



Libra

Geological Assessment

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Geologist

Environmental Guidelines

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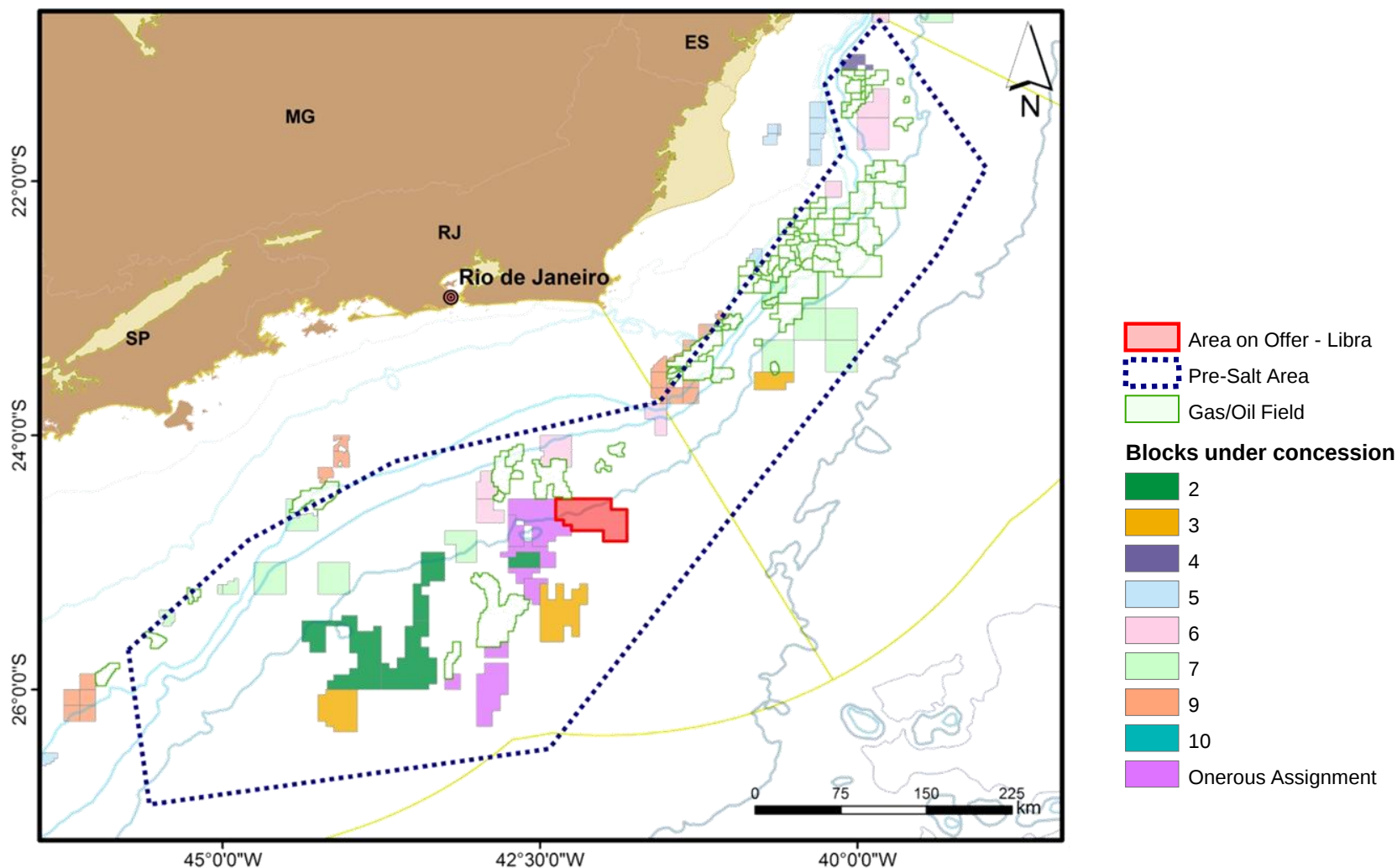


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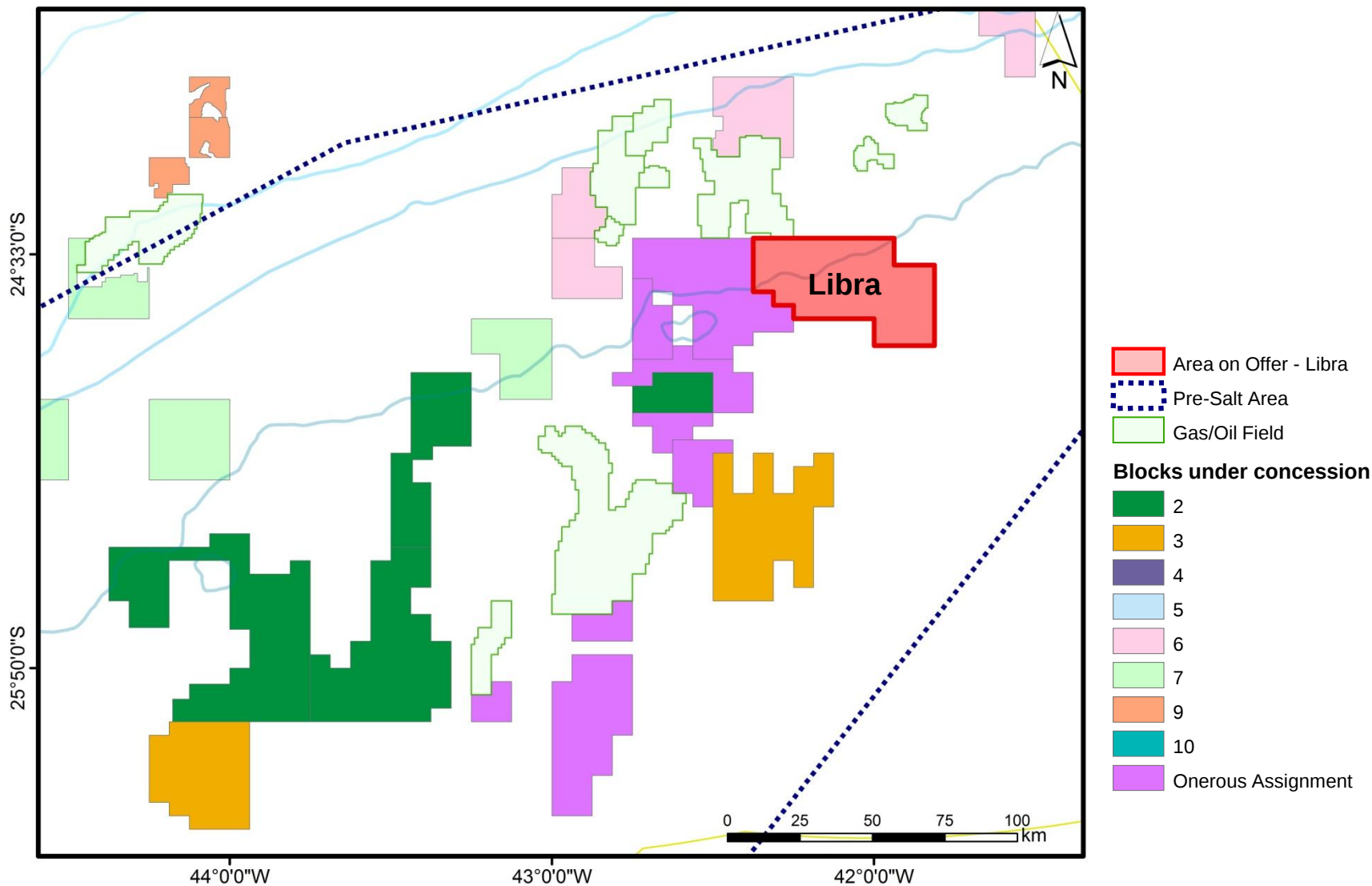
Brasil
PRE-SALT



Introduction



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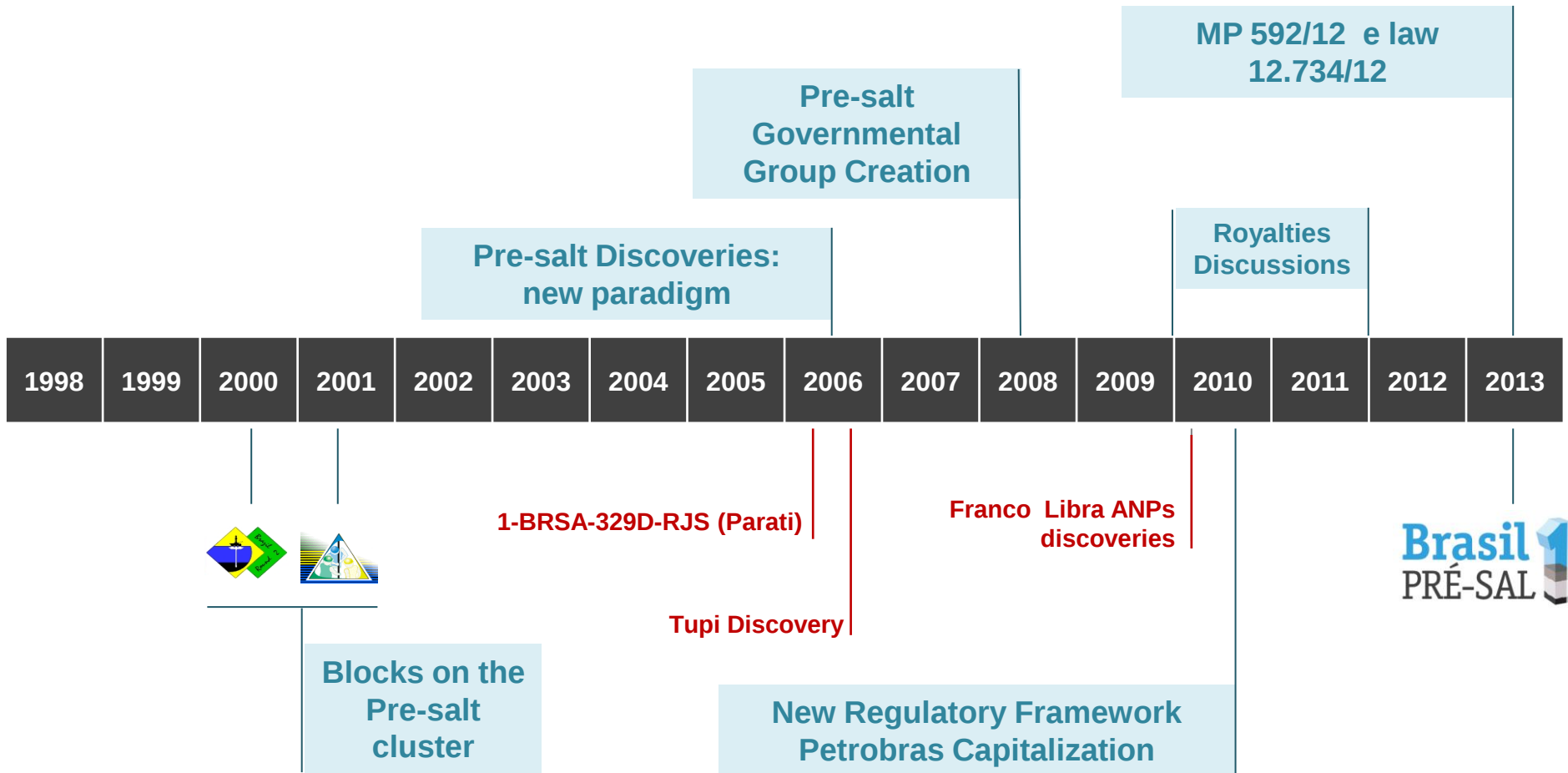
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Pre-salt History



