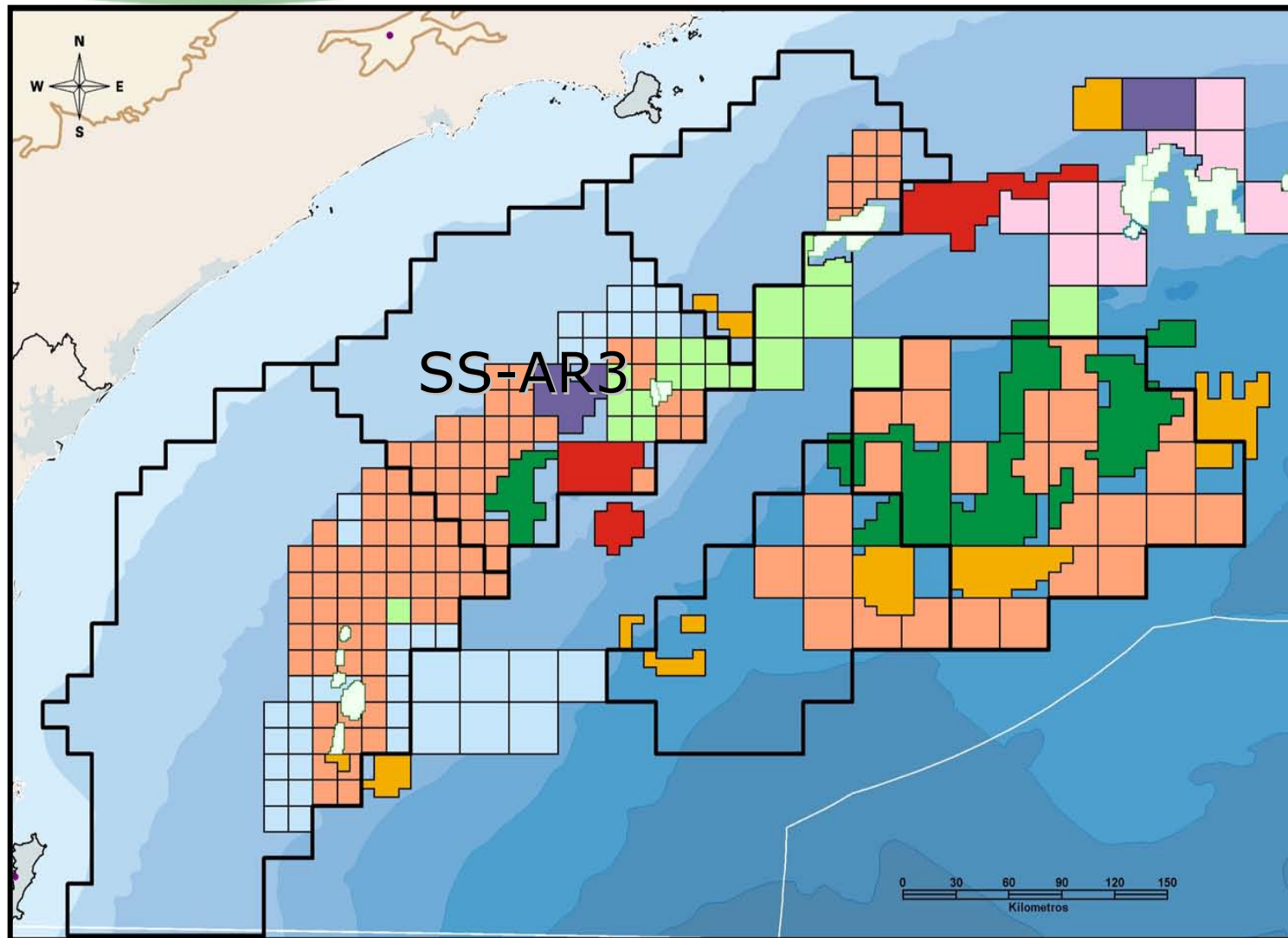
Minimum Exploratory Program

Sector	SS-AR2
Exploratory Class	High Potential
Number of Blocks	10
Total Bid Area	1,413 km²
Exploration Phase	5 years
Exploratory Periods	4+1 years
Operator Qualification	B
Minimum Bonus	R\$ 4,7 millions to 15 millions
Minimum Target	Guarujá Fm (Late Albian)