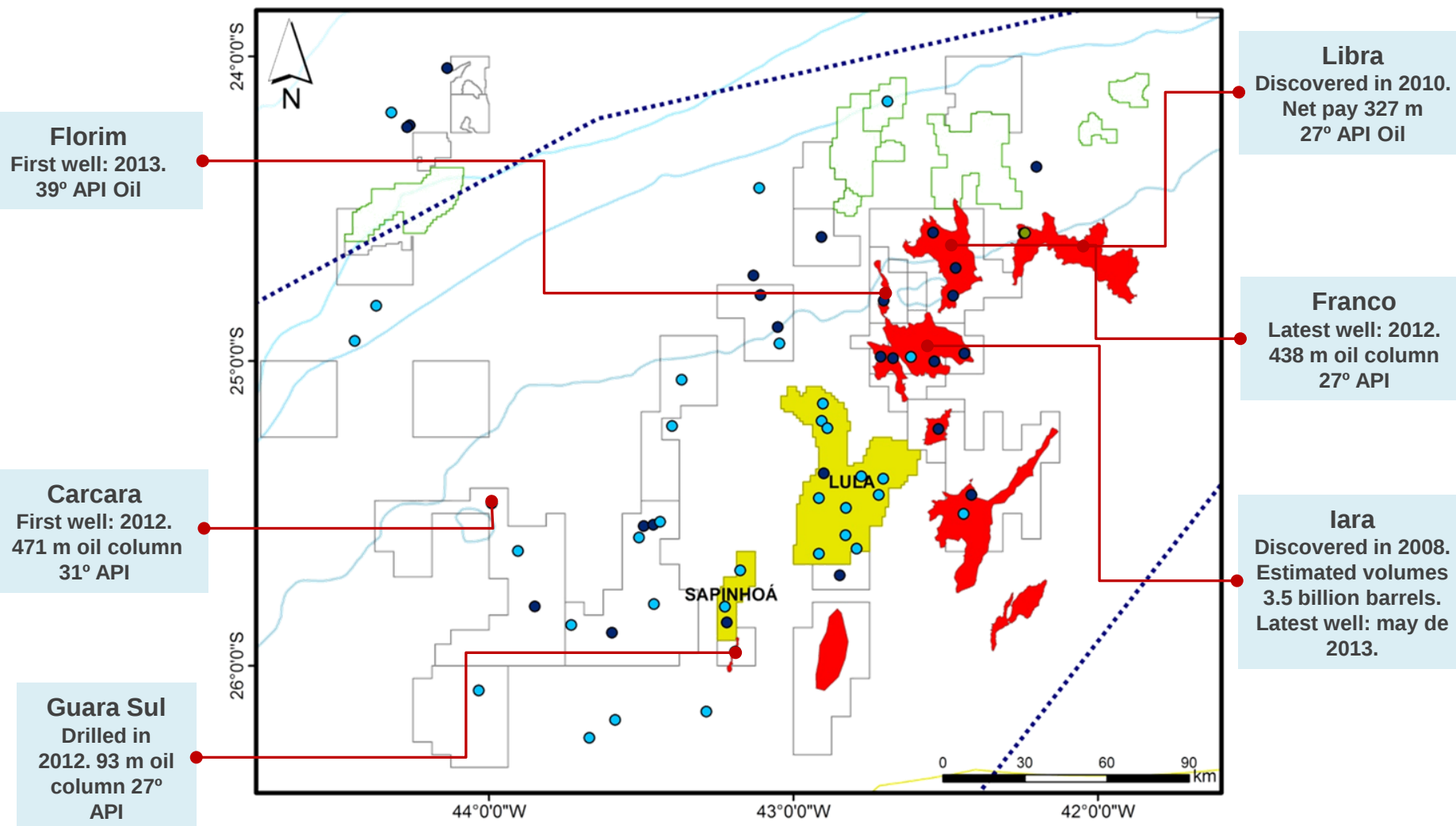


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Recent Discoveries



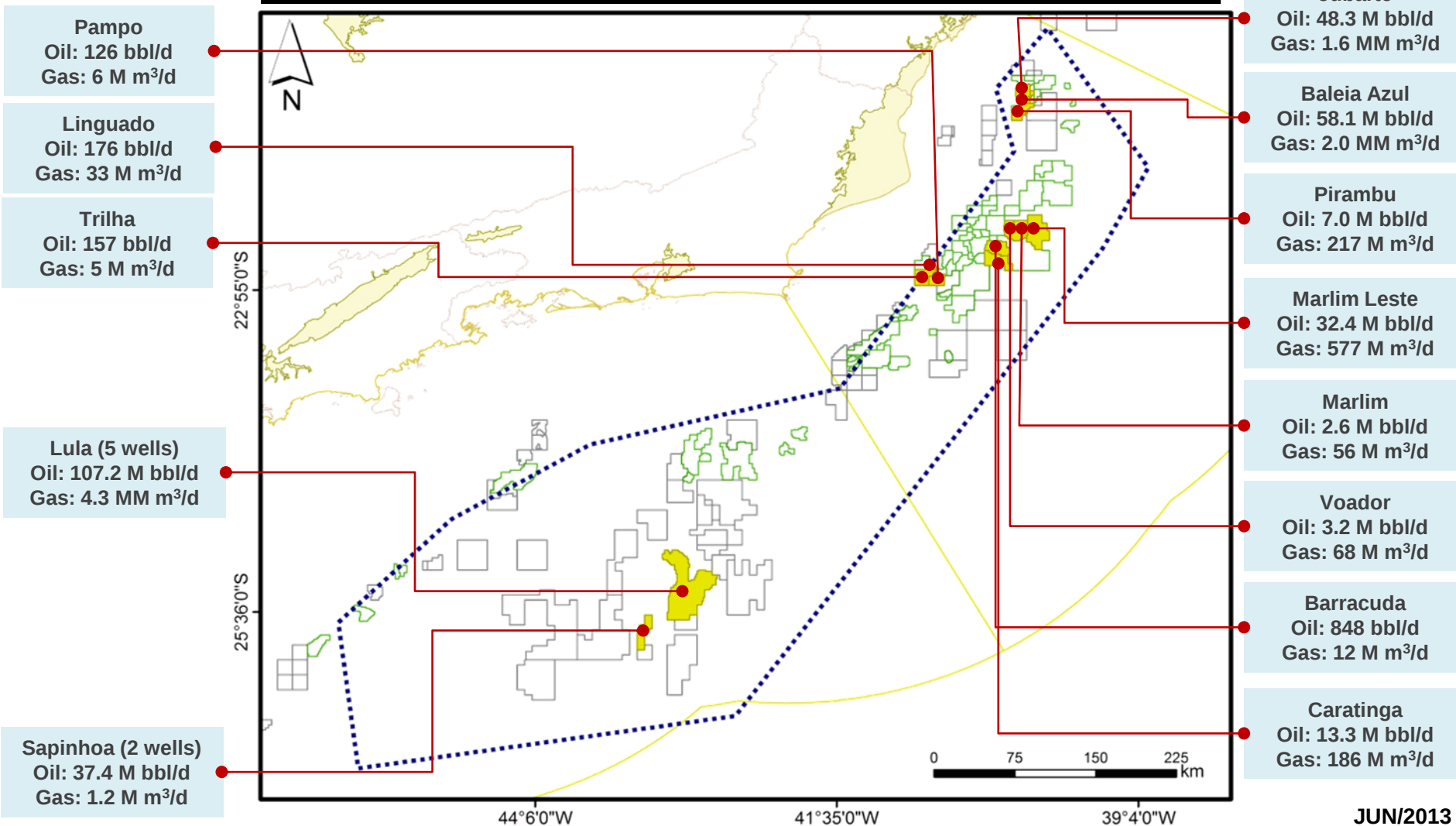


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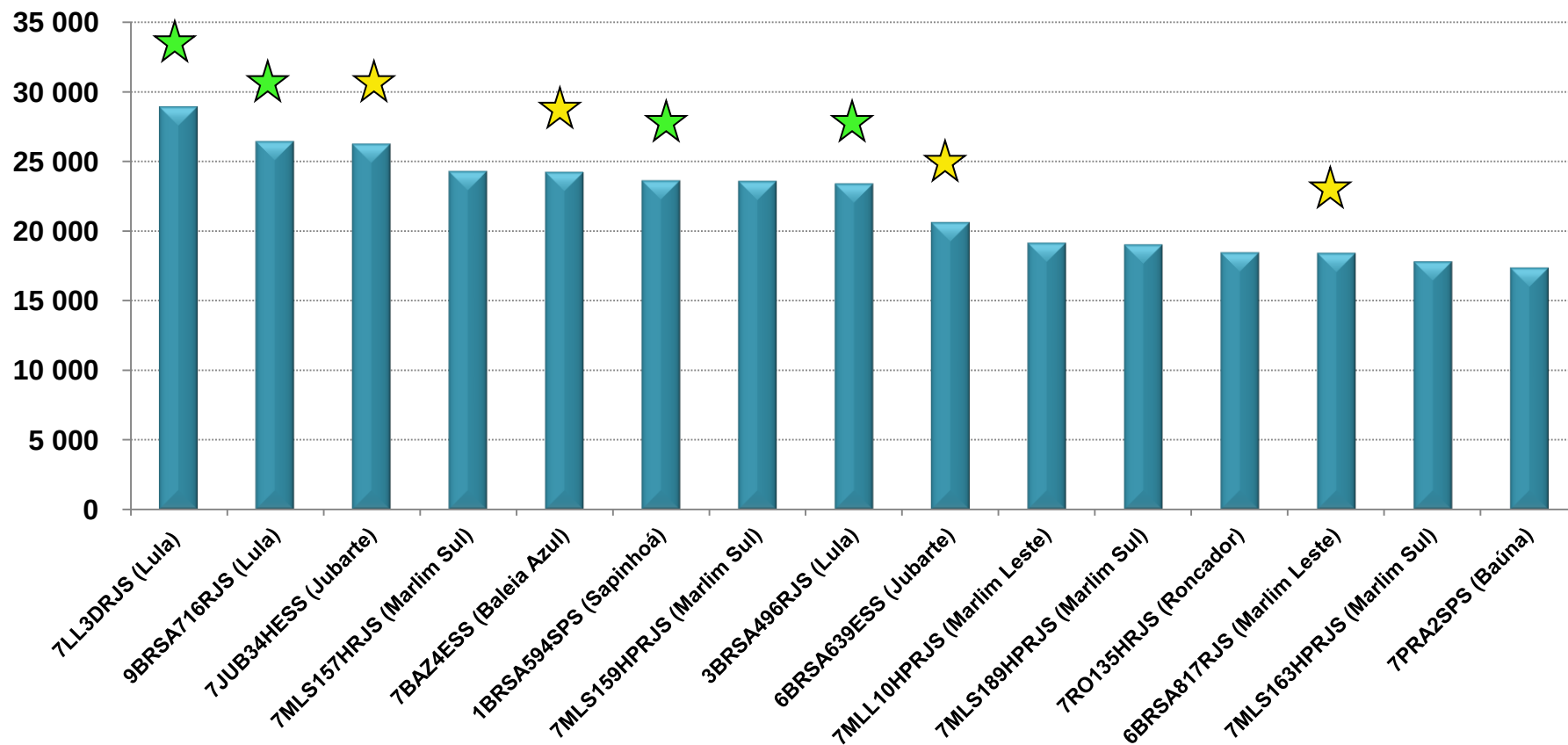
Pre-salt Oil Production

~310 mil barrels/day and ~ 10.4 million m³/day



JUN/2013

Production (bbl/d)



Reserves of oil and natural gas Pre-salt Santos Basin

PROVED RESERVES

Oil (billion barrels)

Natural Gas (billion m³)

3.40

174.29

TOTAL RESERVES

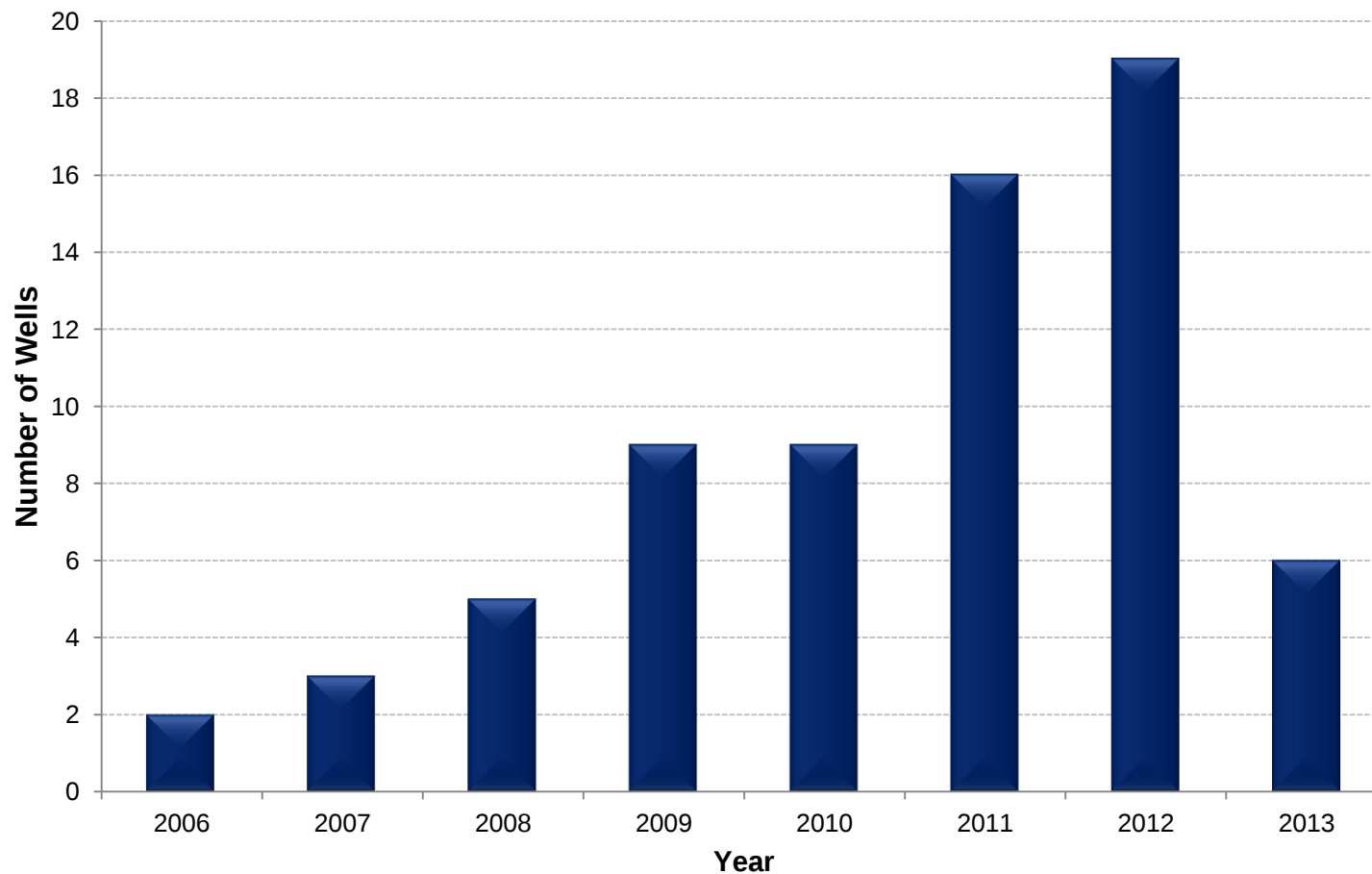
Oil (billion barrels)

Natural Gas (billion m³)

9.37

433.21

Exploration Wells drilled in the Pre-Salt Santos Basin



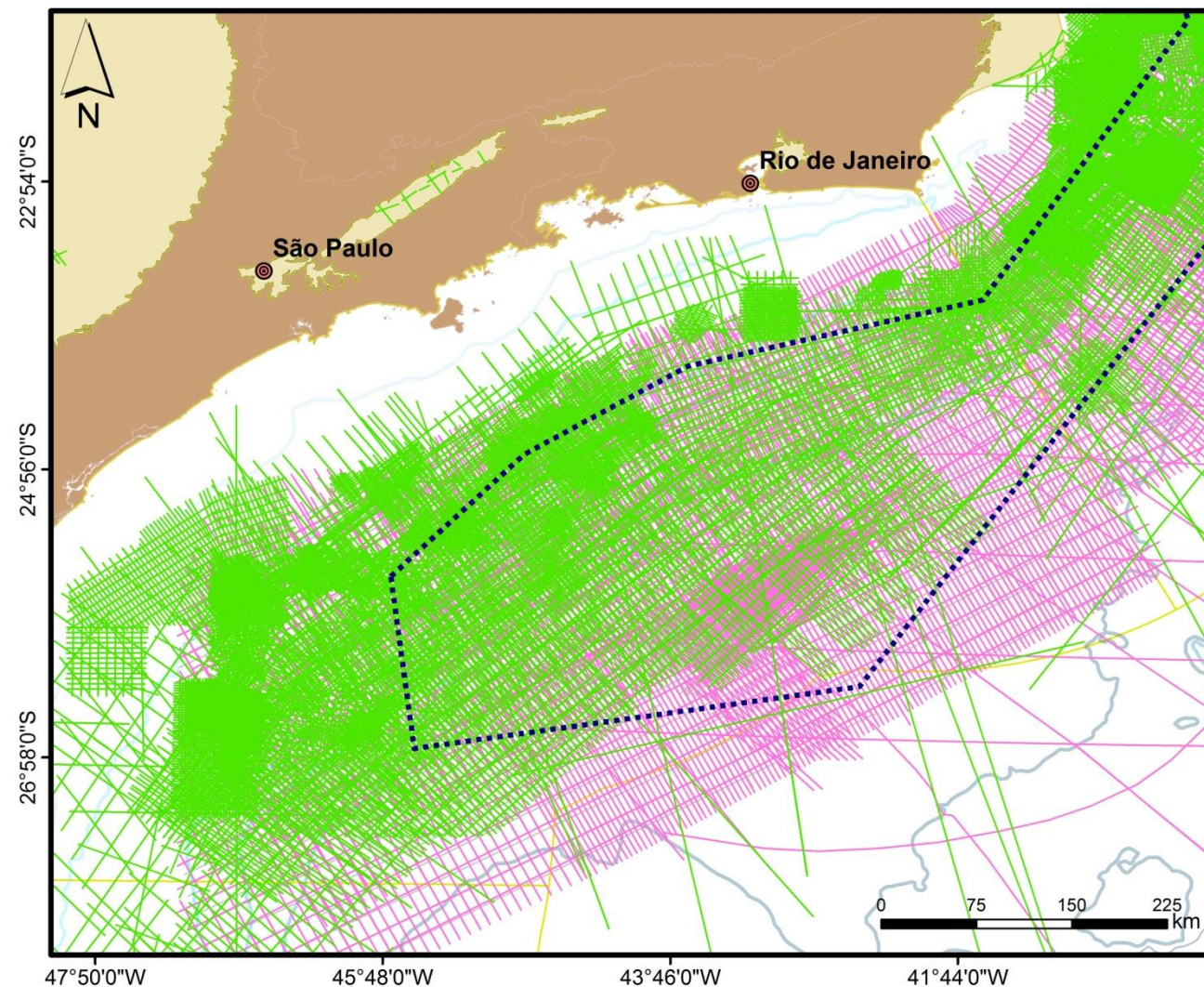


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Available Data



- ***~192,000 km linear 2D confidential post-stack seismic data;***
- ***~300,000 km linear 2D public post-stack seismic data.***

- Public post-stack 2D seismic
- Confidential post-stack 2D seismic
- Pre-salt polygon