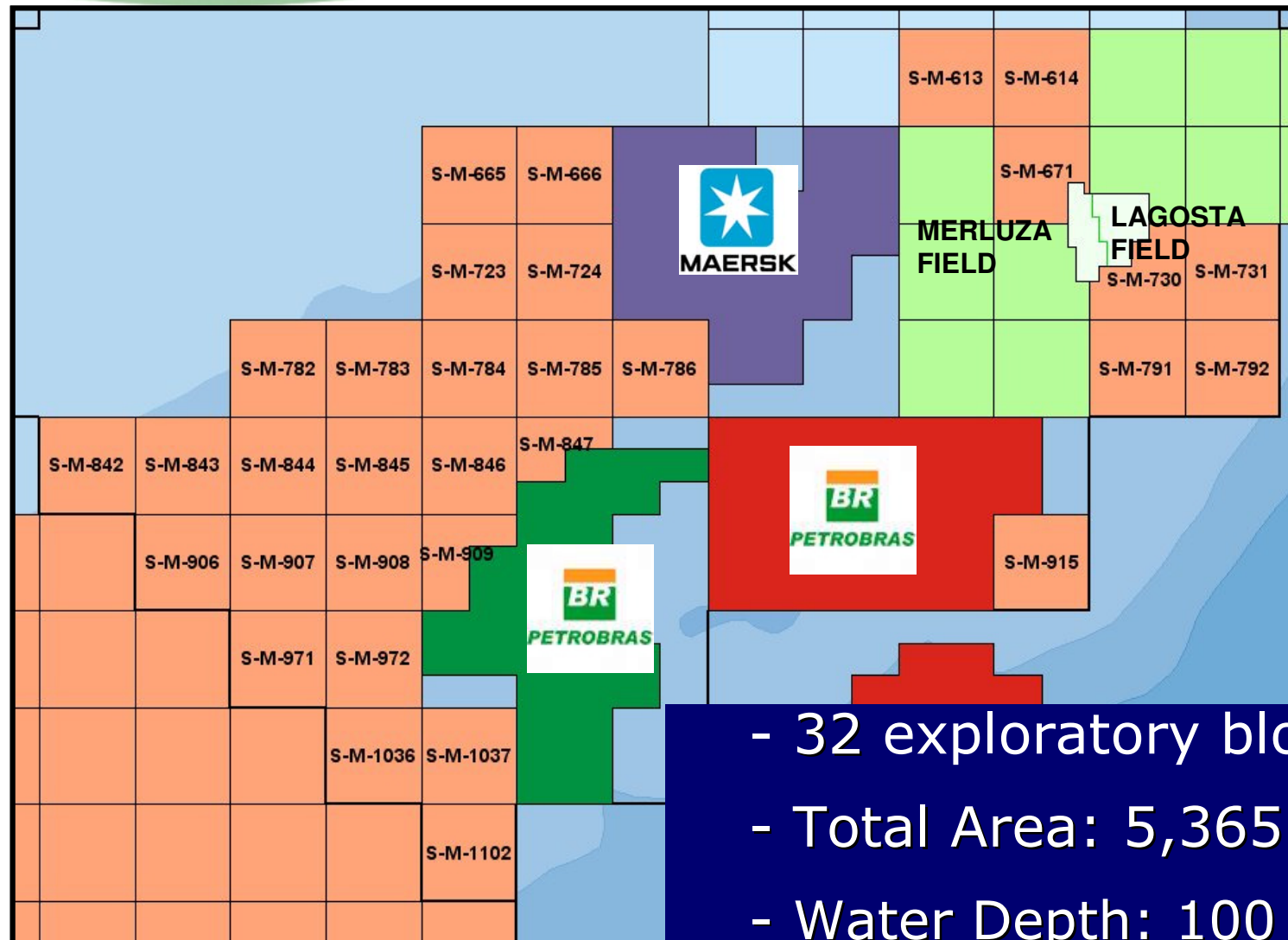


BrasilRound9
Nona Rodada de Licitações

Sector SS-AR3 Blocks Offered

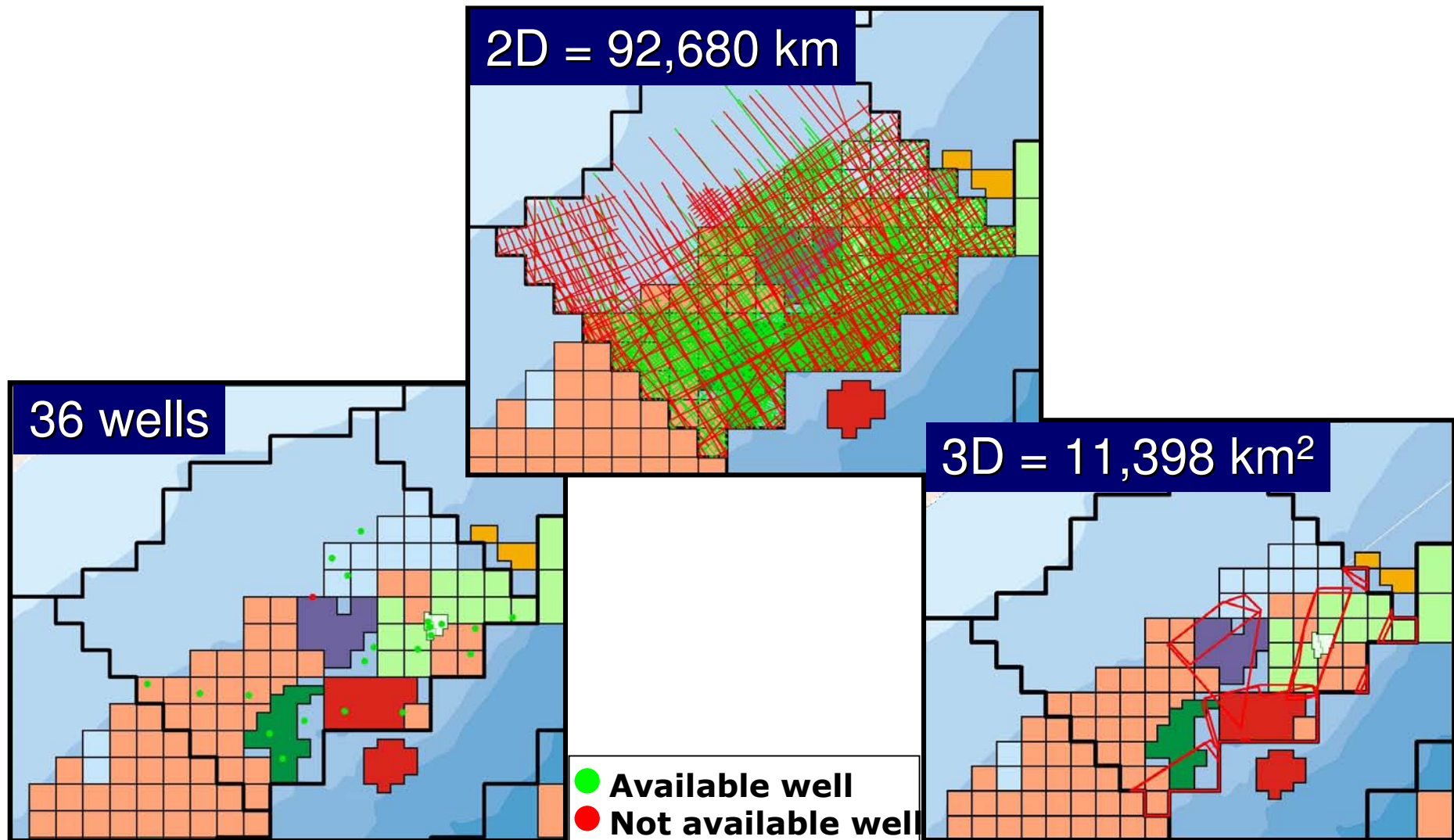


Sector SS-AR3 Blocks Offered

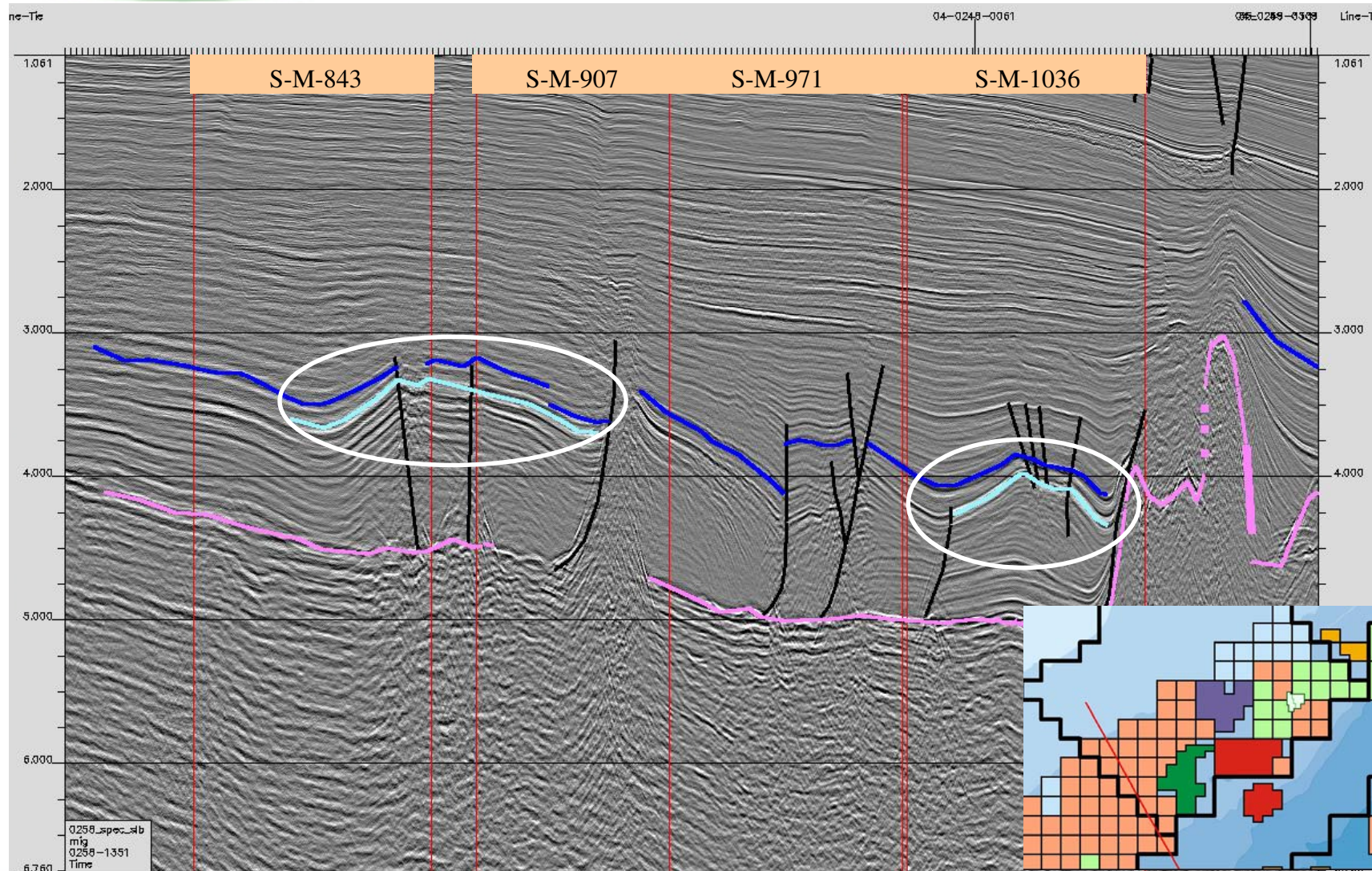


- 32 exploratory blocks
- Total Area: 5,365 km²
- Water Depth: 100 to 400 m

Exploratory Activities

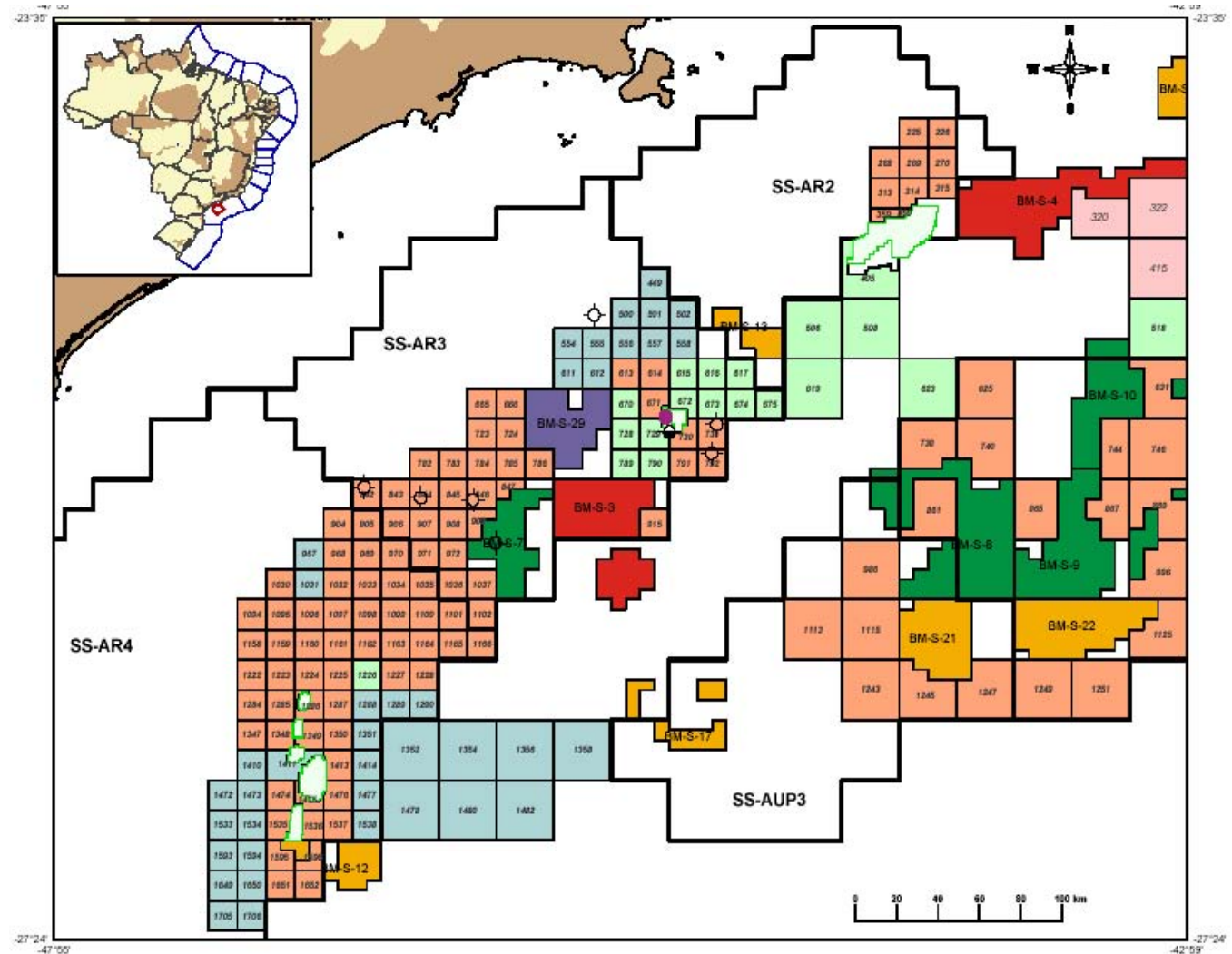


Albian Exploratory Opportunities



Courtesy Schlumberger-Western Geco

- **SS-AR3**
 - Wells: 9
 - Seismic: 15,963 km 2D pos-stack





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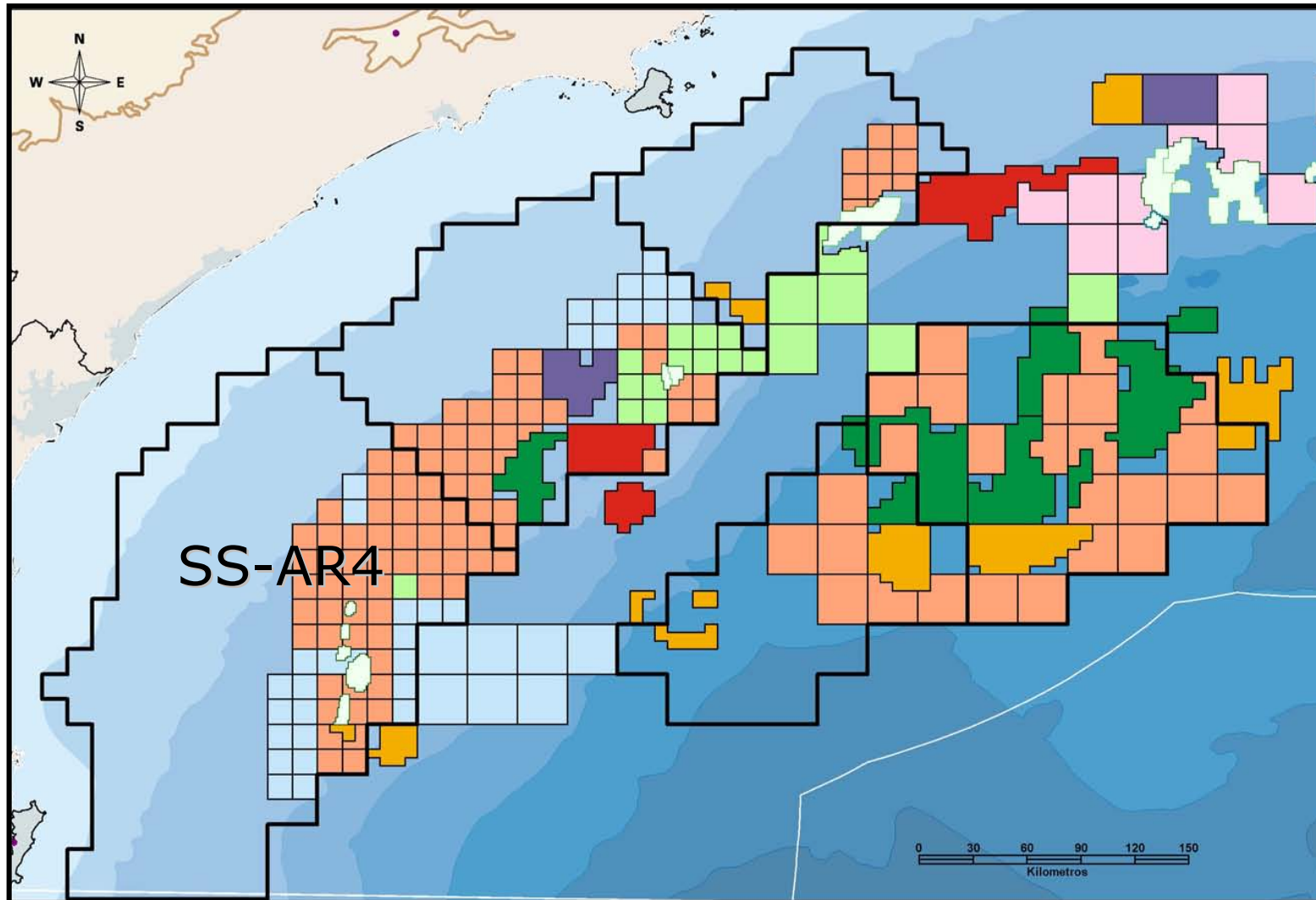