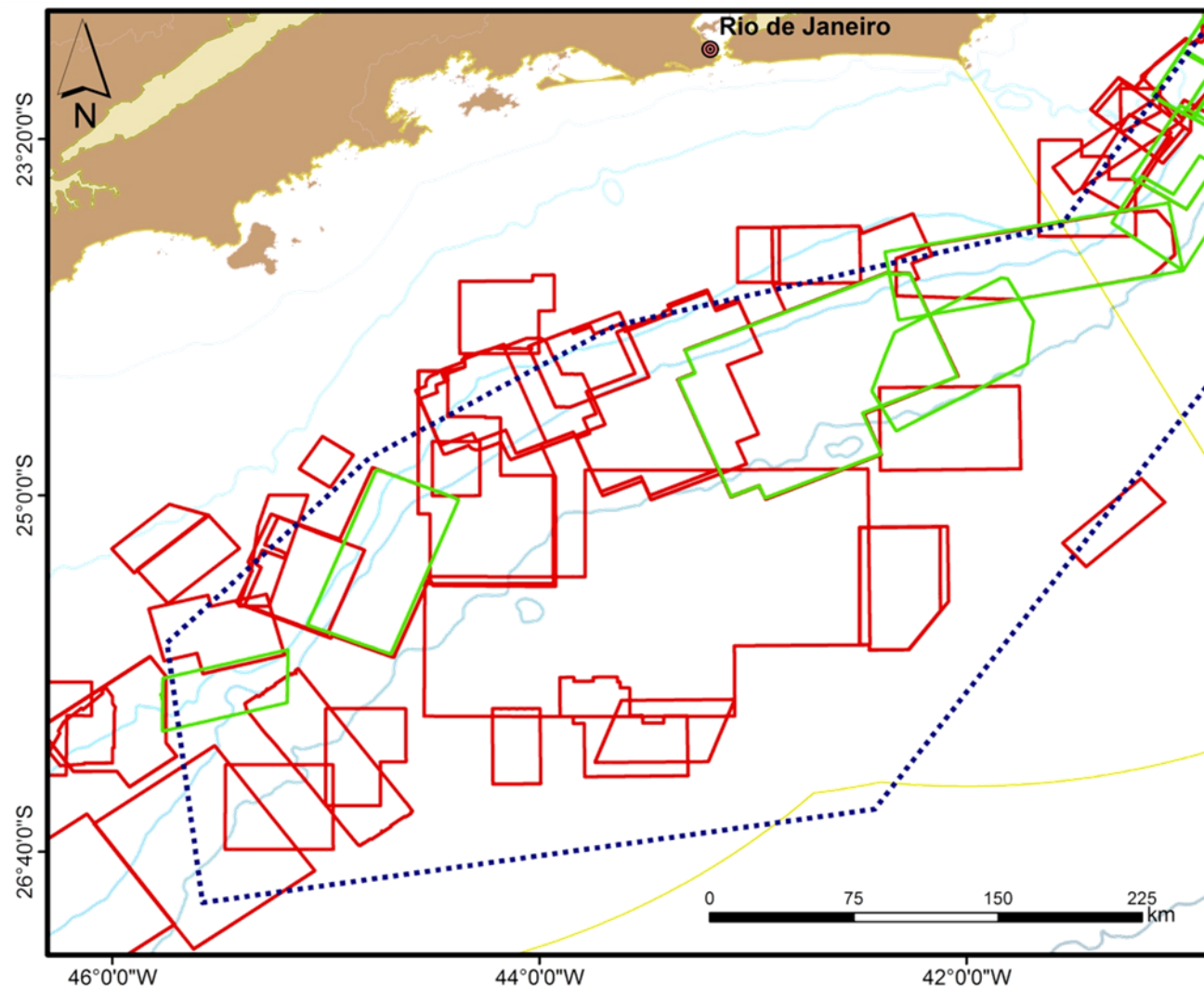


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Available Data



- **~137,000 km² 3D
confidential post-
stack seismic data;**

- **~21,000 km² 3D
public post-stack
seismic data**

-  Pre-salt polygon
-  Public post-stack 3D seismic
-  Confidential post-stack 3D seismic

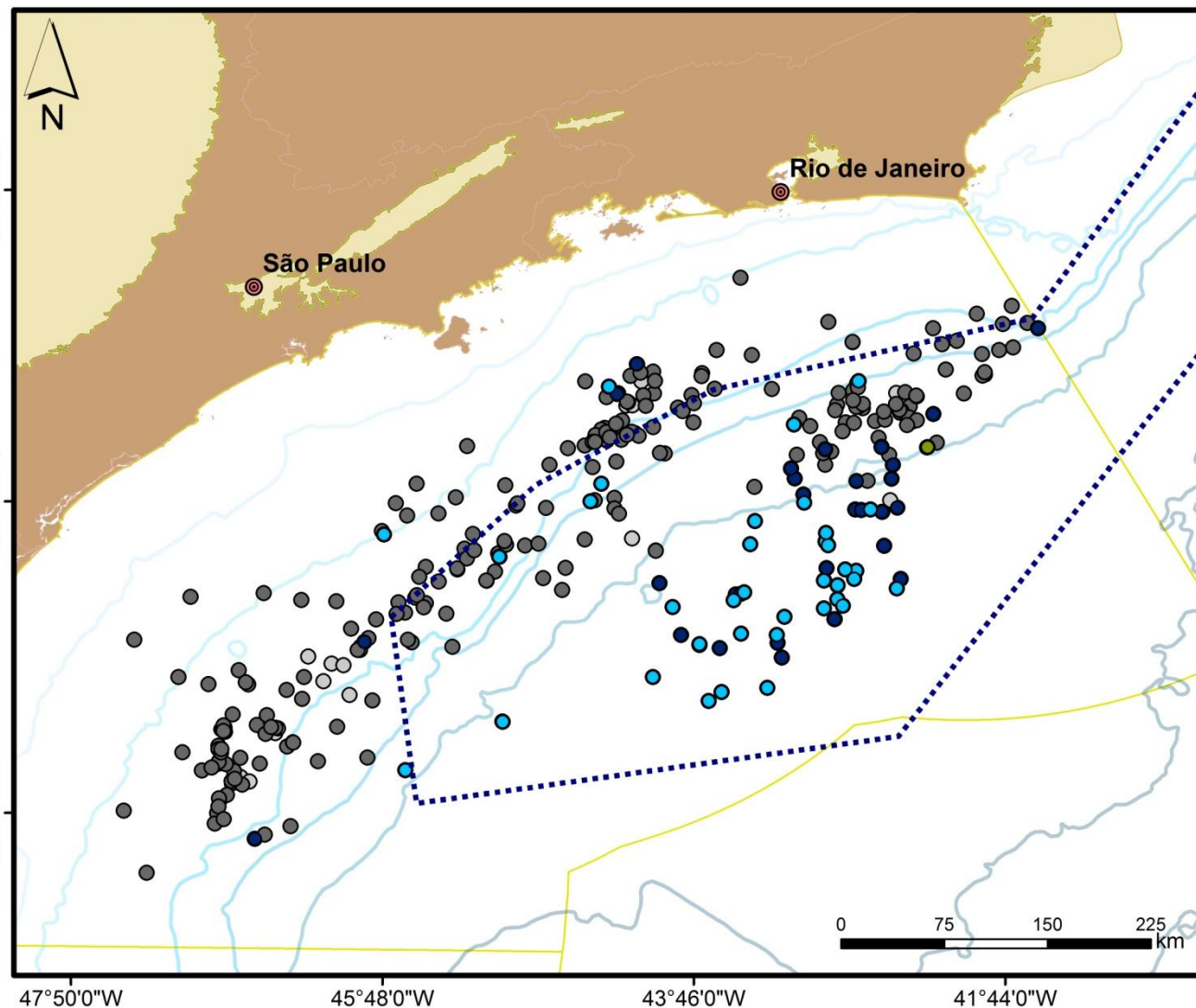


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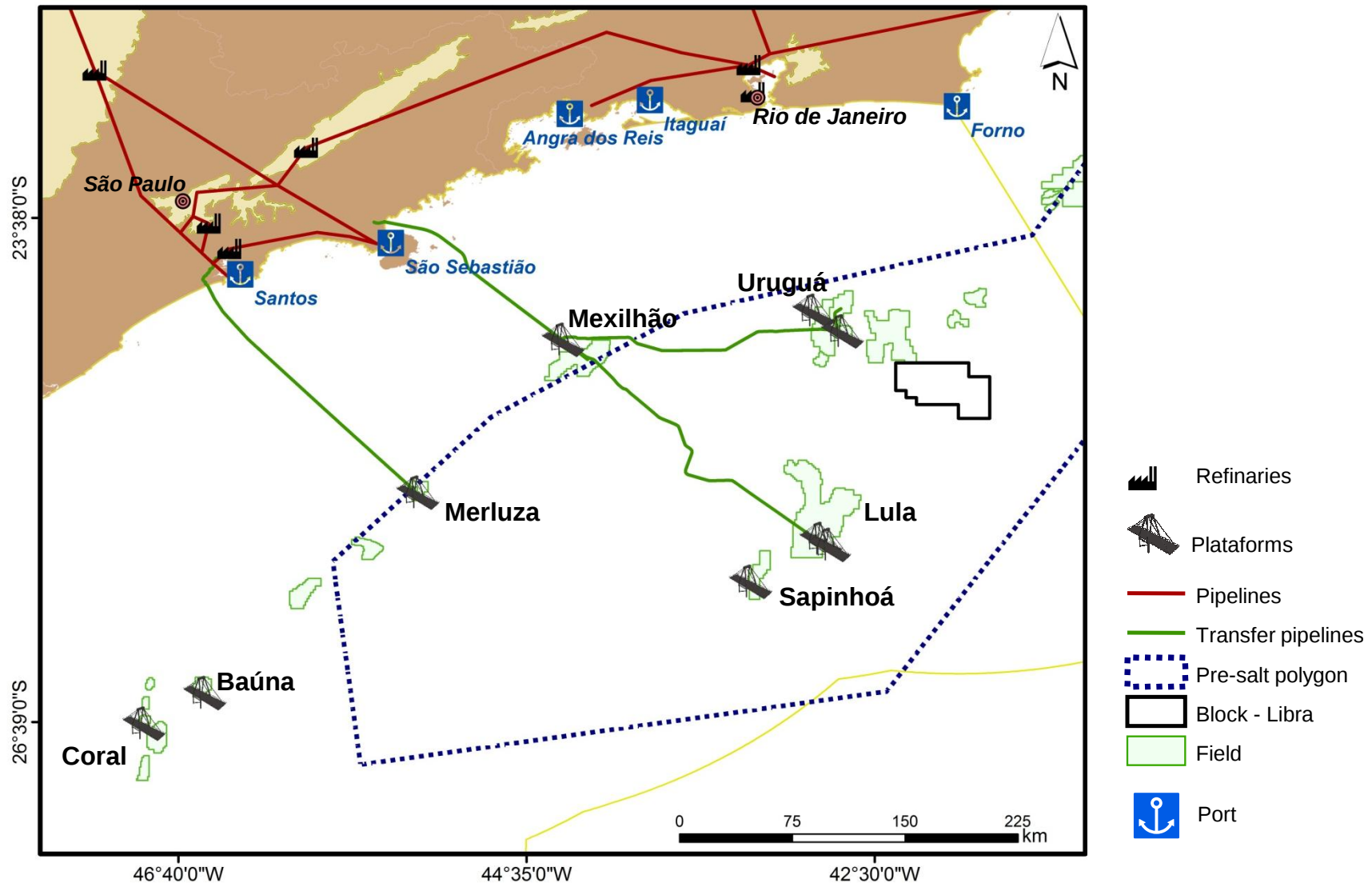
Available Data



**323 exploratory
wells:
70 reached Pre-salt
layers**

- Pre-salt public exploratory wells
- Pre-salt confidential exploratory wells
- Confidential exploratory wells
- Public exploratory wells

Infraestrutura and Operational Conditions



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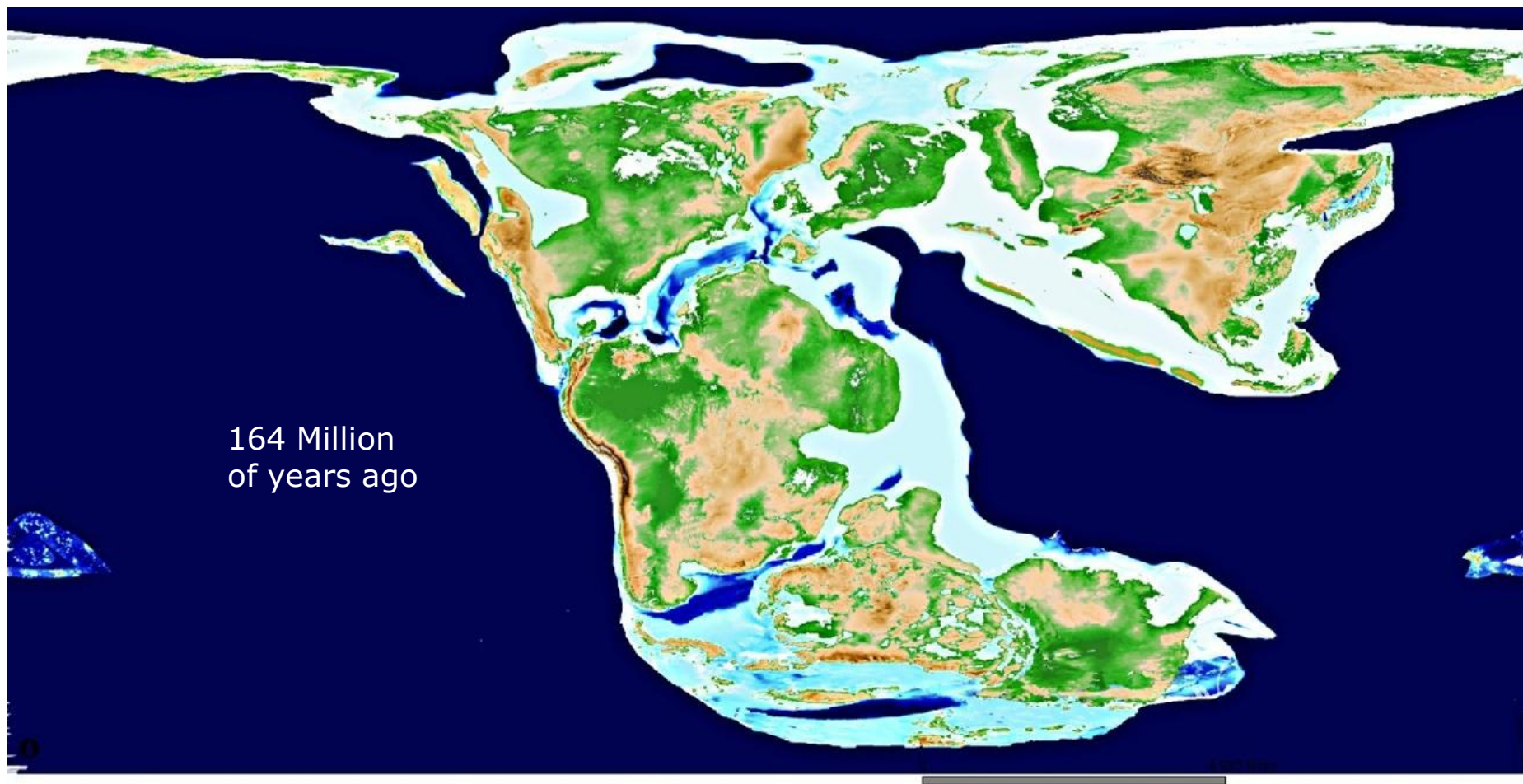