BrasilRound9
Nona Rodada de Licitações

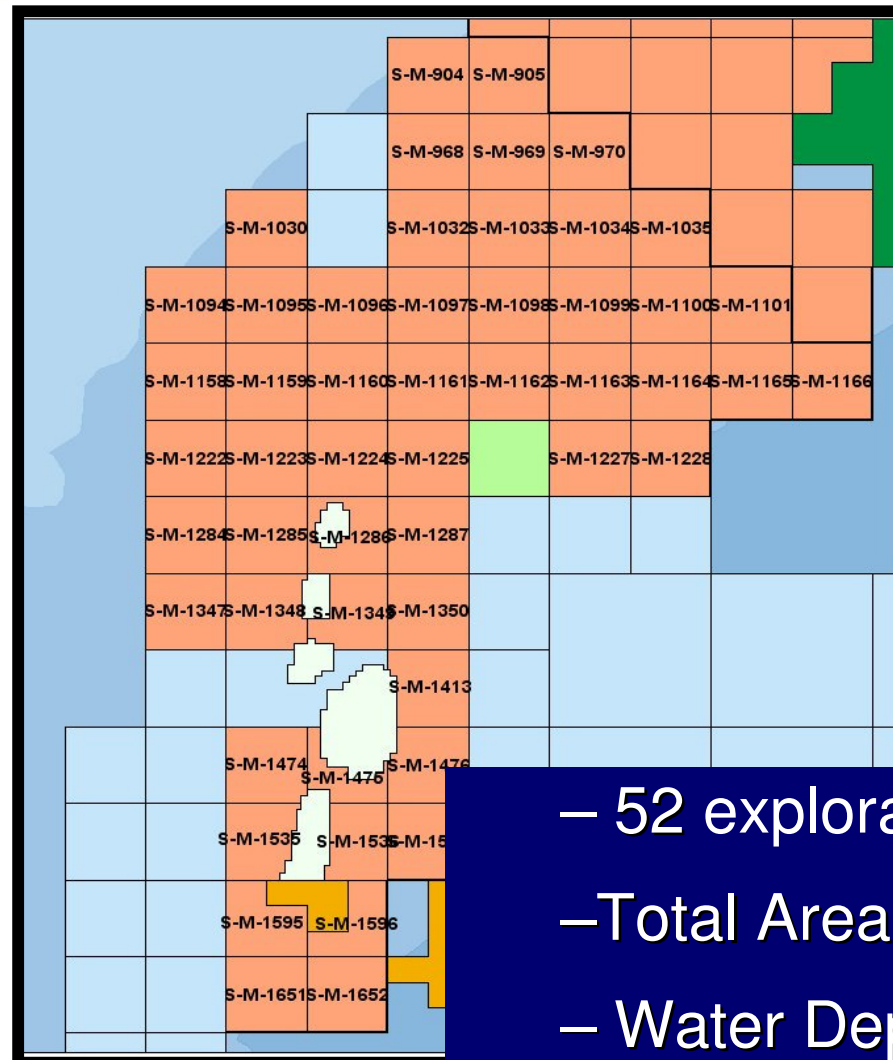
Minimum Exploratory Program

Sector	SS-AR3
Exploratory Class	High Potential
Number of Blocks	32
Total Bid Area	5,365 km²
Exploration Phase	5 years
Exploratory Period	4+1 years
Operator Qualification	B
Minimum Bonus	R\$ 4,5 millions to 16 millions
Minimum Target	Guarujá Fm (Early Albian)