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164 Million
of years ago



SINBPA/Petrobras
Scotese

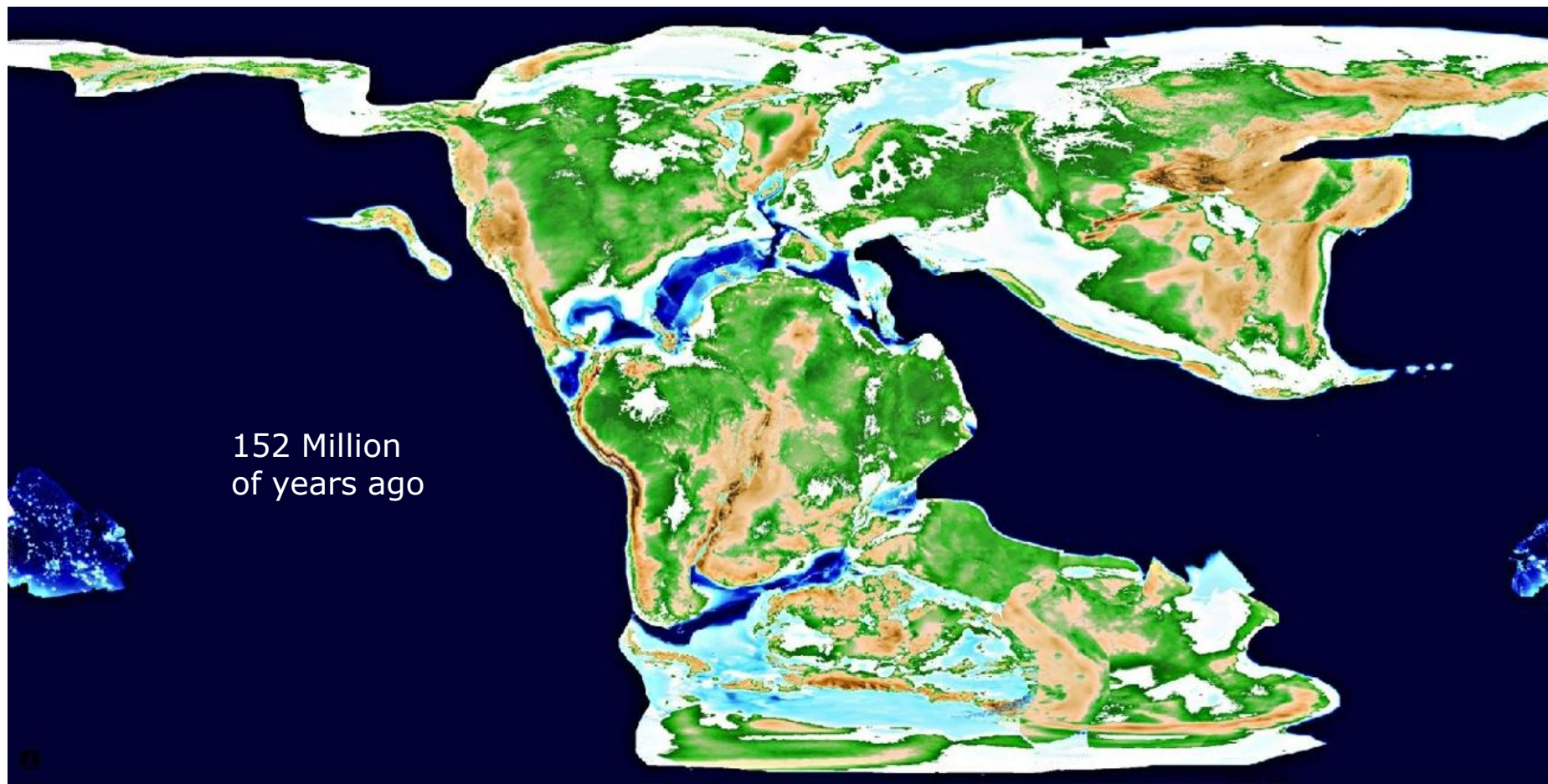


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152 Million
of years ago

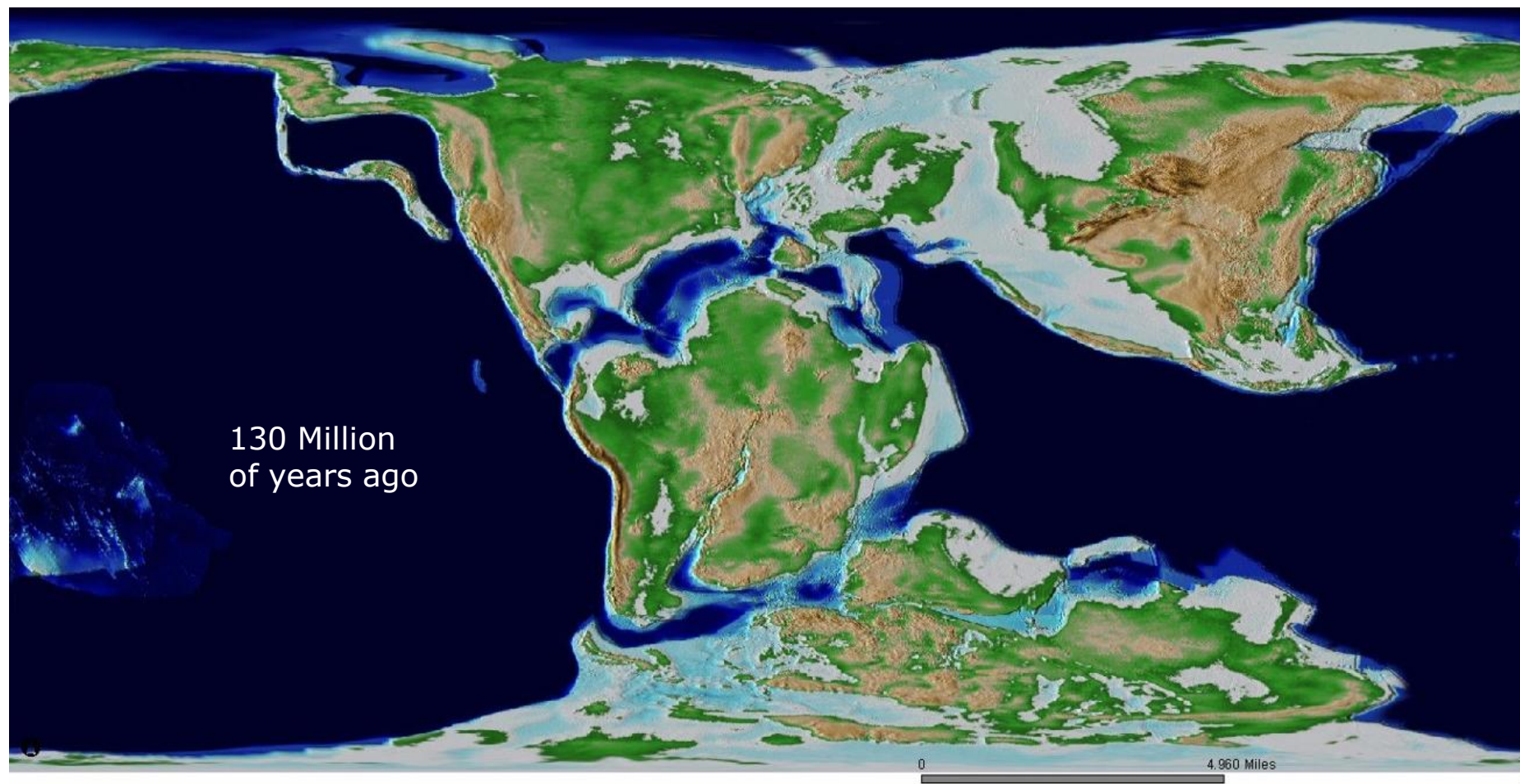


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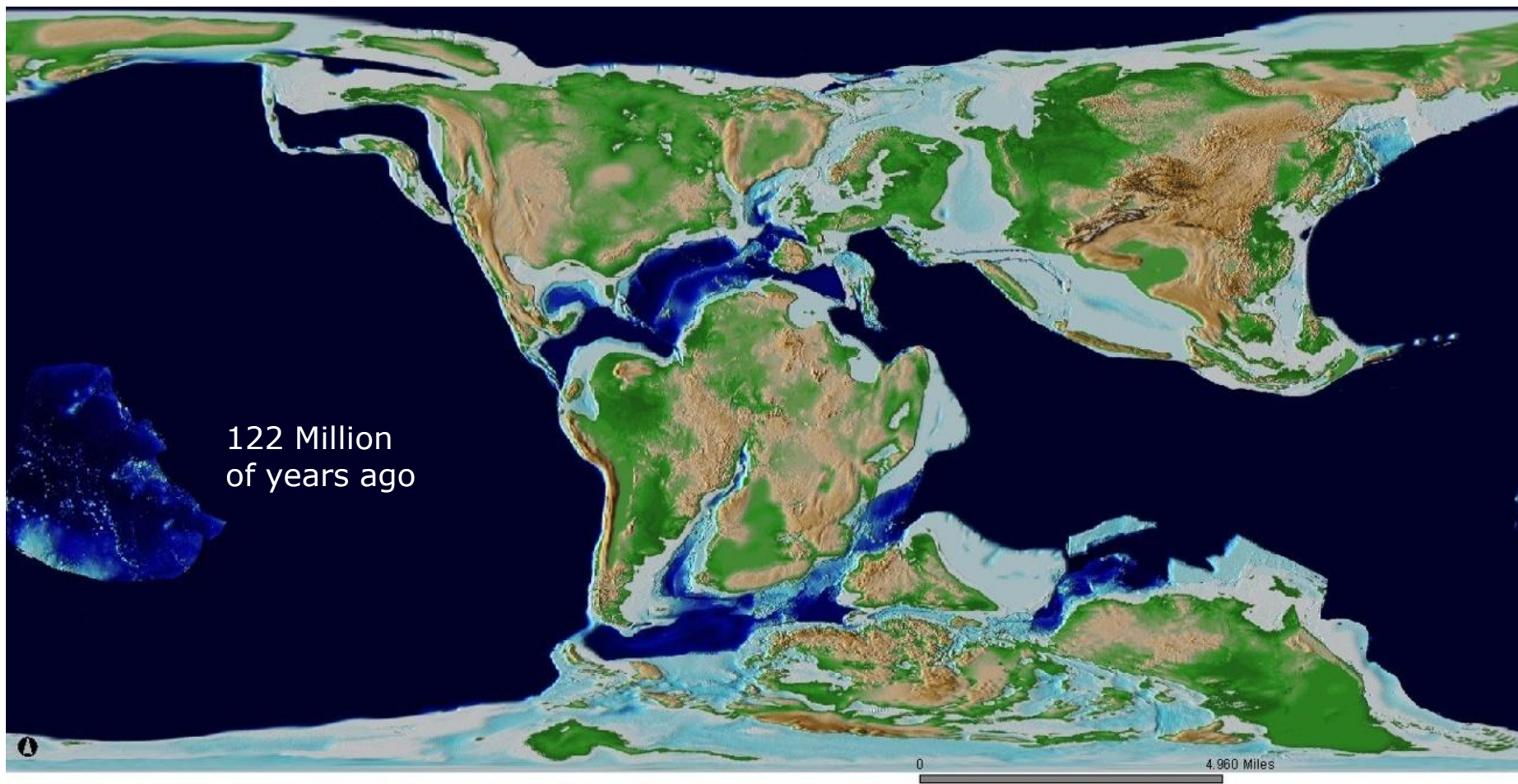


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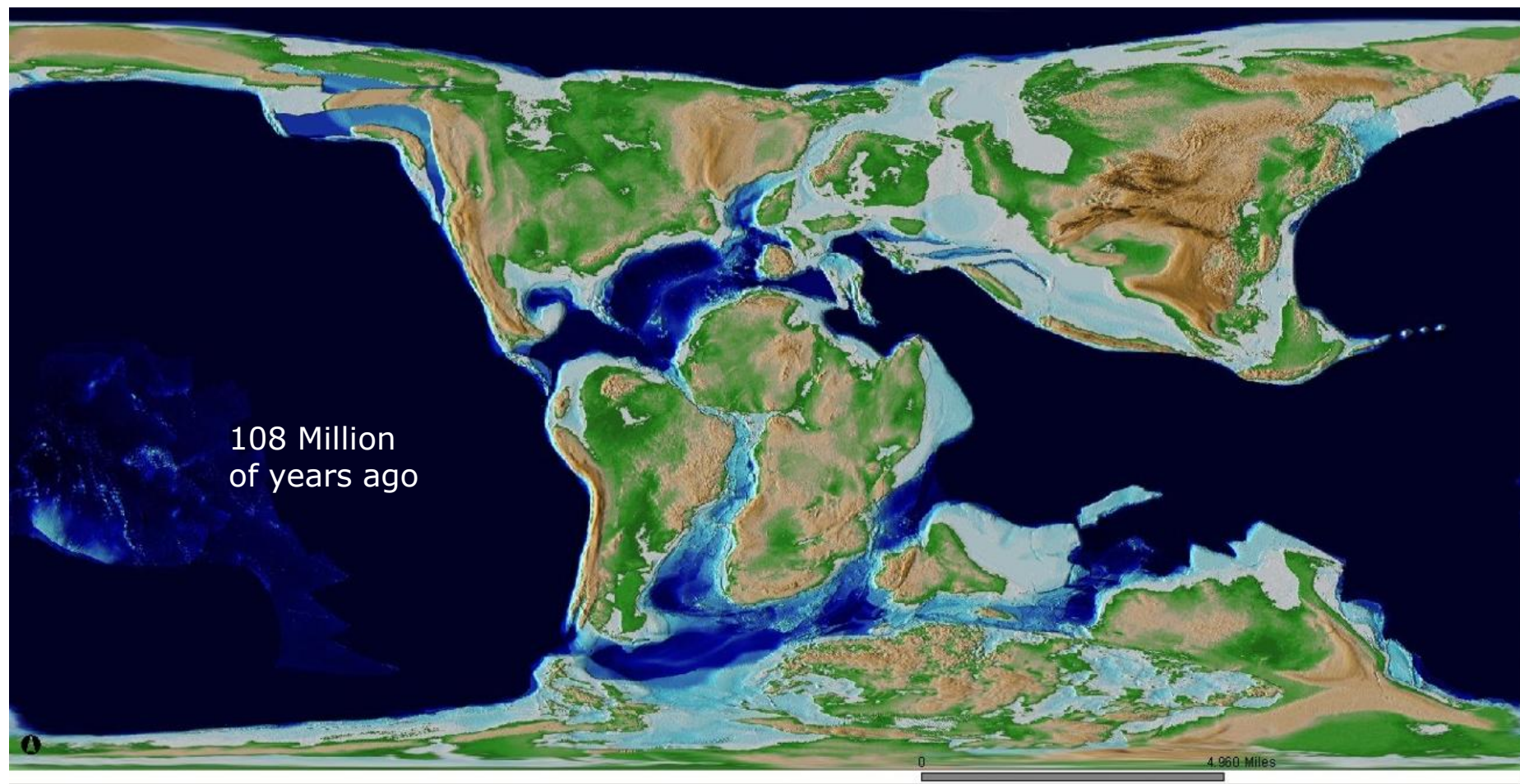


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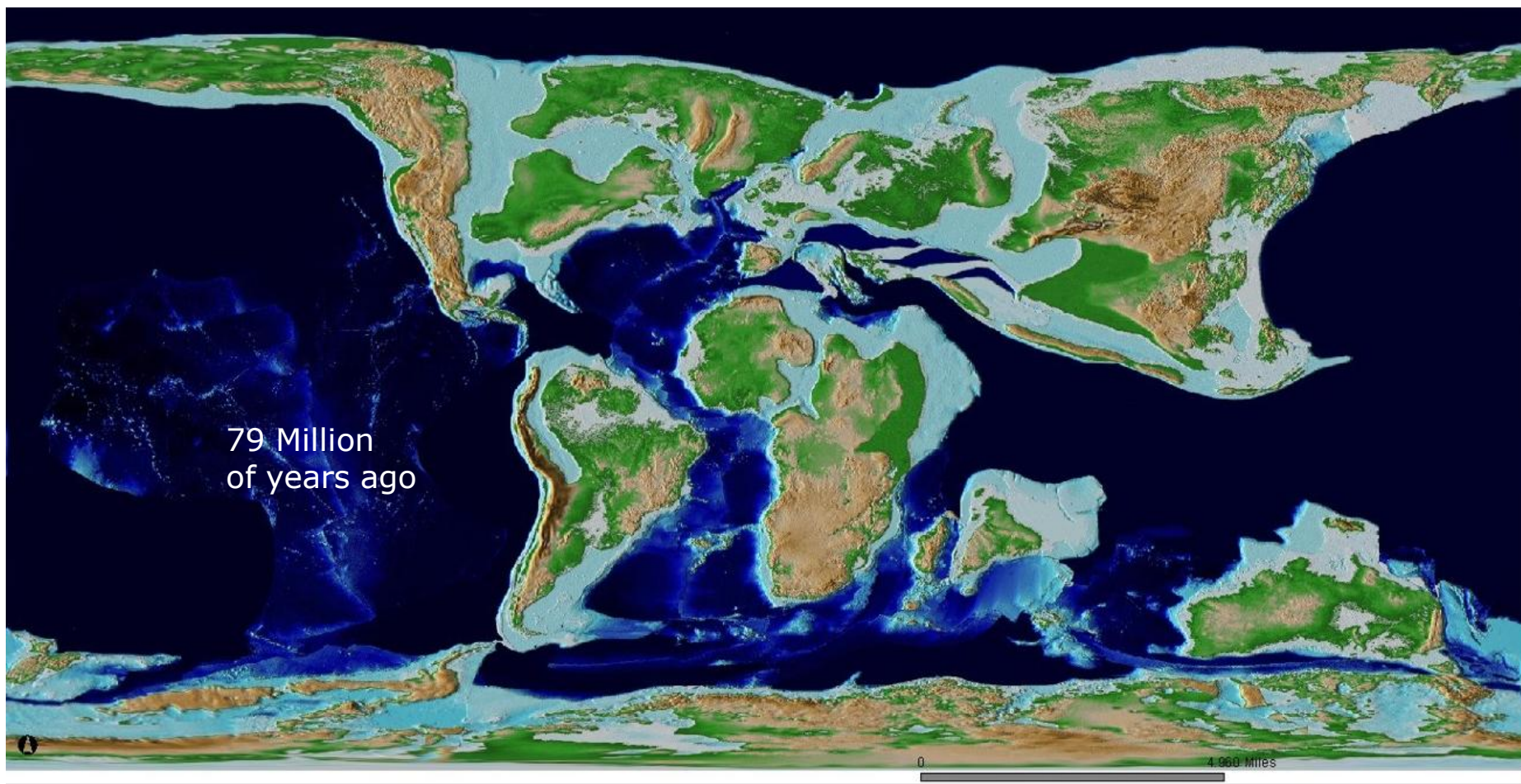