Sector SS-AR4 Blocks Offered

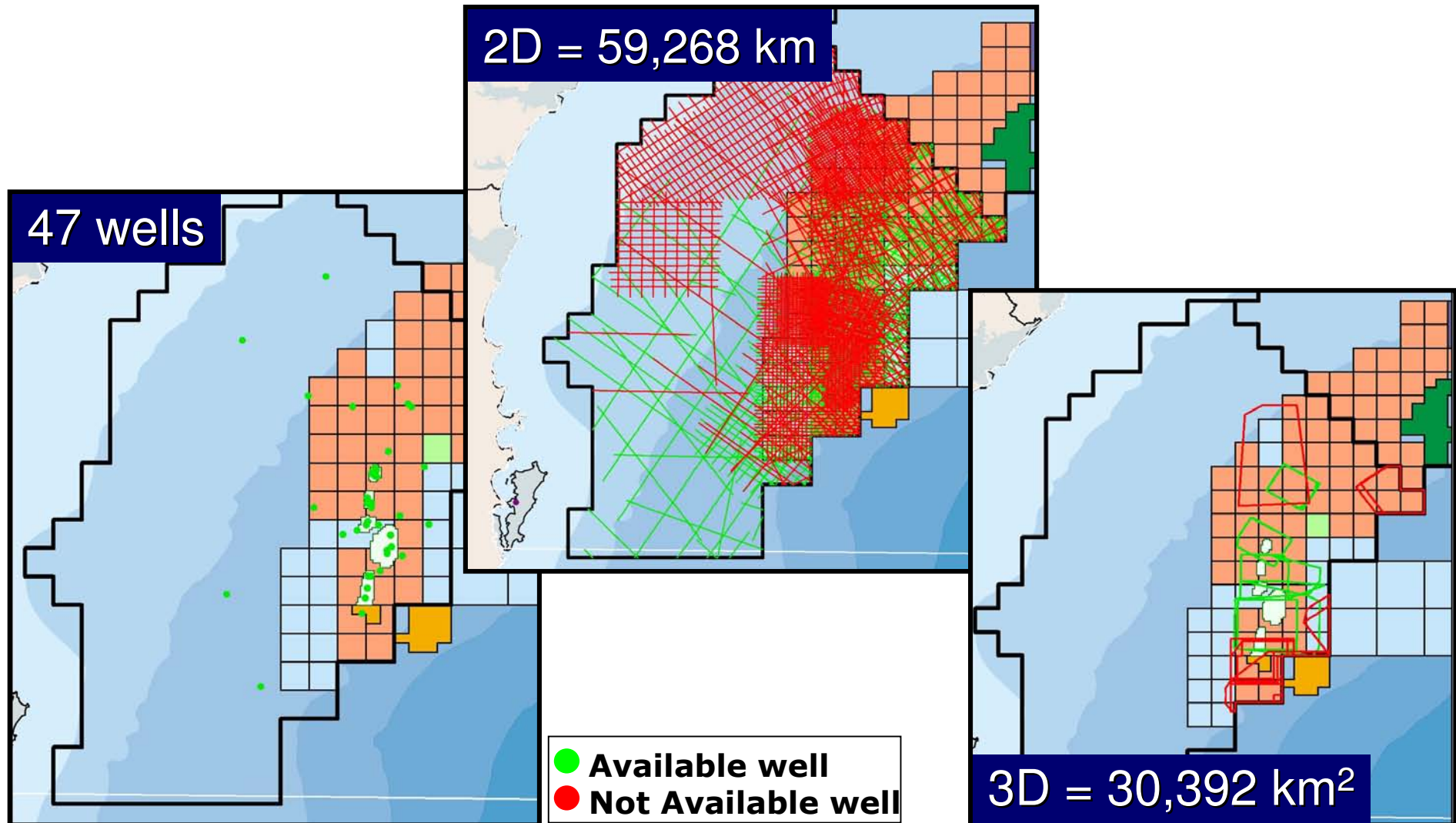


Sector SS-AR4 Blocks Offered

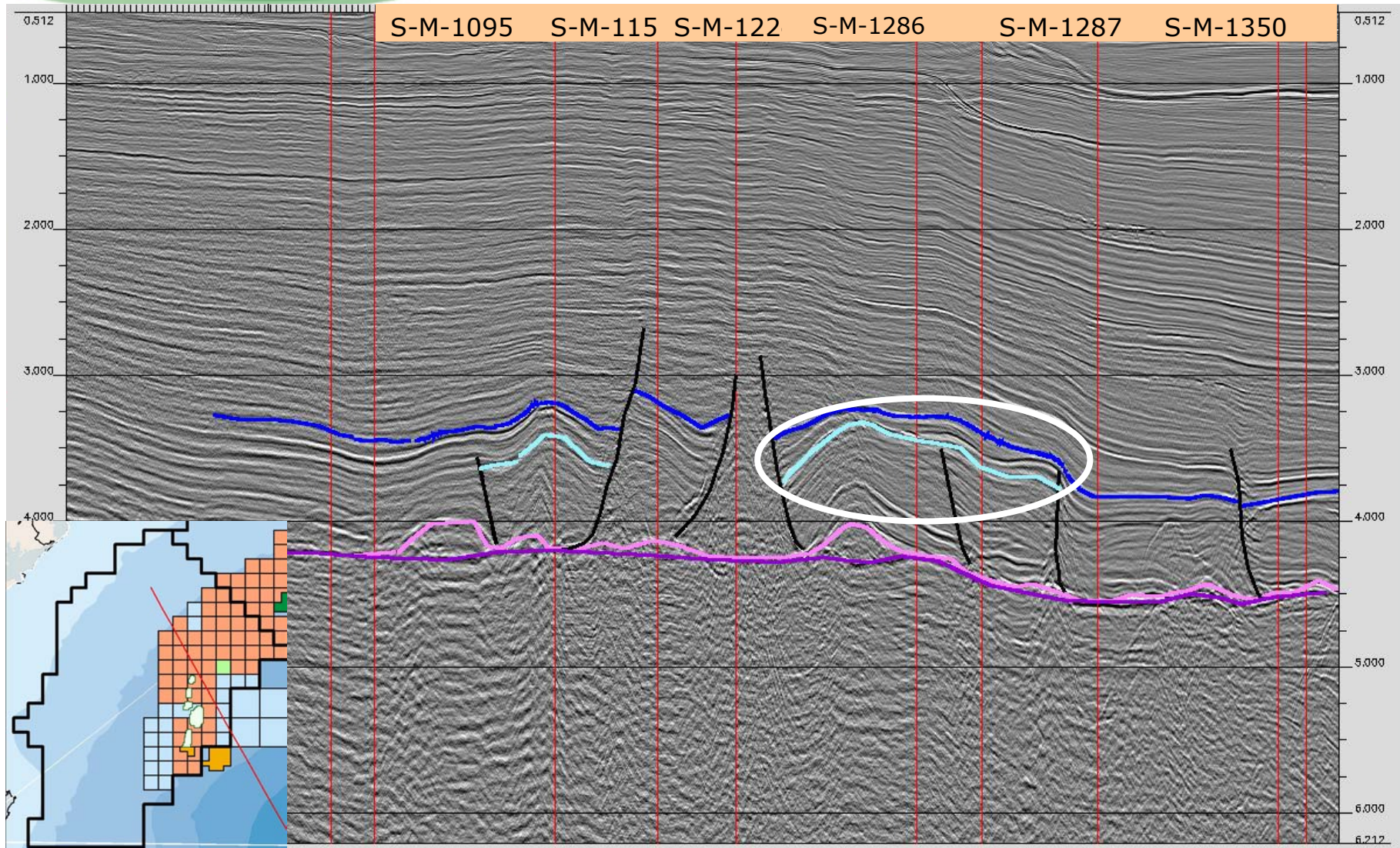


- 52 exploratory blocks
- Total Area: 8,638 km²
- Water Depth: 100 to 400 m

Exploratory Activities

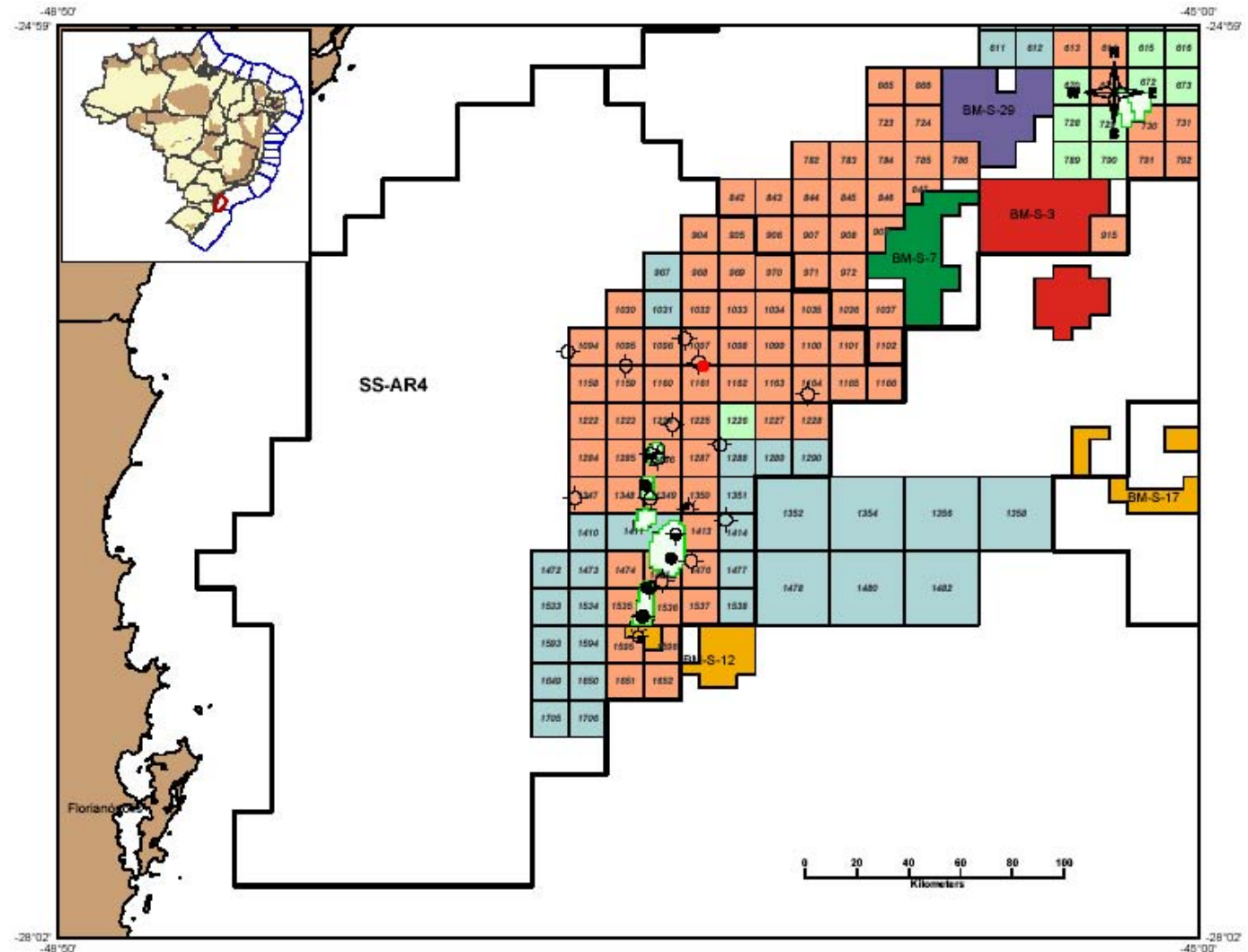


Albian Exploratory Opportunities

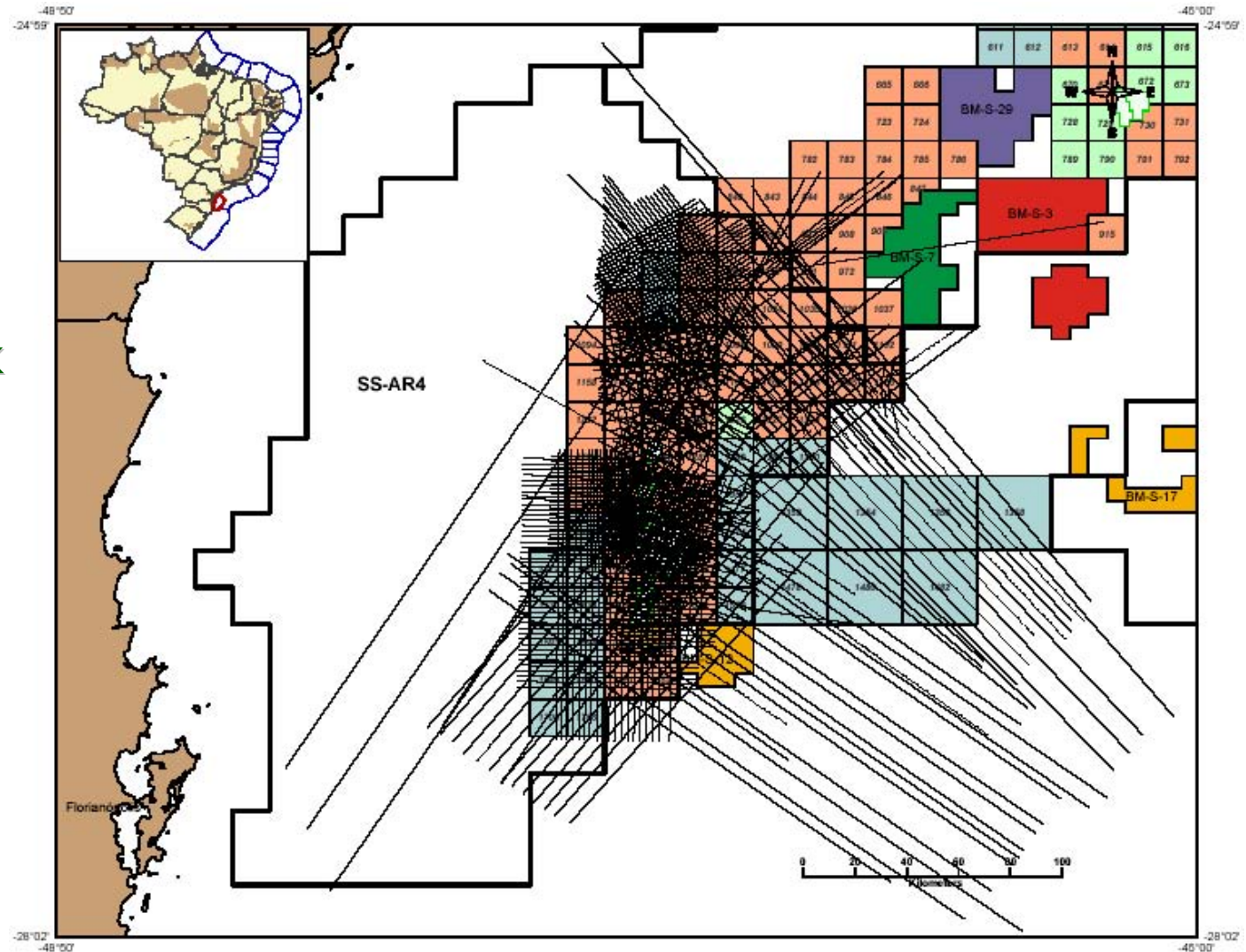


Courtesy Schlumberger-Western Geco

- **SS-AR4**
Wells: 24
Seismic:
26,877 km
2D pos-stack



- **SS-AR4**
Wells: 24
Seismic: 26,877 km
2D pos-stack



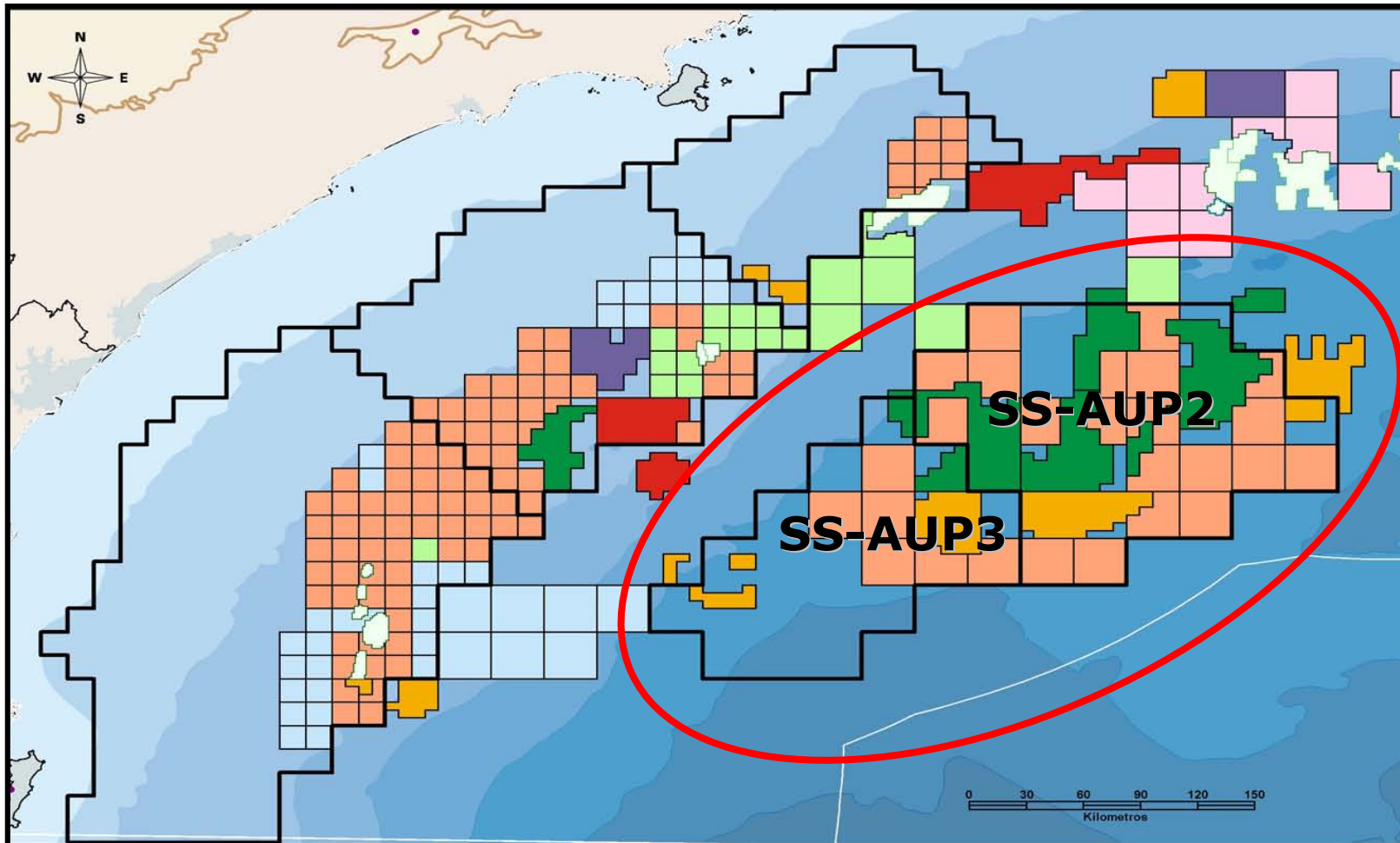


BrasilRound9
Nona Rodada de Licitações