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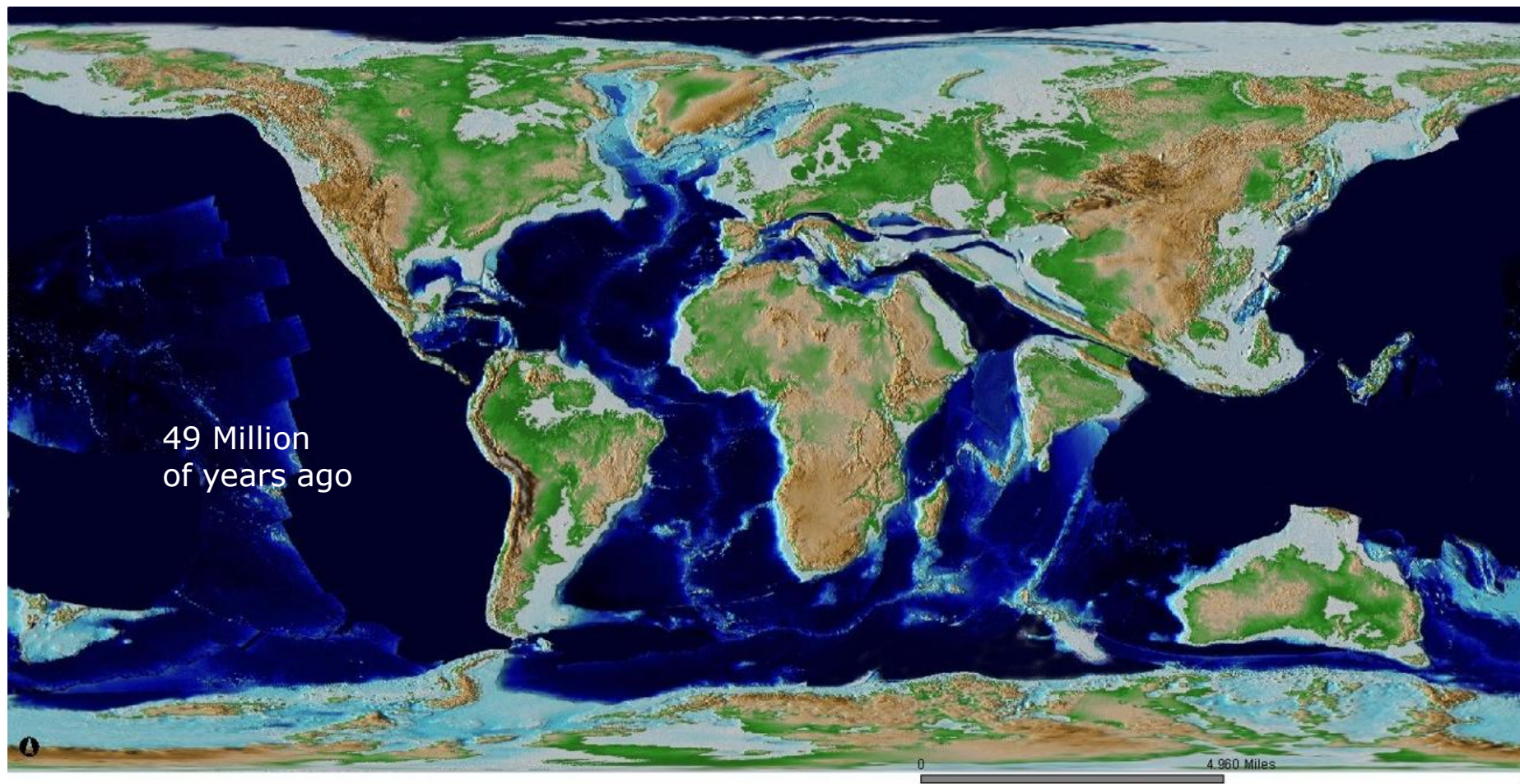


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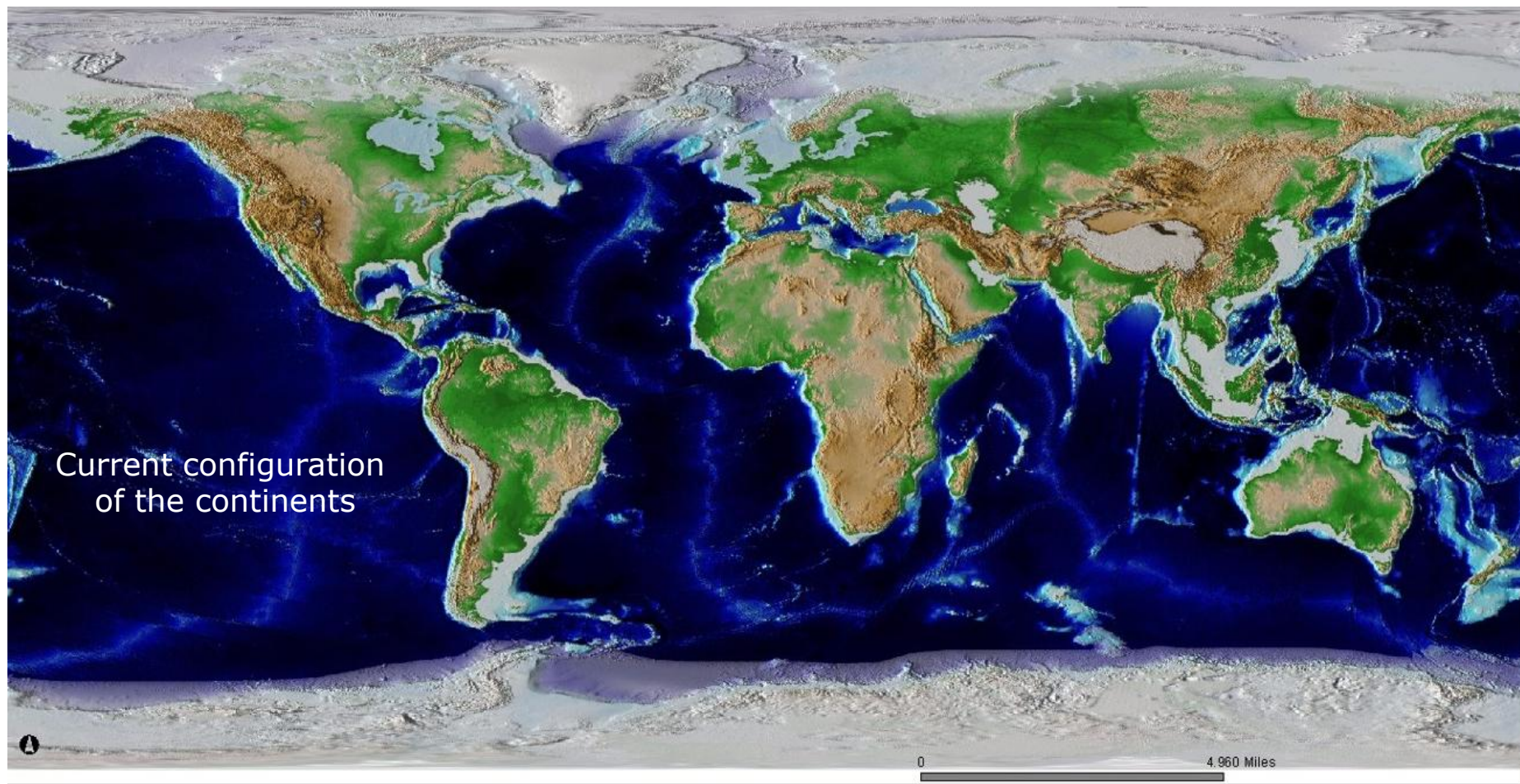


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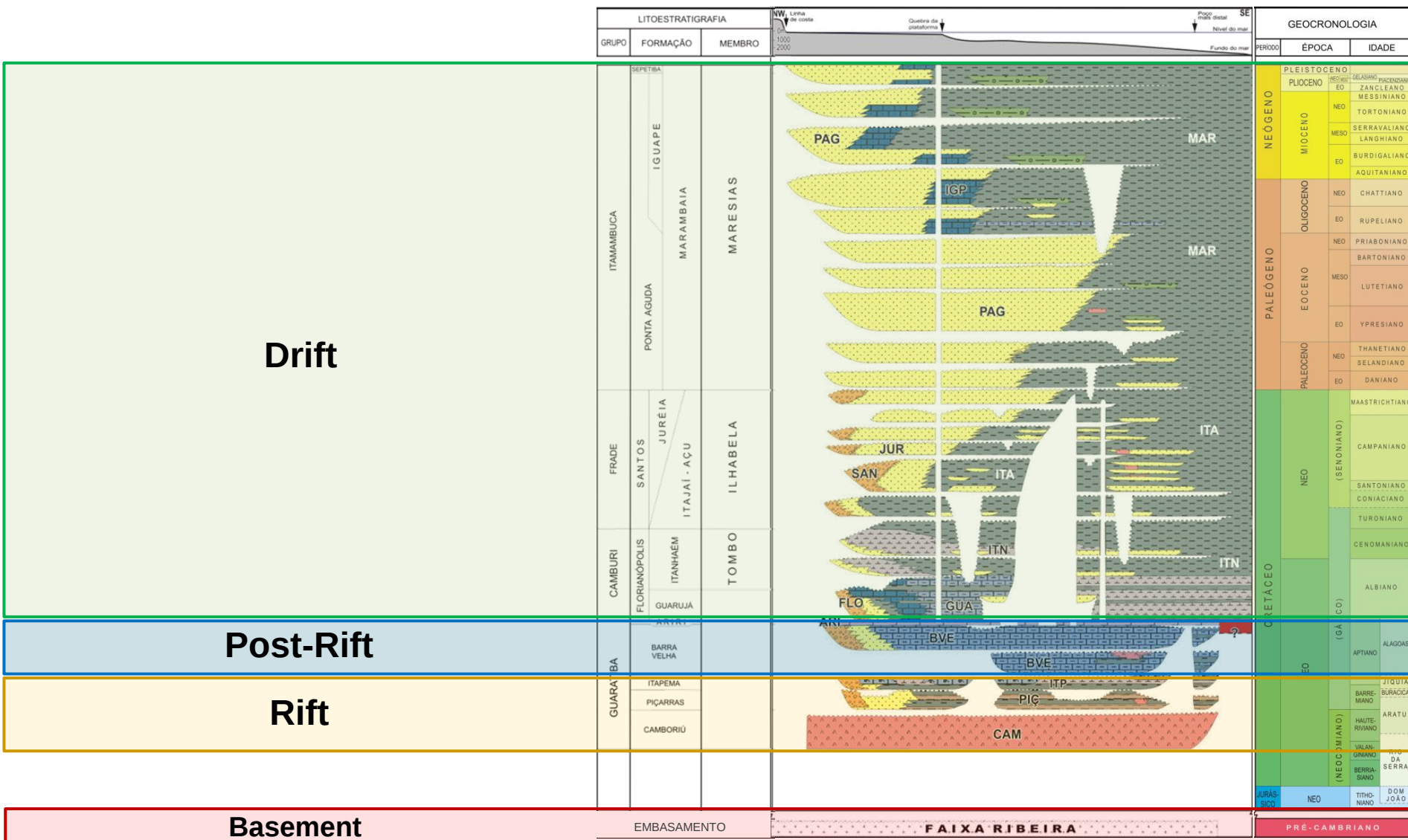
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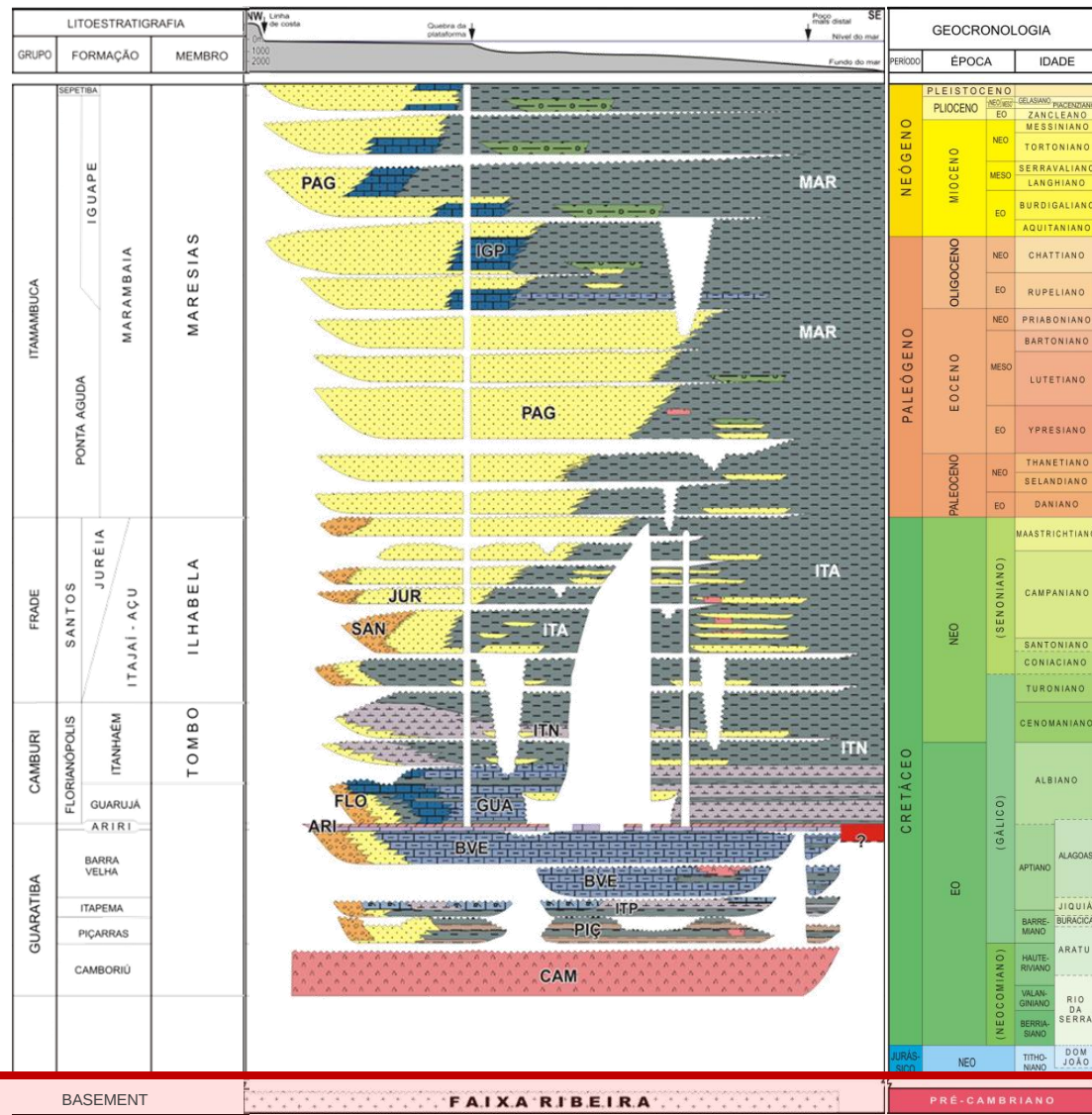


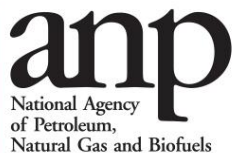
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Tectonostratigraphic Evolution