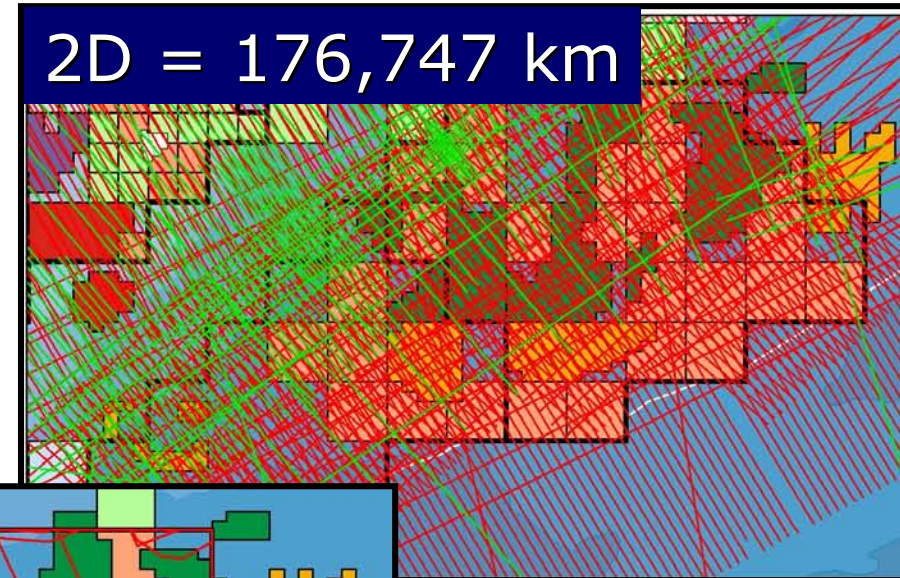
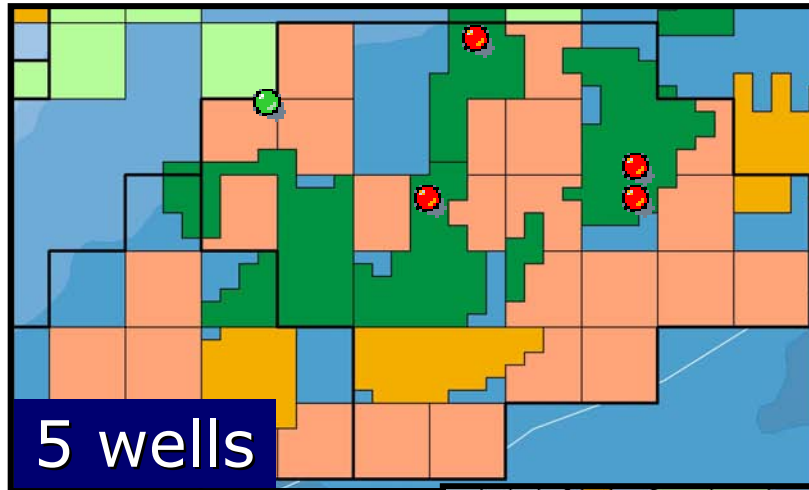
Minimum Exploratory Program

Sector	SS-AR4
Exploratory Class	High Potential
Number of Blocks	52
Total Bid Area	8,638 km²
Exploration Phase	5 years
Exploratory Period	4+1 years
Operator Qualification	B
Minimum Bonus	R\$ 4,5 millions to 19 millions
Minimum Target	Guarujá Fm (Late Albian)

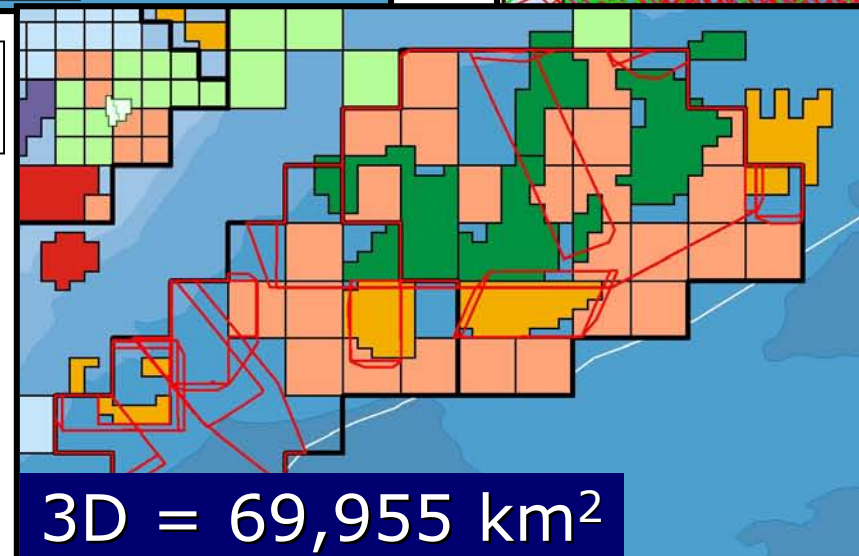
Sectors SS-AUP2 & SS-AUP3 Blocks Offered



Exploratory Activities



-  Public well
-  Confidential well



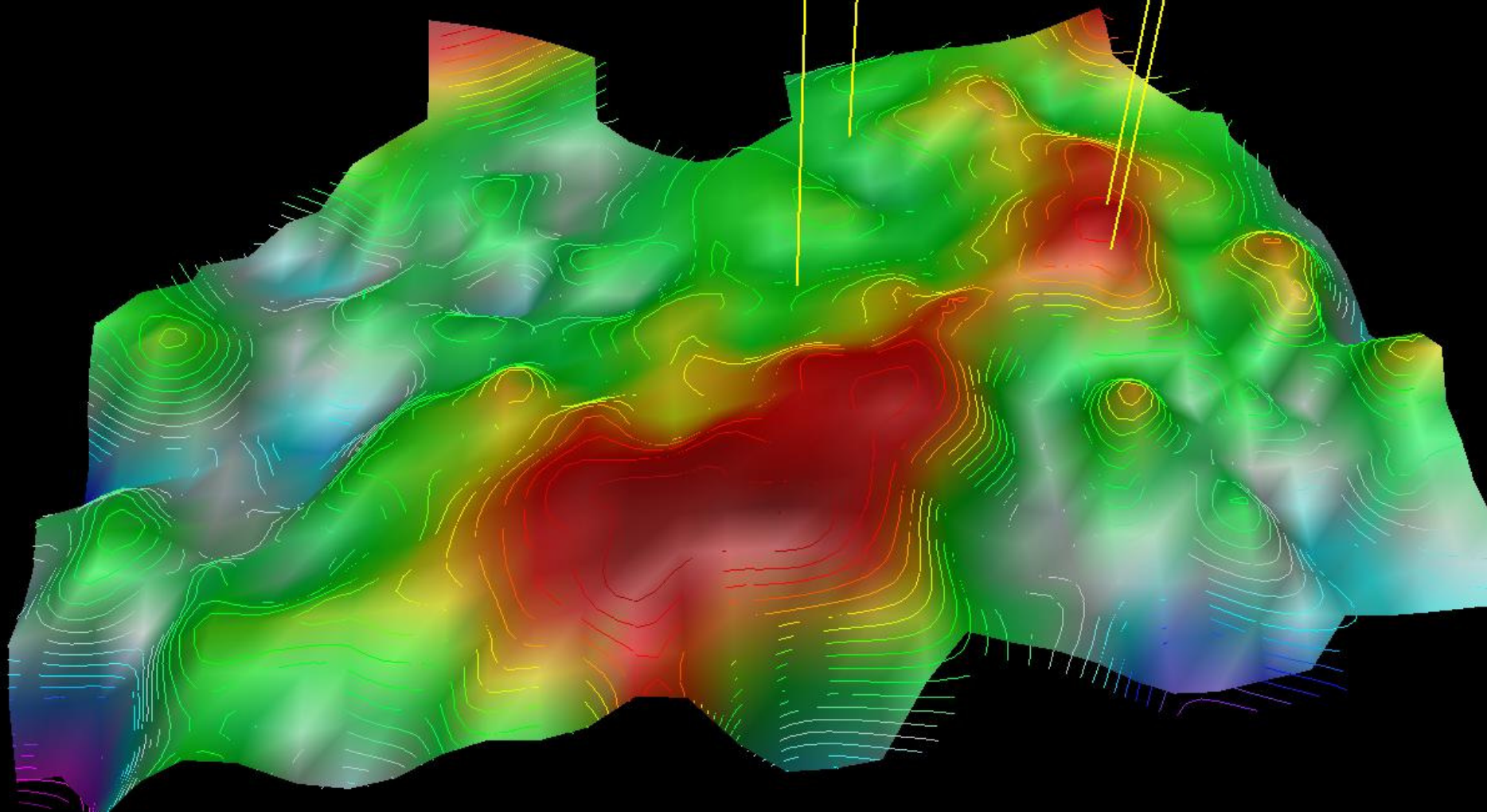
Salt Base Map (Depth)

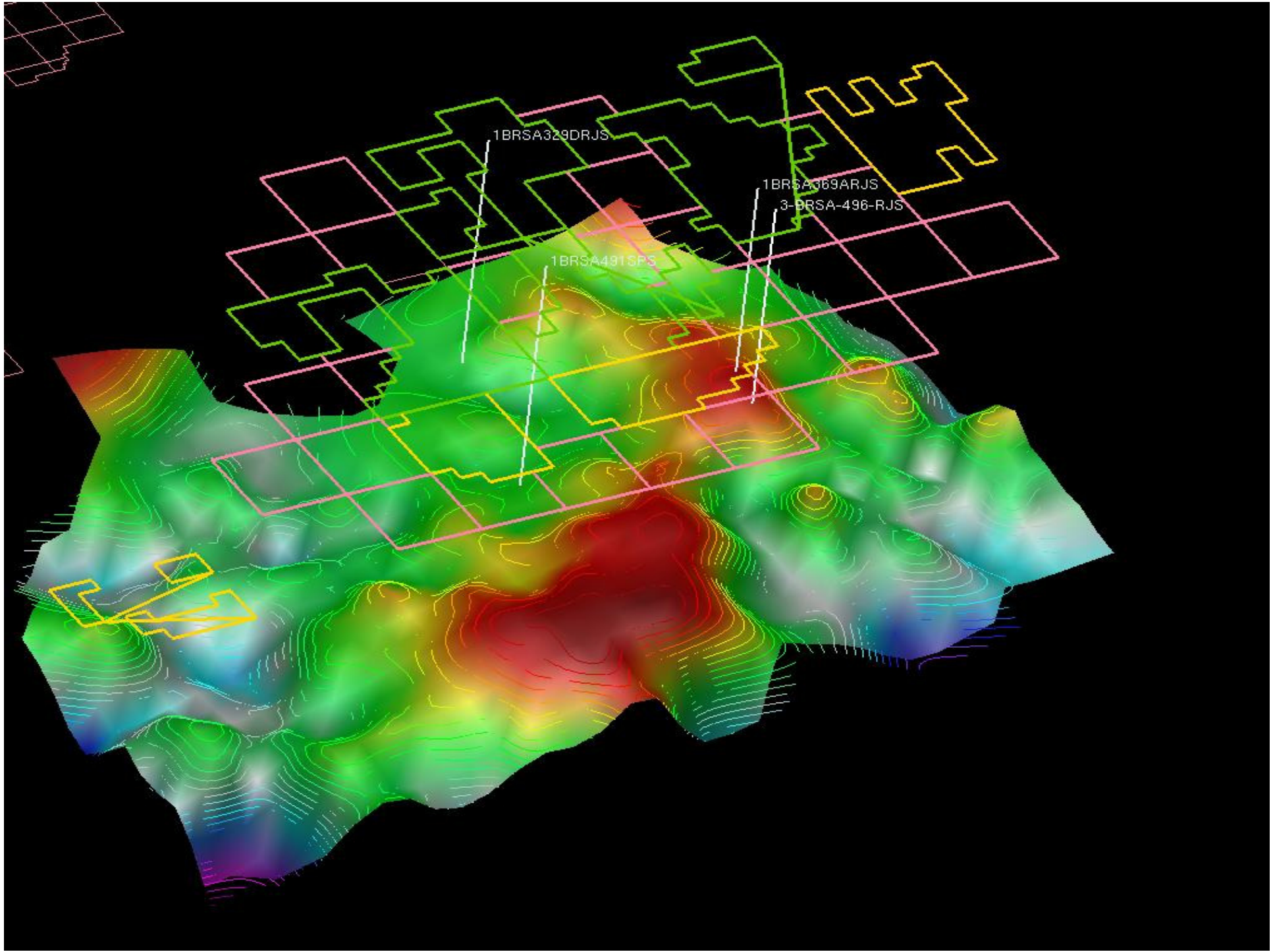
1BRSA329DRJS

1BRSA491SPS

1BRSA369ARJS

3-BRSA-496-RJS





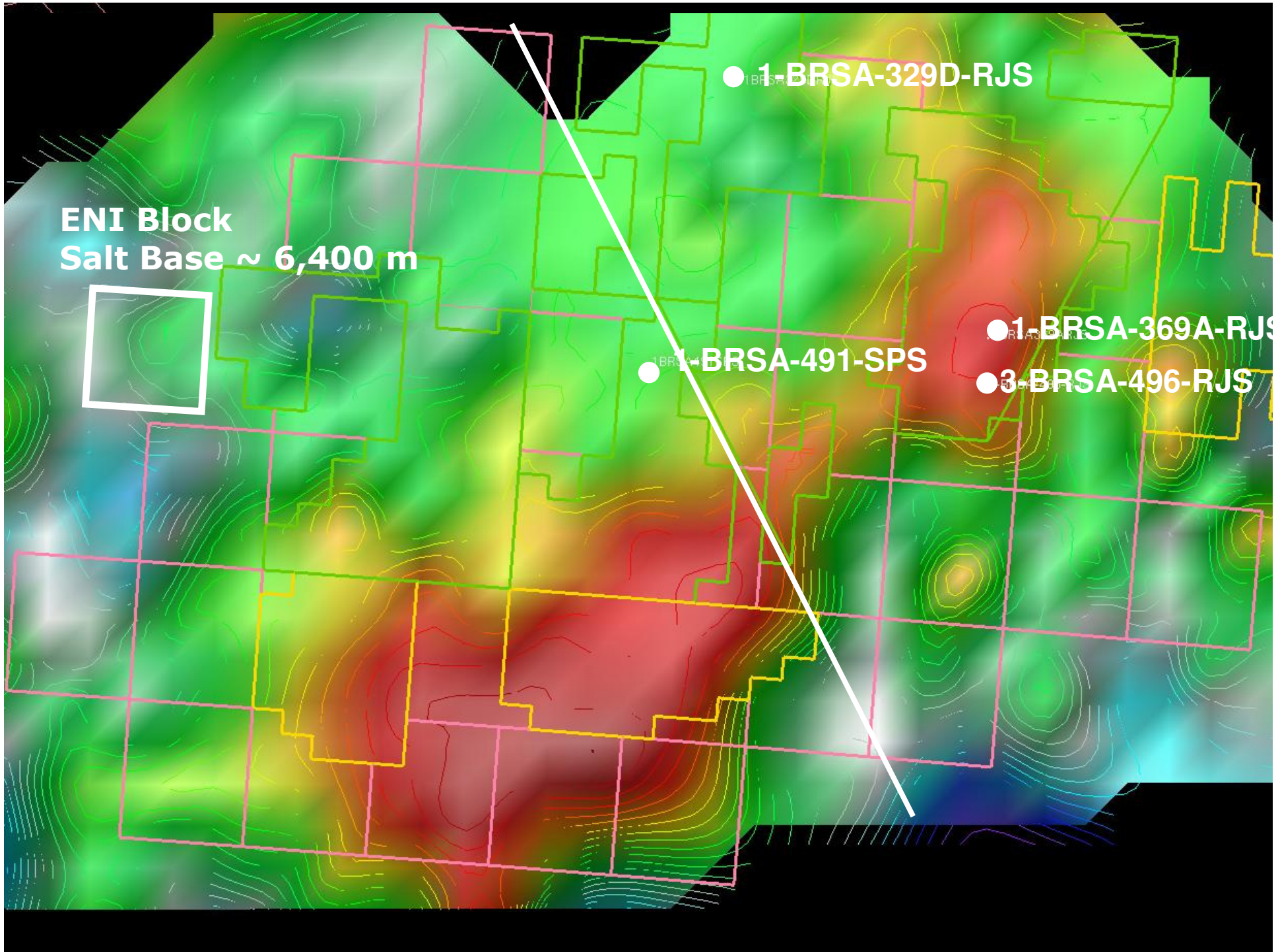
ENI Block
Salt Base ~ 6,400 m

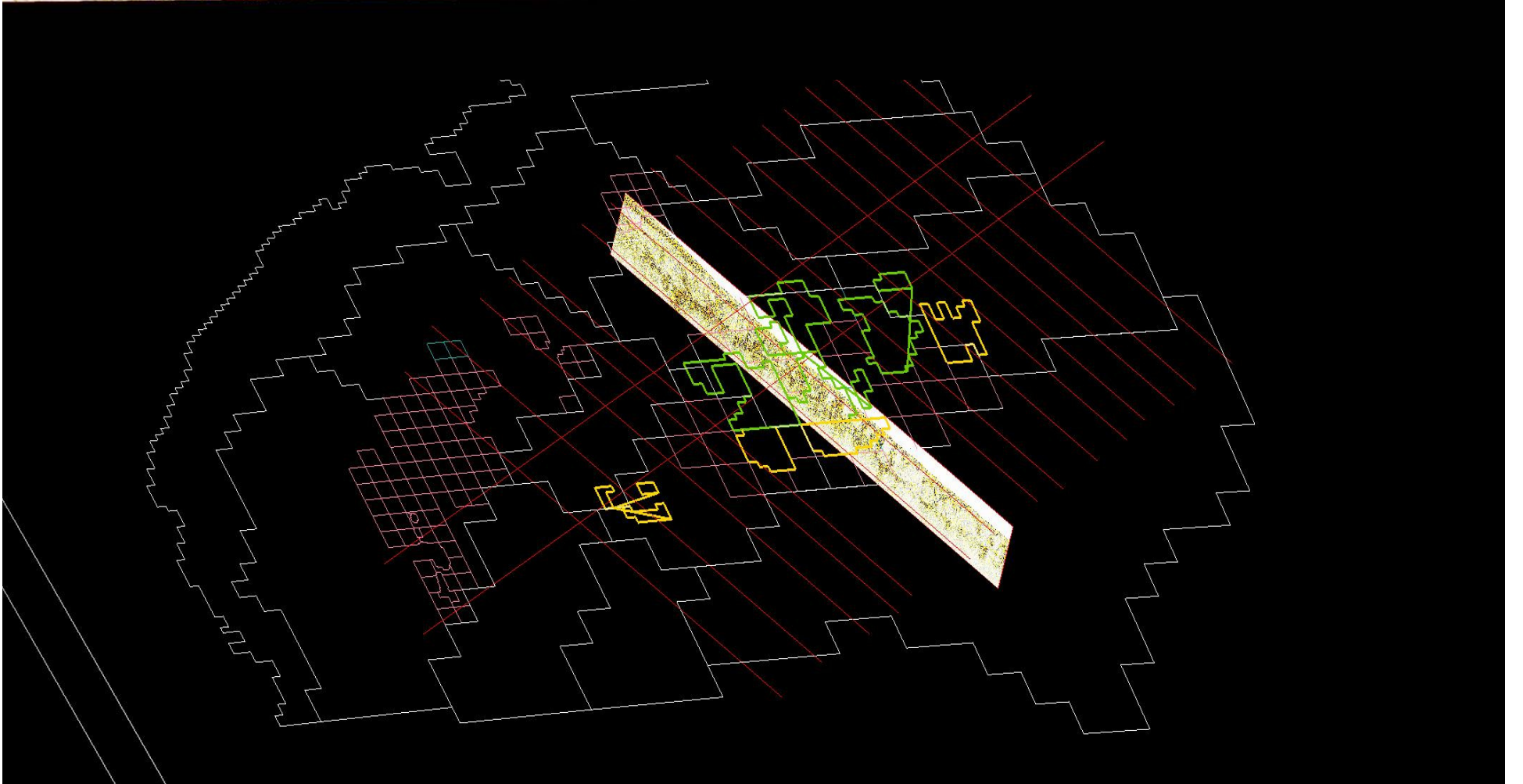
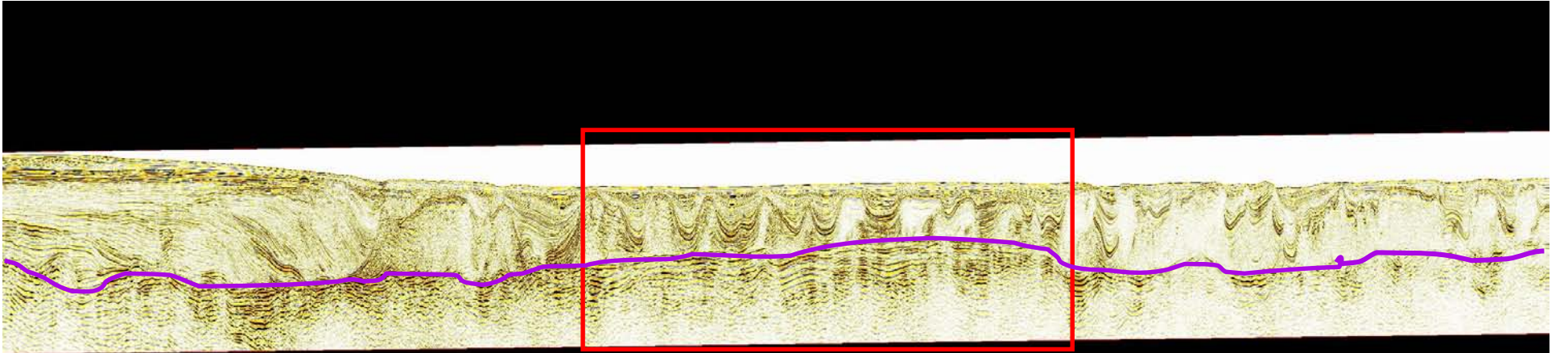
● 1-BRSA-329D-RJS