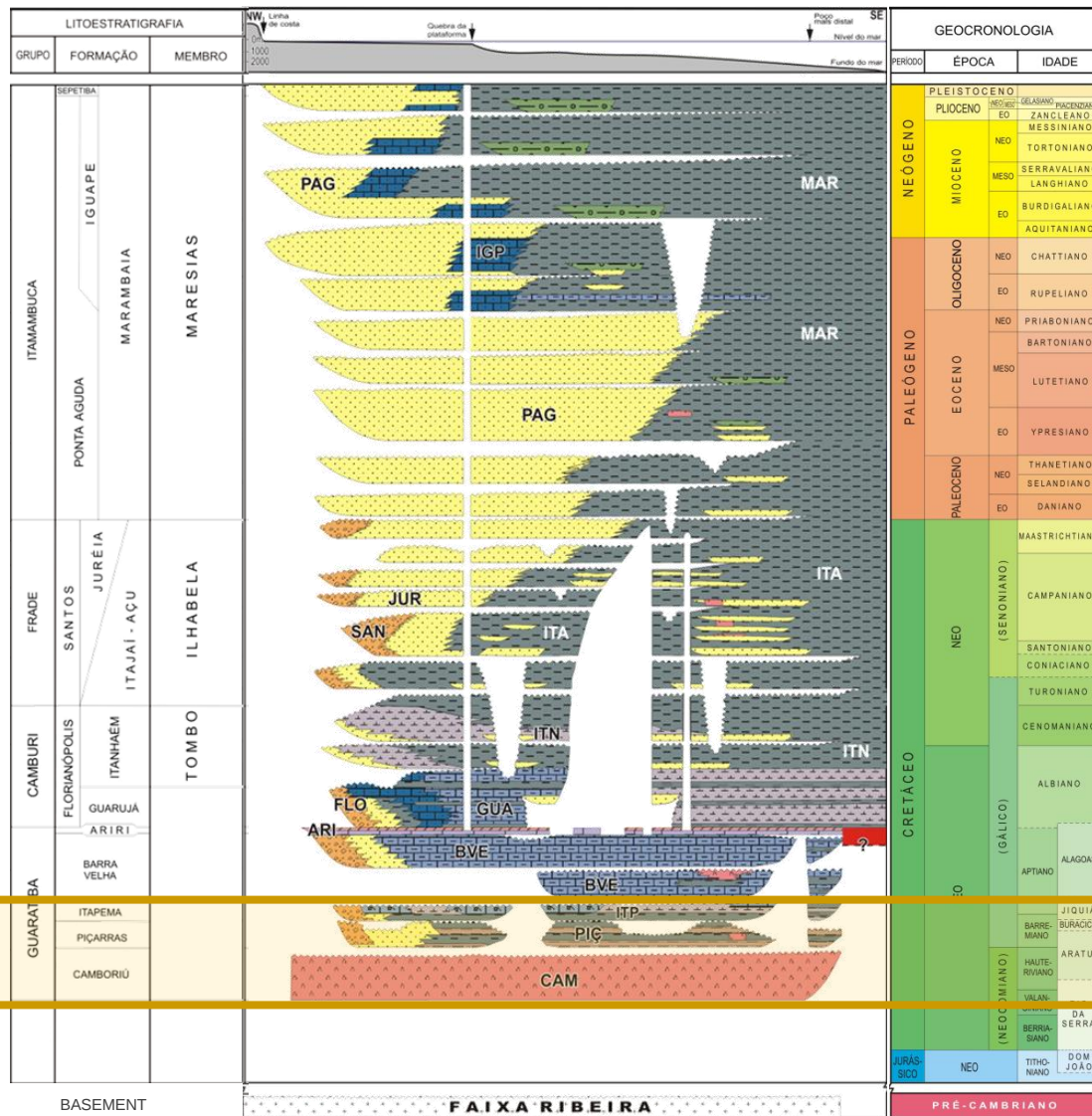
Tectonostratigraphic Evolution



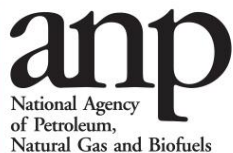


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Tectonostratigraphic Evolution

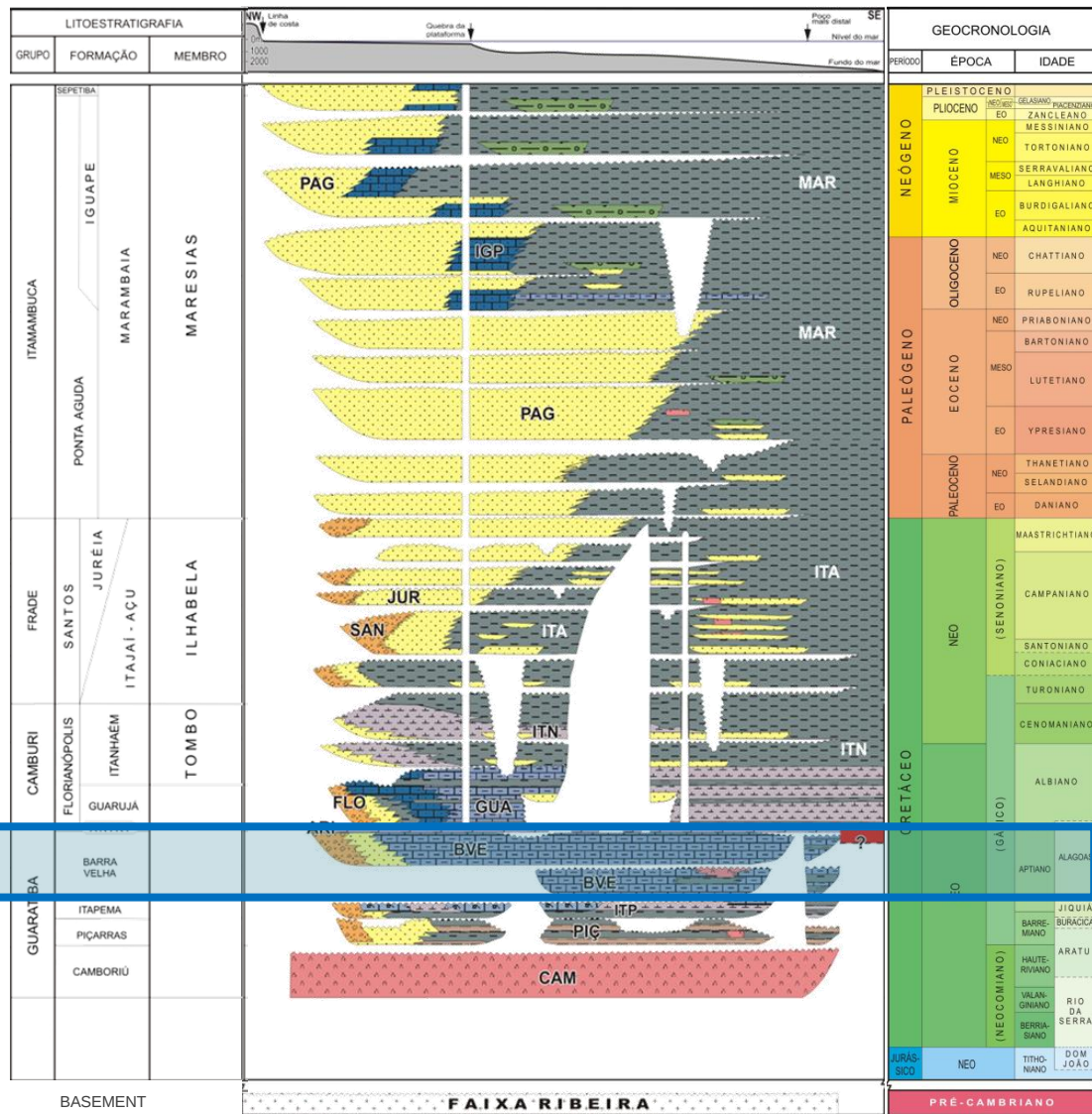


Rift



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Tectonostratigraphic Evolution



Post-Rift



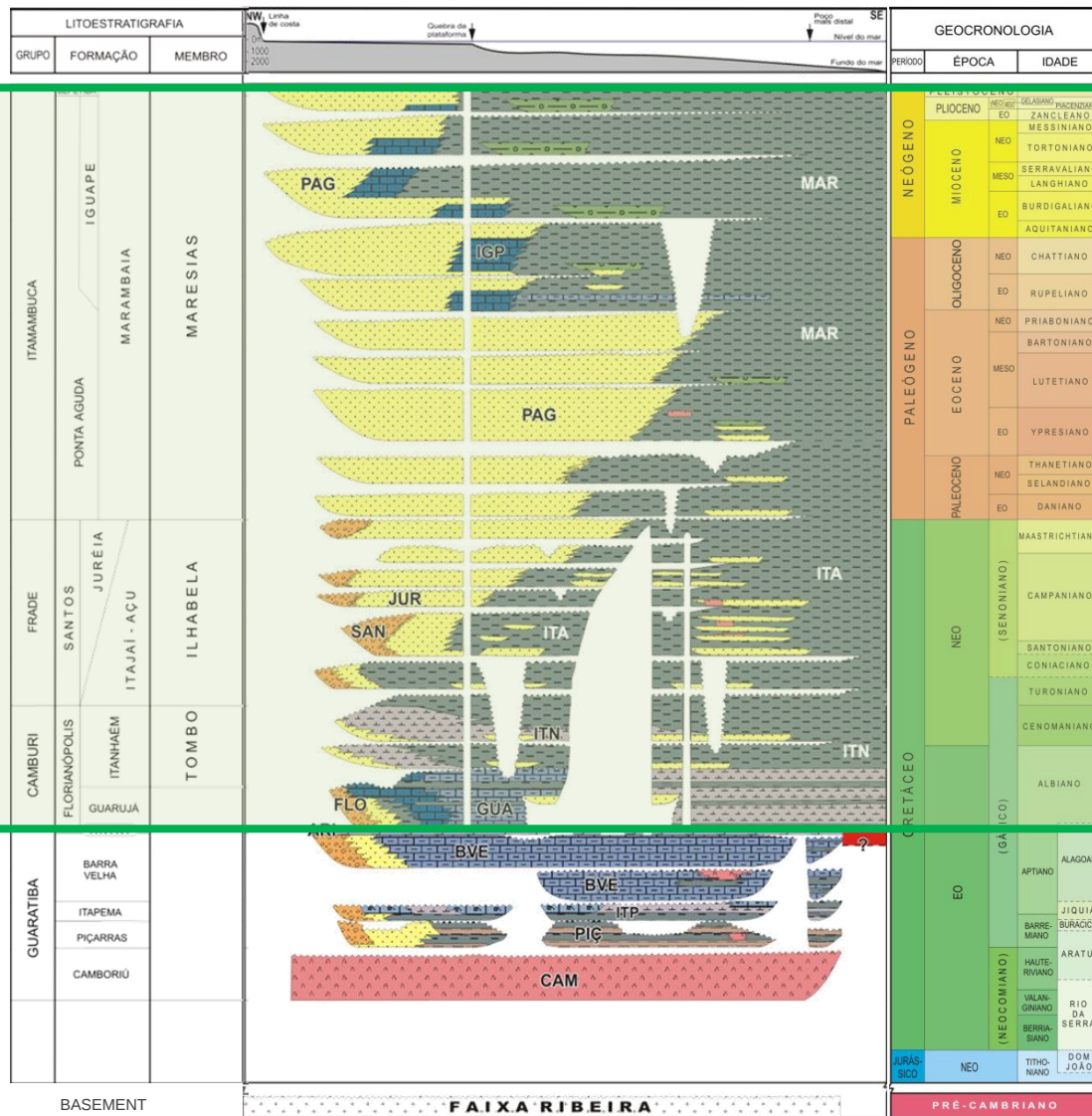
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Tectonostratigraphic Evolution

Drift





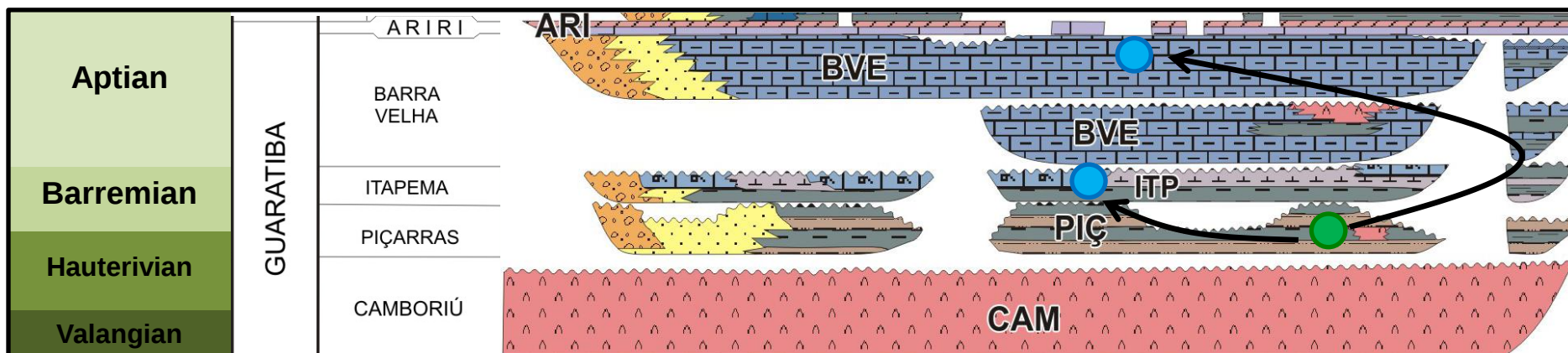
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Petroleum System