● 1-BRSA-491-SPS

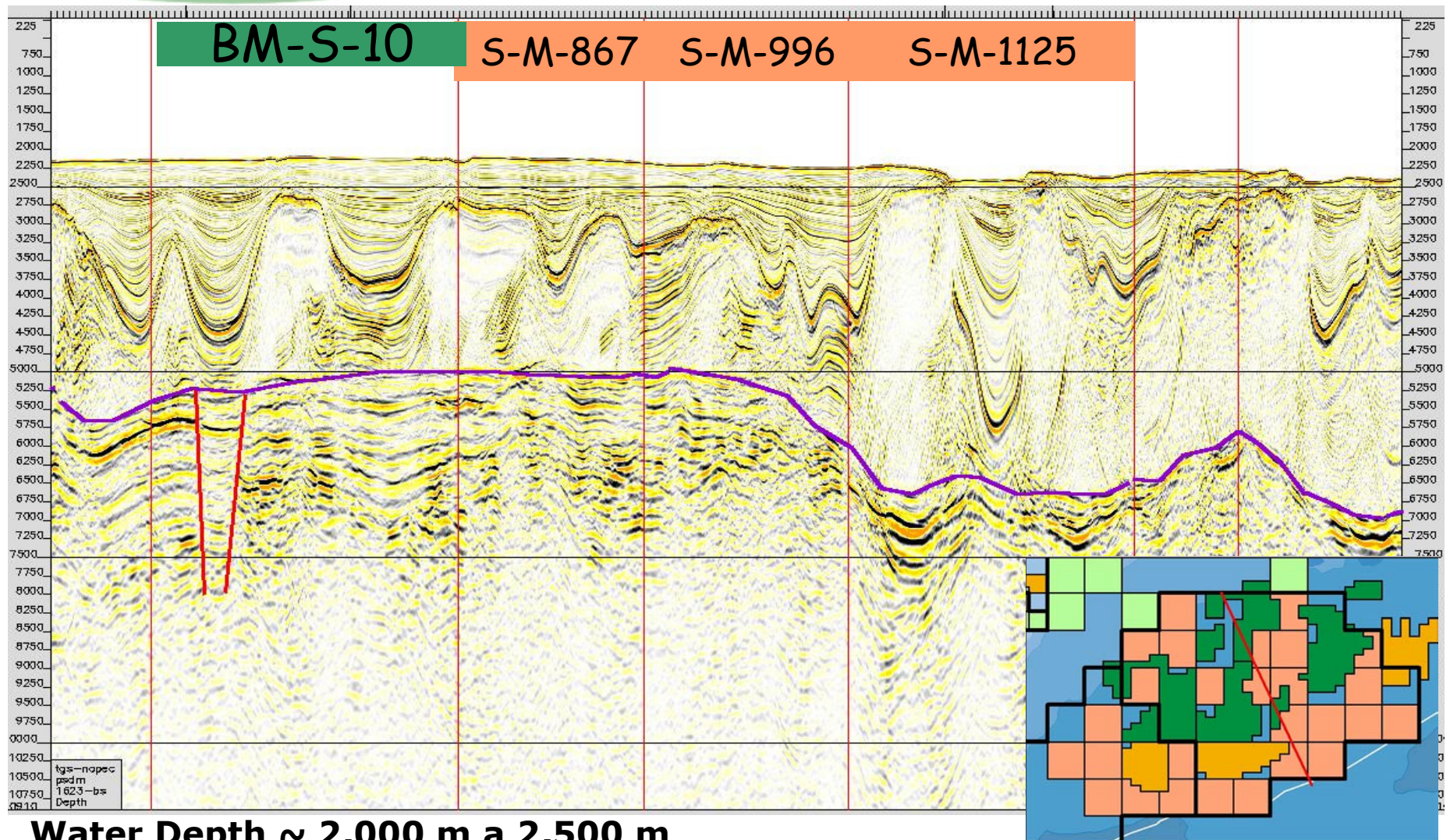
● 1-BRSA-369A-RJS

● 3-BRSA-496-RJS



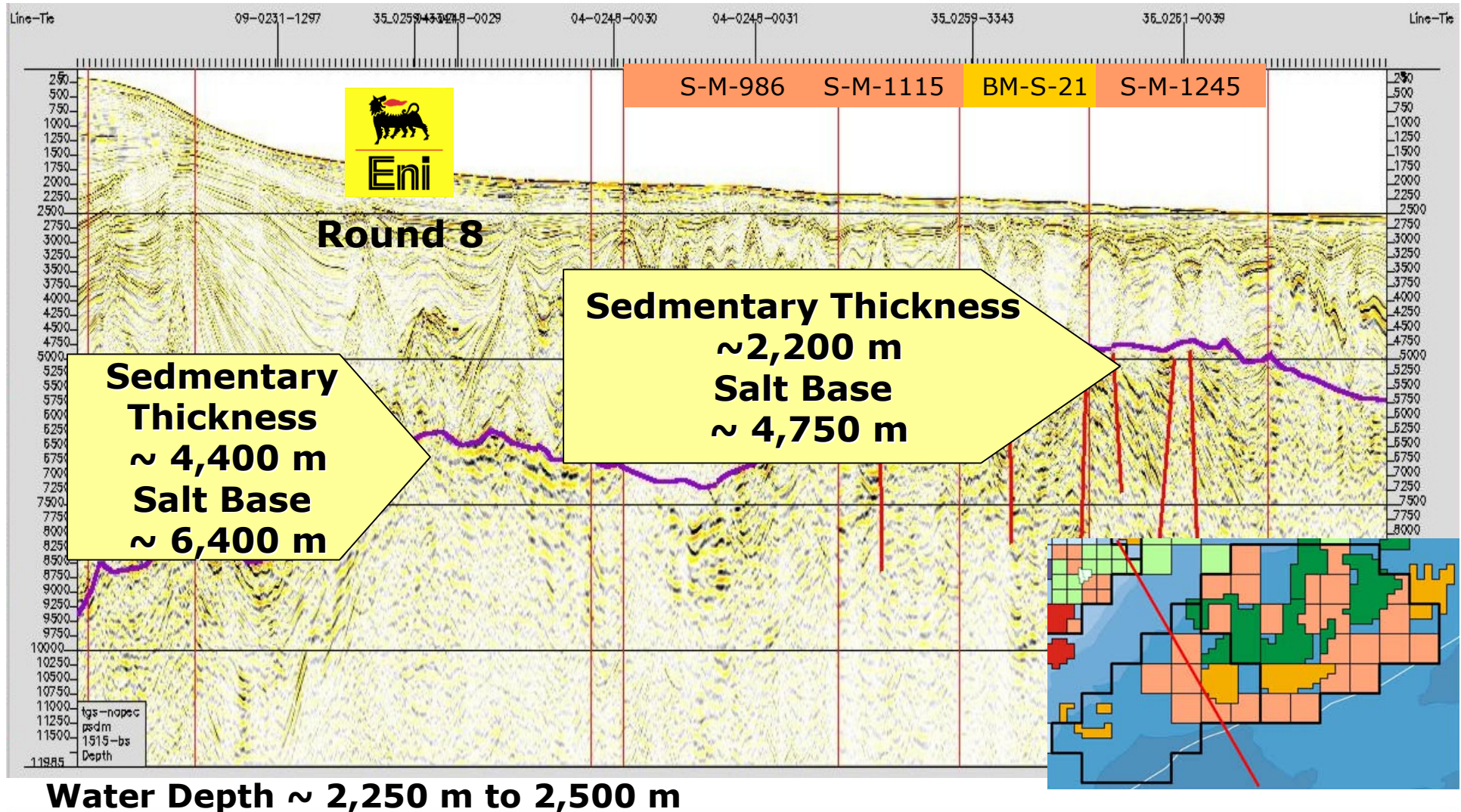


Pre-Salt Exploratory Opportunities

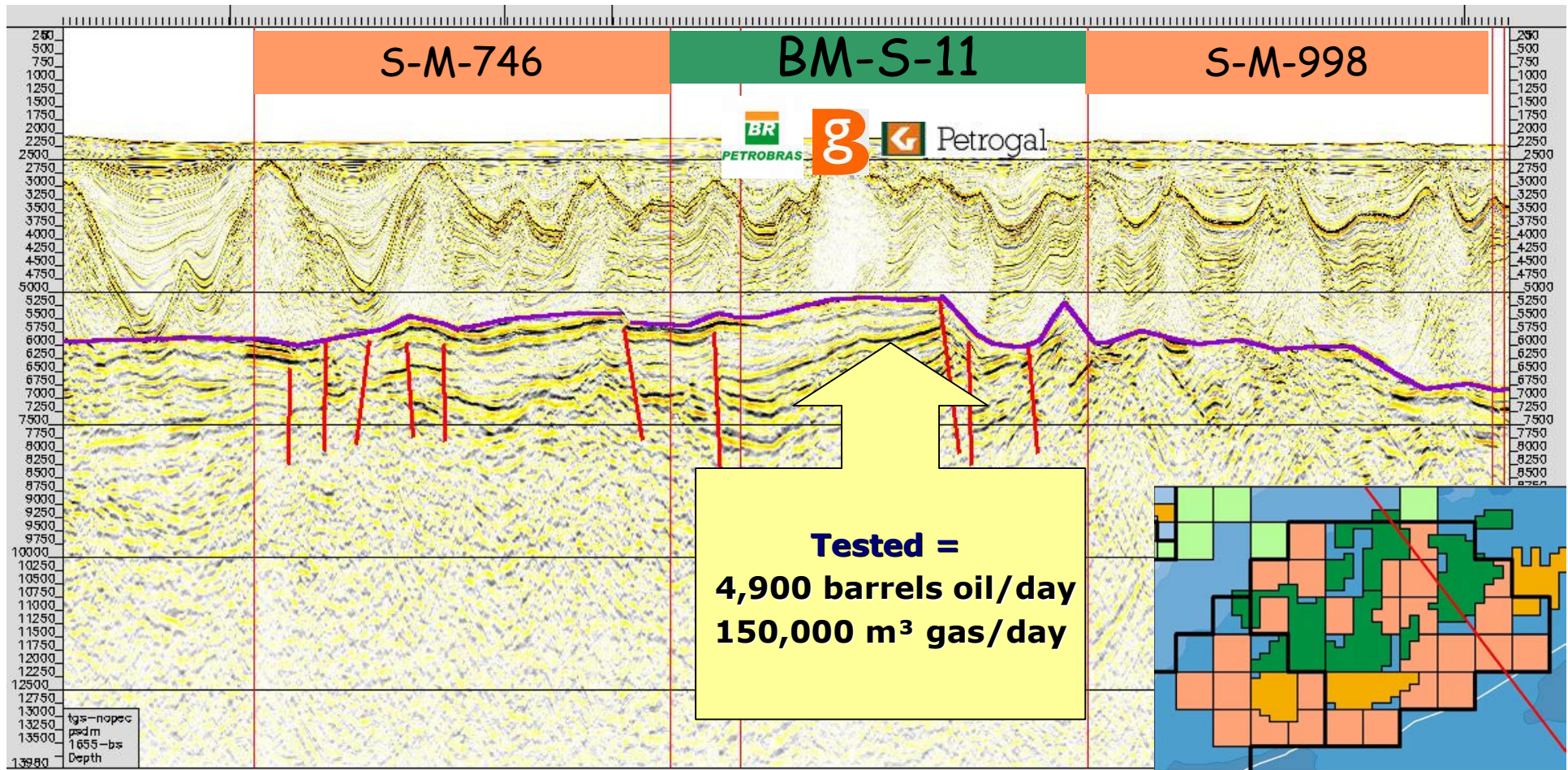


Water Depth ~ 2,000 m a 2,500 m

Pre-Salt Exploratory Opportunities

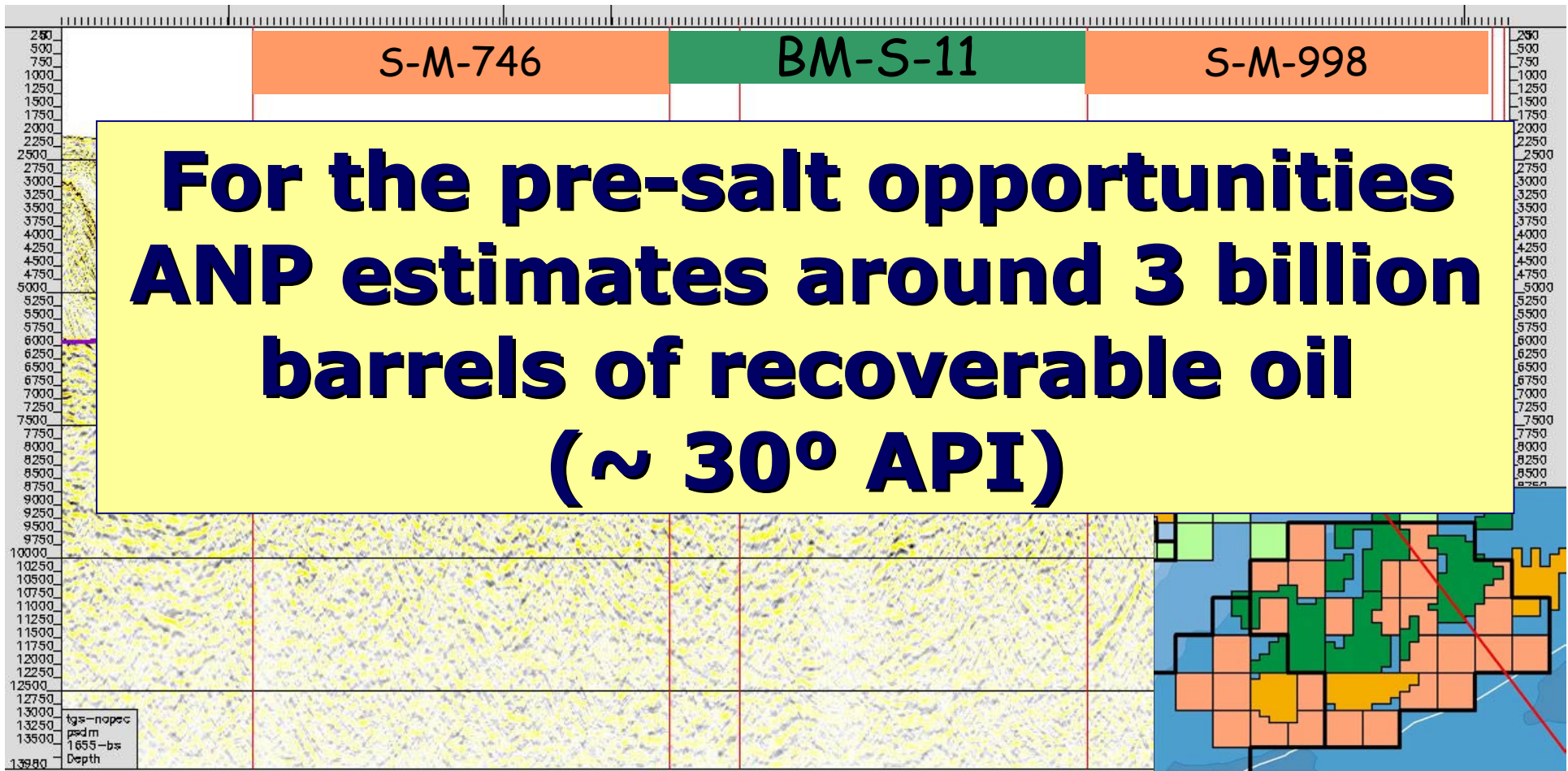


Pre-Salt Exploratory Opportunities



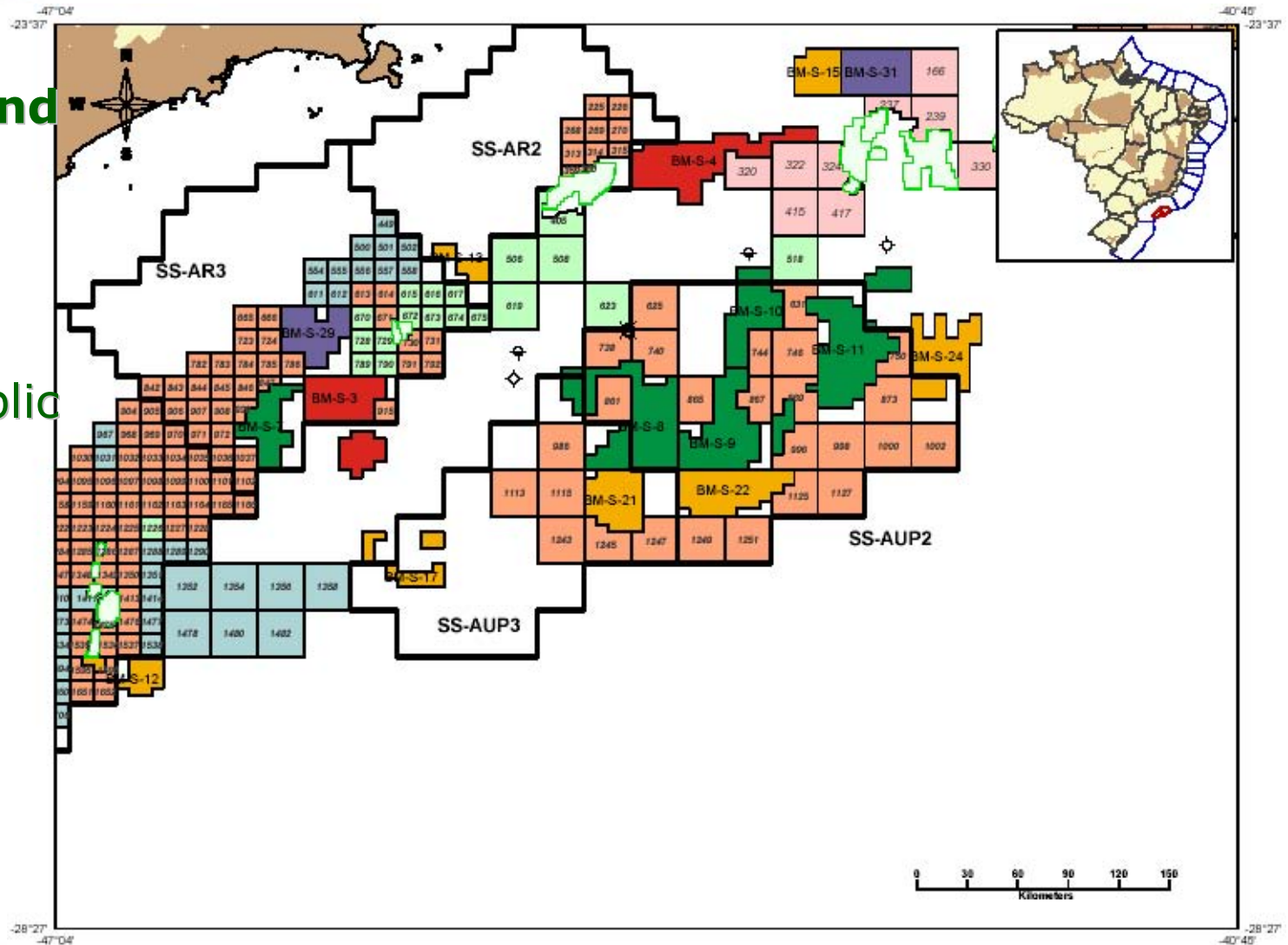
Water depth ~ 2,250 m

Pre-Salt Exploratory Opportunities

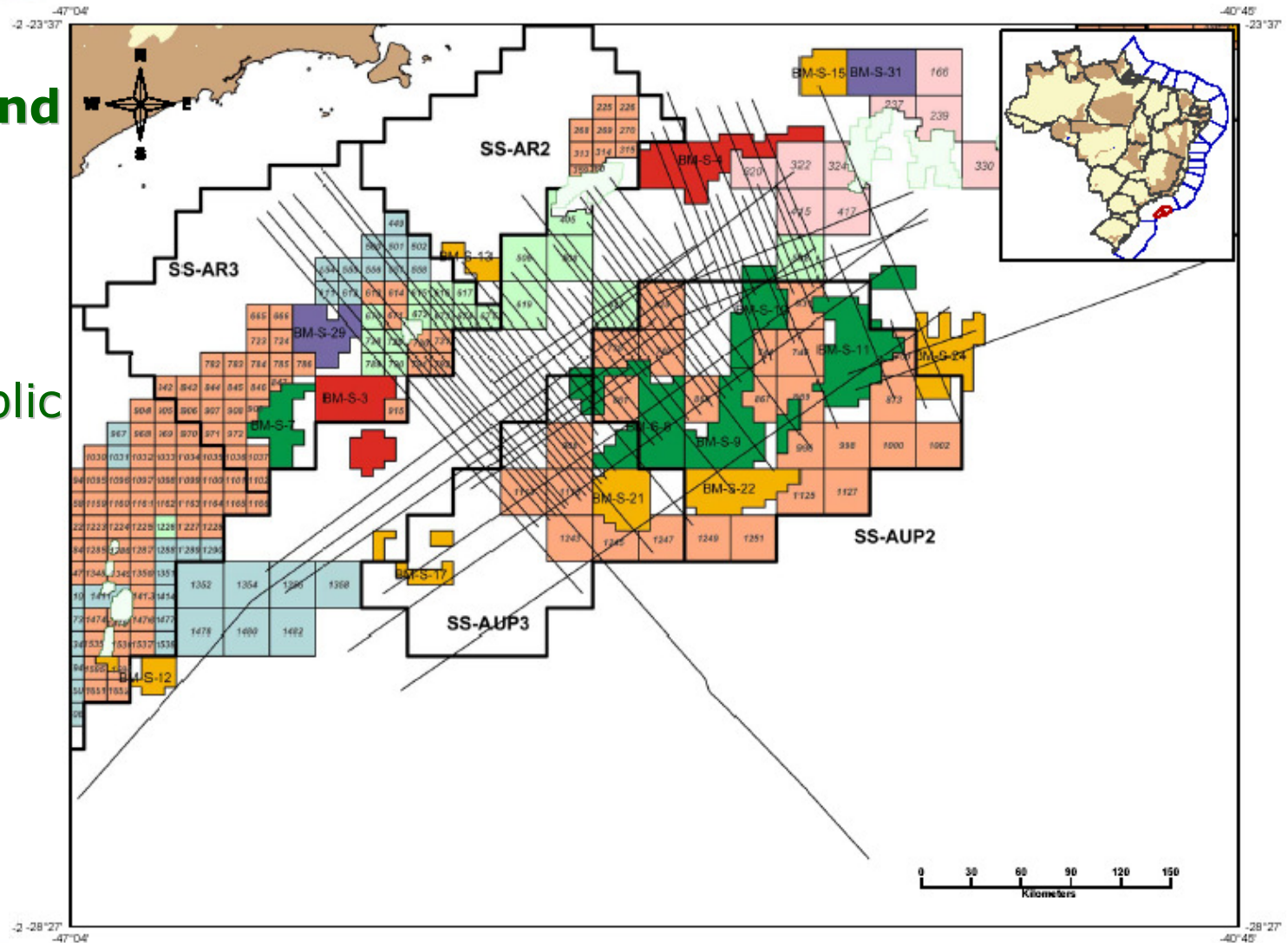


Water depth ~ 2,250 m

- **SS-AUP2 and SS-AUP3**
Wells: 6
Seismic:
9,685 km
2D public
pos-stack



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BrasilRound9
Nona Rodada de Licitações

Minimum Exploratory Program

Sector	SS-AUP2 & SS-AUP3
Exploratory Class	High Potential
Number of Blocks	26
Total Bid Area	15,676 km²
Exploration Phase	7 years
Exploratory Period	5+2 years
Operator Qualification	A
Minimum Bonus	R\$ 20 millions to 240 millions
Minimum Target	Guaratiba Fm (Barremian)



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Final Remarks

- ✓ After the pre-salt discoveries Santos basin has now been considered a potential oil and gas producer
- ✓ There exists four proved plays (Pre-Salt, Albian, Late Cretaceous and Tertiary). Pre-salt play is expected to spread to other eastern margin basin
- ✓ Recent pre-salt discoveries may add huge light oil reserves
- ✓ Bid areas are close to the most important South America consuming region (SP – RJ)
- ✓ The basin has already production facilities (e.g. Merluza and Mexilhão gas pipelines)

Santos Basin is a High Potential basin.

However, it has many areas where the exploration efforts is too small.

Wildcat wells (1 well per 1,600 km²)



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