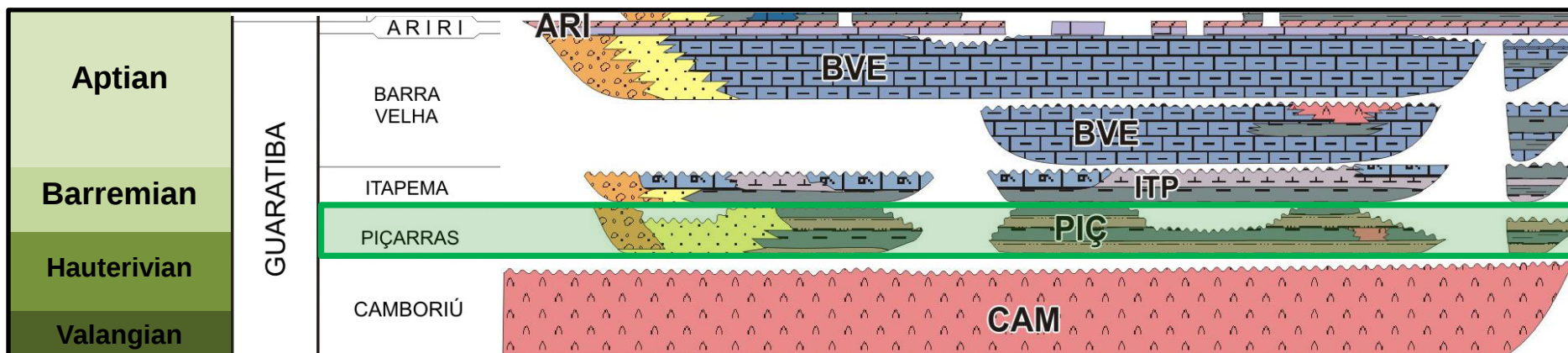
Picarras – Itapema/Barra Velha



Stratigraphic chart: Moreira *et al.*, 2007

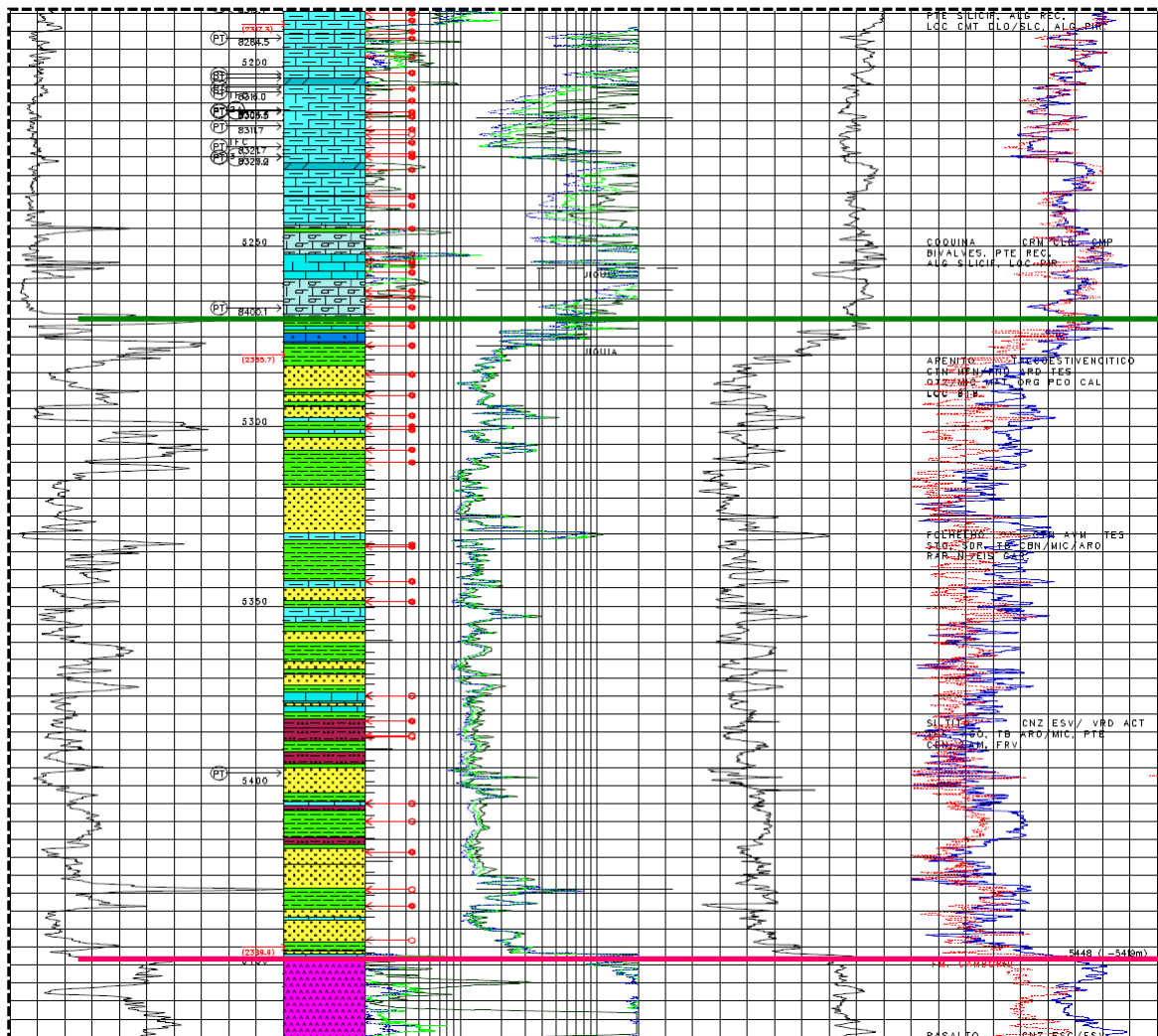
Hauterivian/Barremian Picarras Formation

Sampled at 1 BRSA 369A RJS well (Lula)



Source Rock

1 BRSA 0369A RJS



Itapema Formation

Picarras Formation

Camboriu Formation

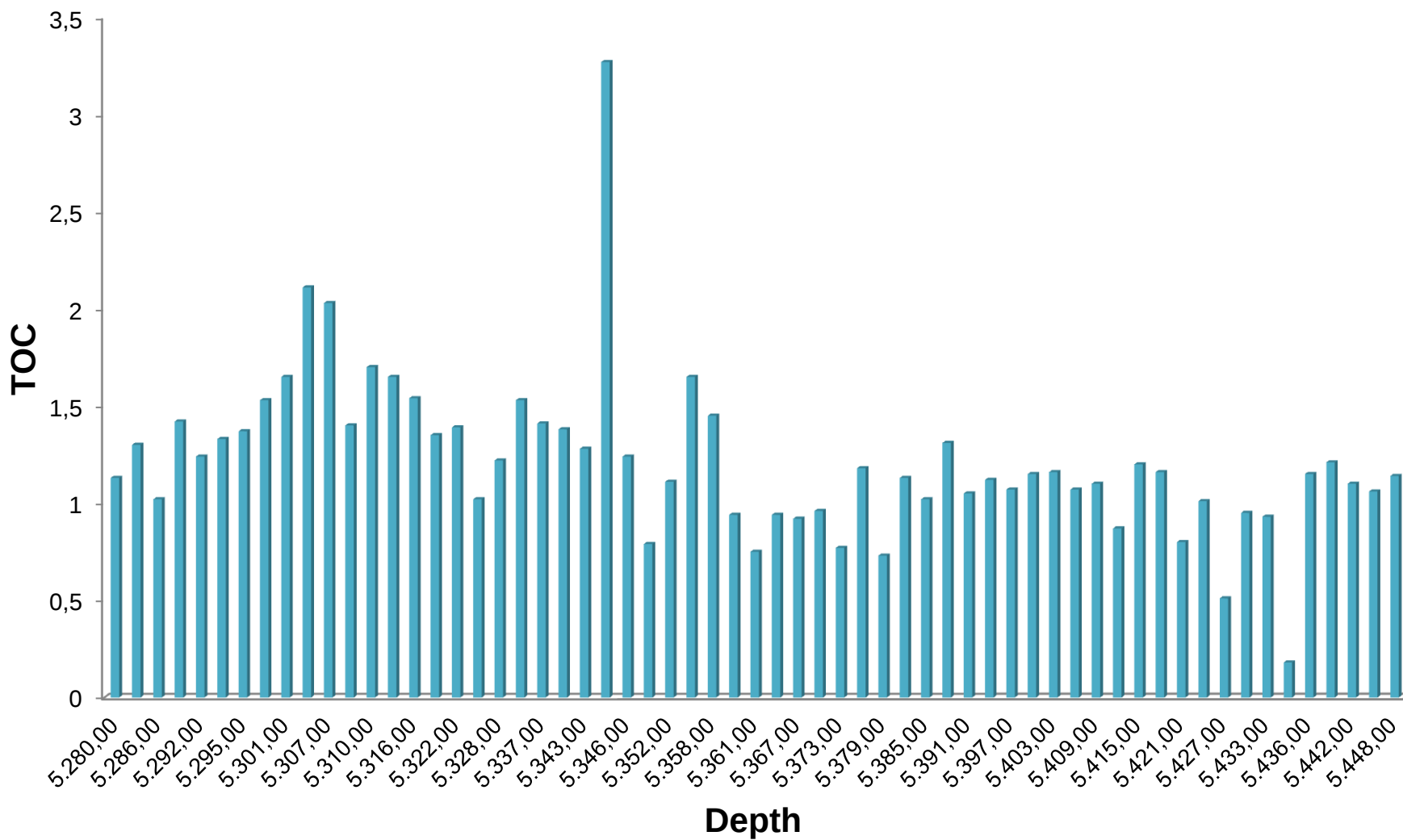


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Source Rock





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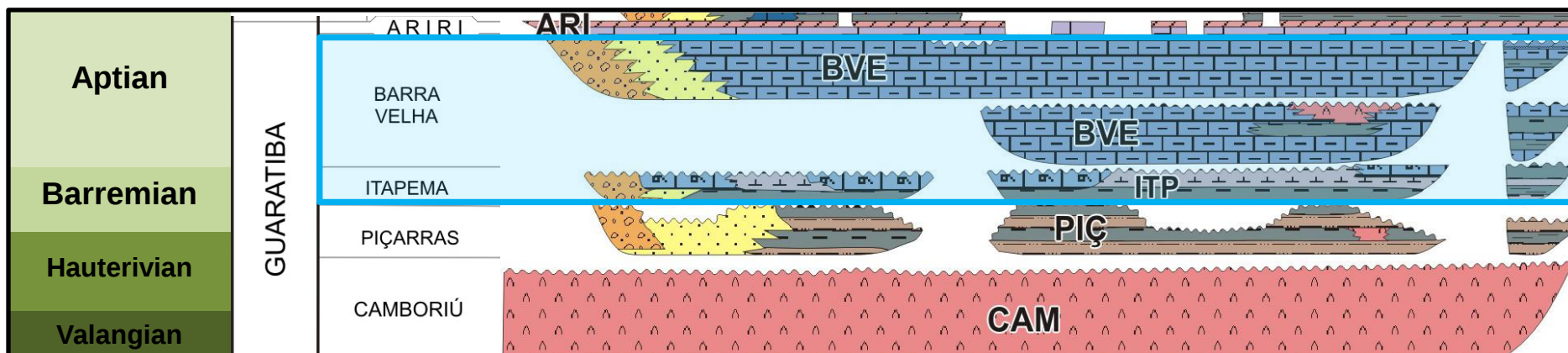


Reservoir

Barremian/Aptian

Itapema and Barra Velha formations

Carbonatic rocks formed by coquinas and/or microbialites. The microbial carbonates are found on the sag (post-rift) and upper rift layers.





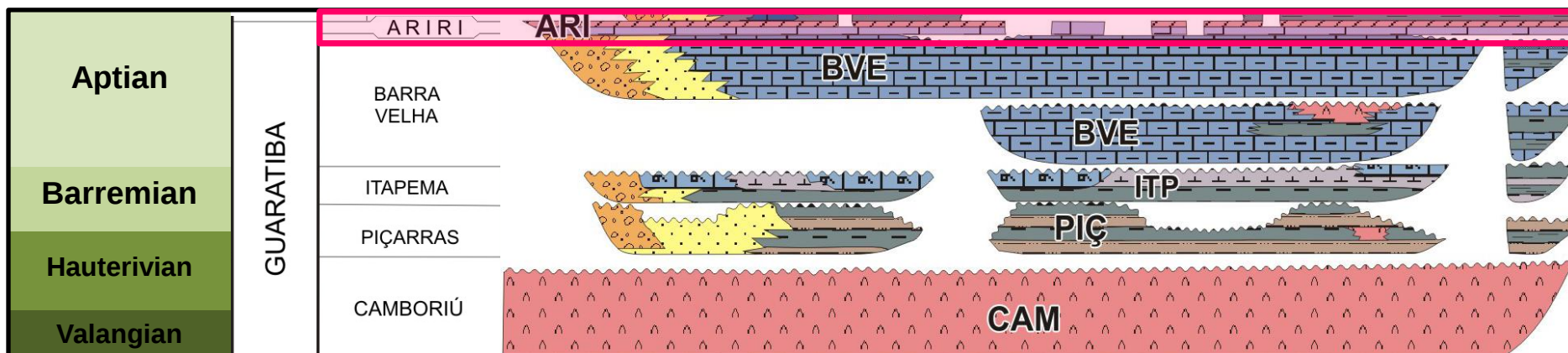
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Seals

Aptian Ariri Formation

Composition: Halite, anhydrite and eventually tachyhydrite, carnallite and sylvite



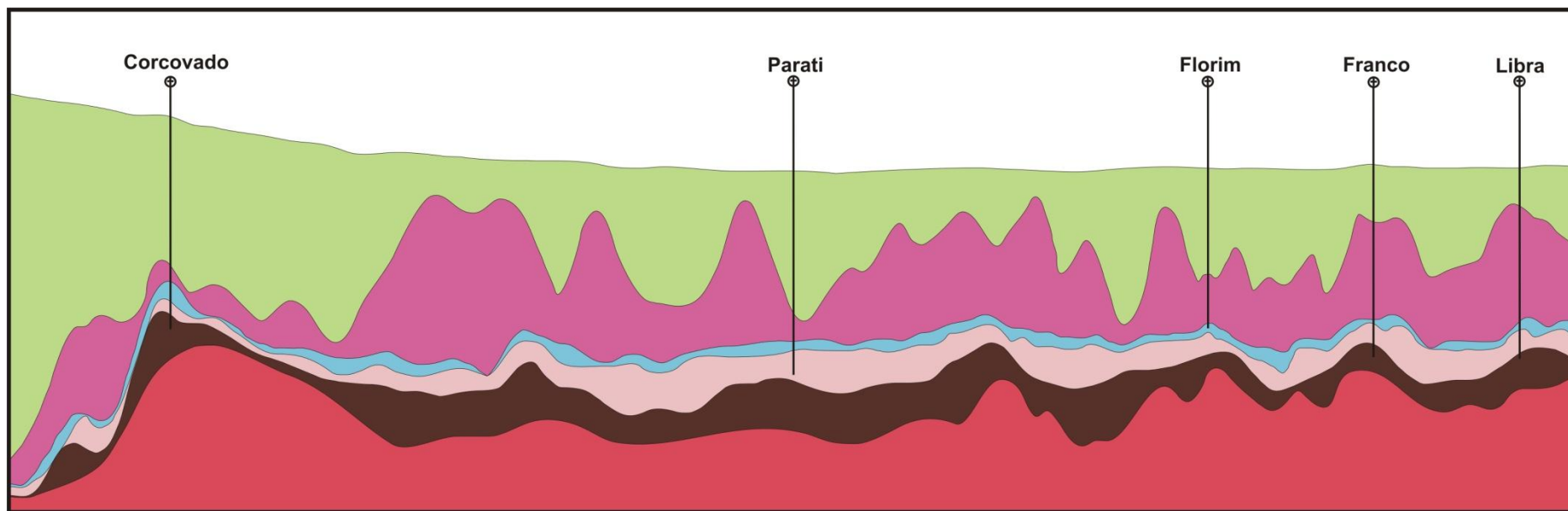


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Accumulation Model



- Post-salt
- Salt
- Sag
- Upper Rift
- Lower Rift
- Basement

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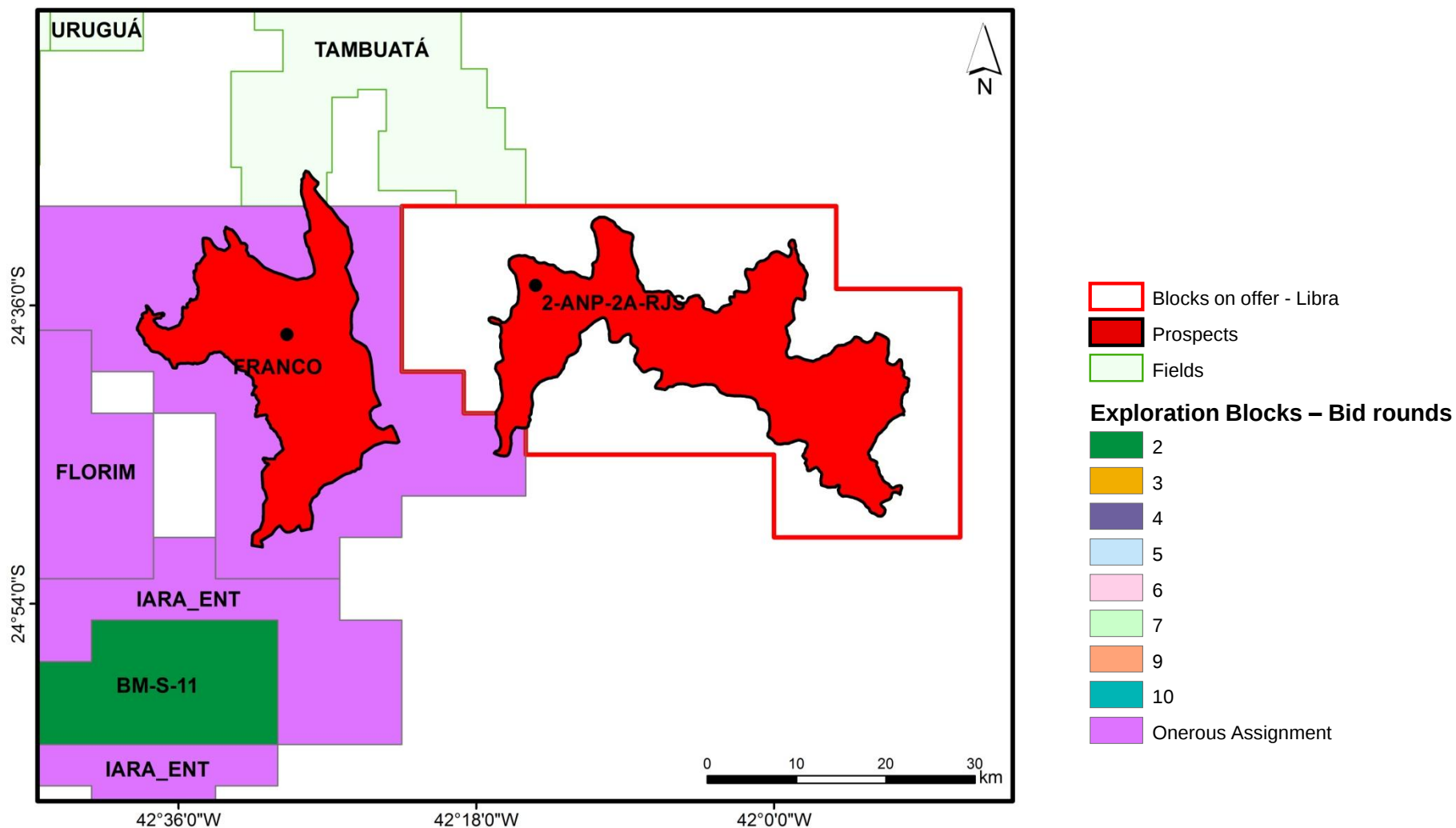


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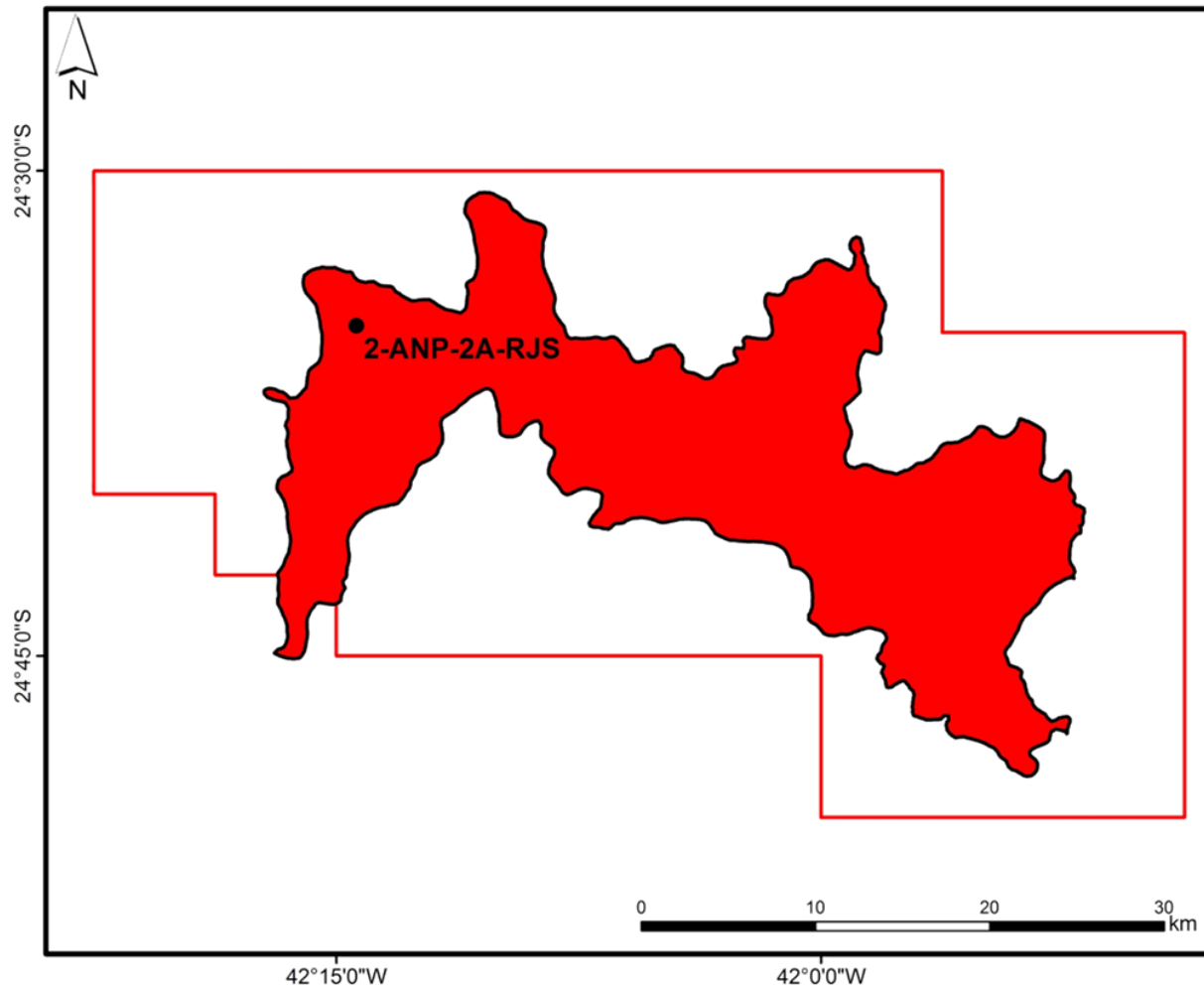


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Area on Offer



Discovery:
2-ANP-0002A-RJS

Area: ~ 500 km²

Water depth:
~ 2,200 m

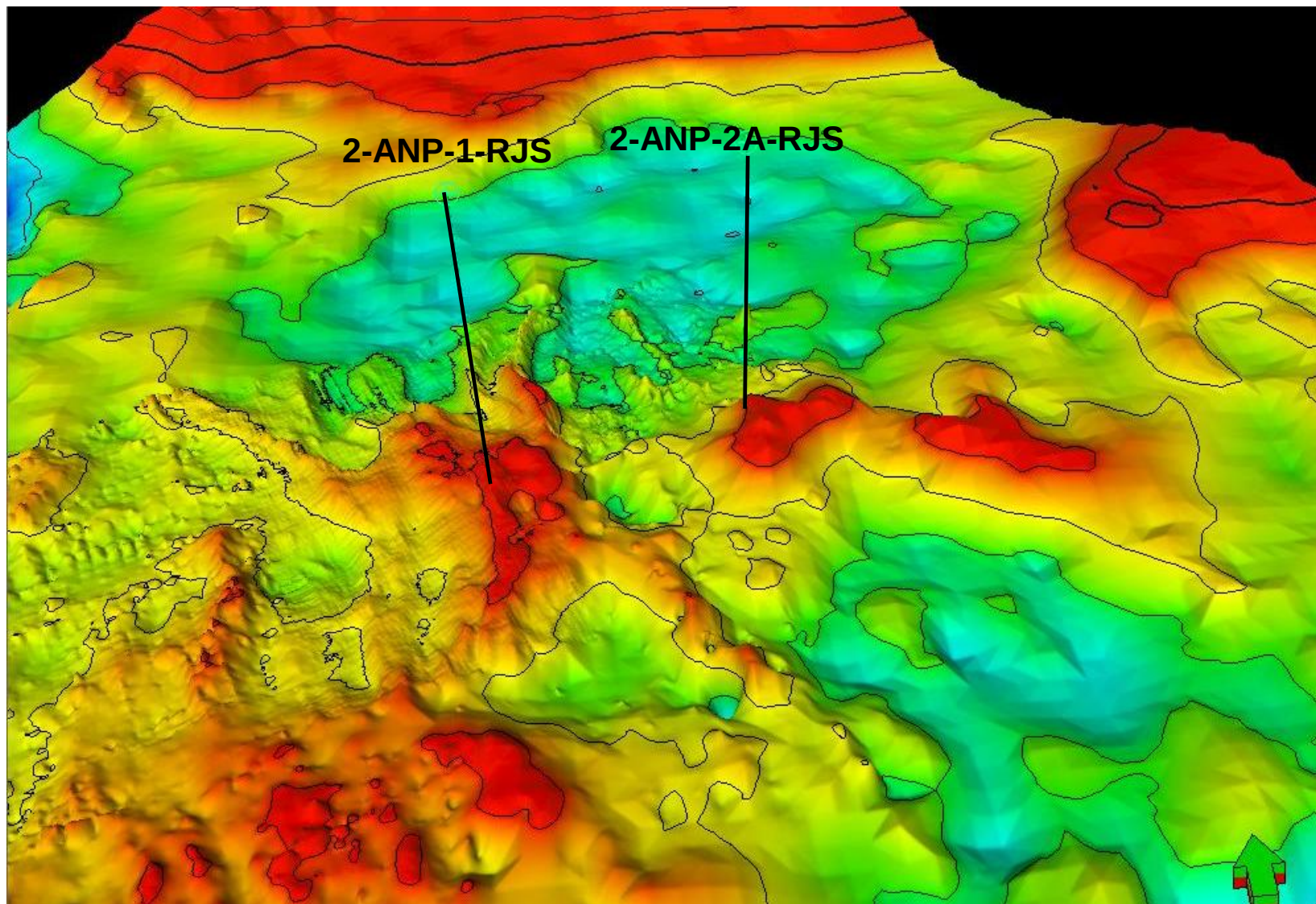


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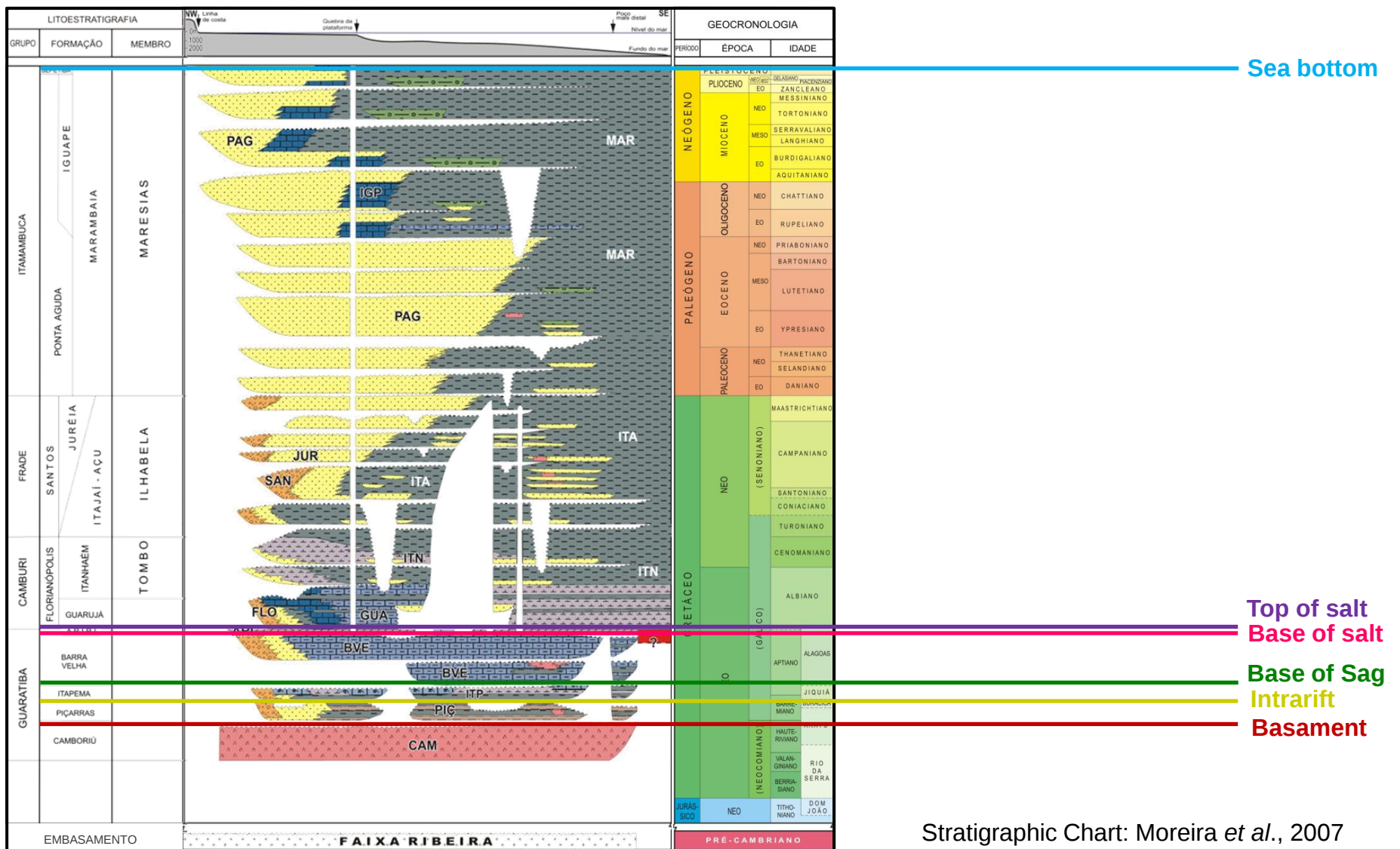
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Franco and Libra



Tectonostratigraphic Evolution



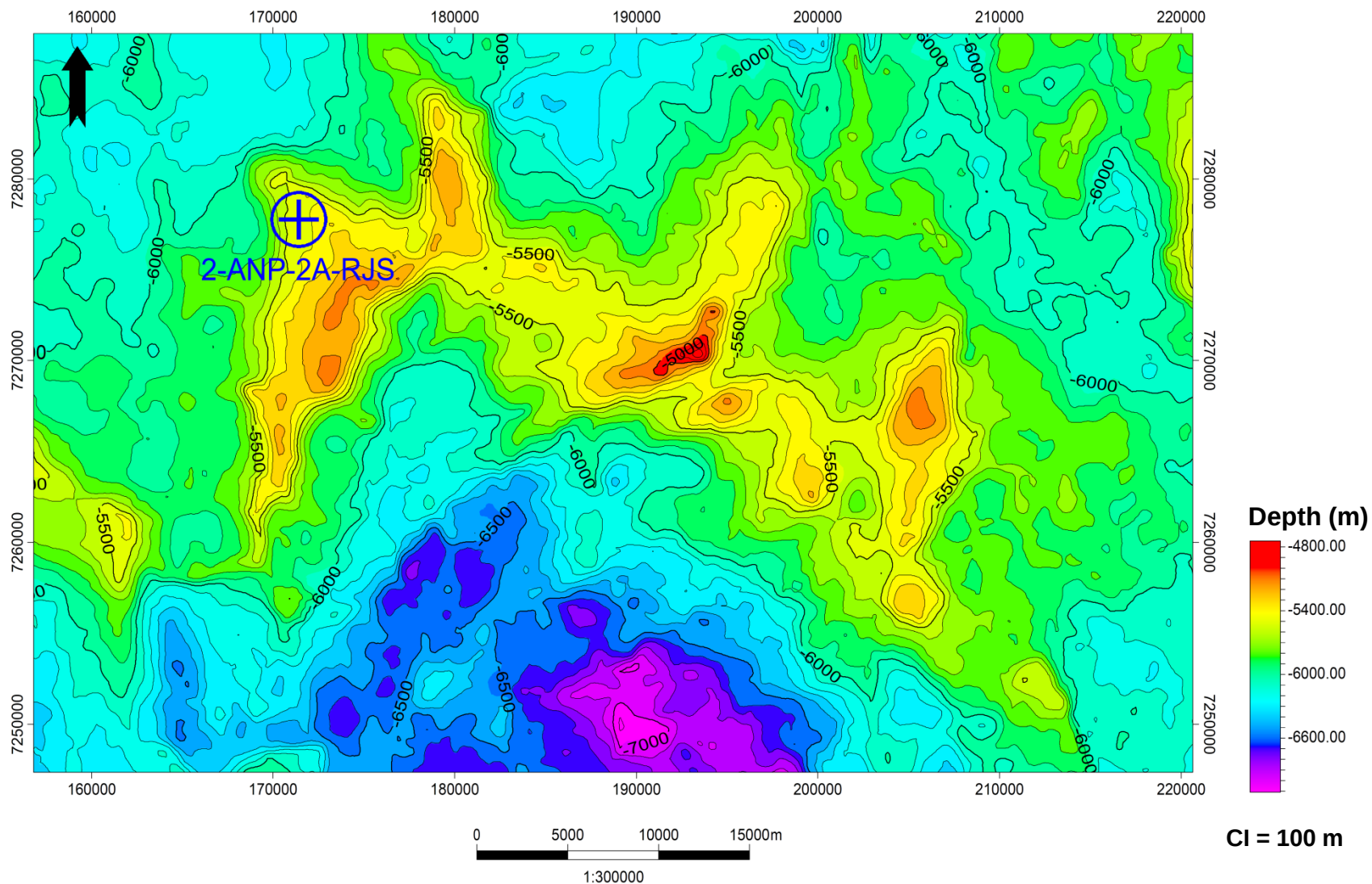


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Structural Map (depth) Base of Salt



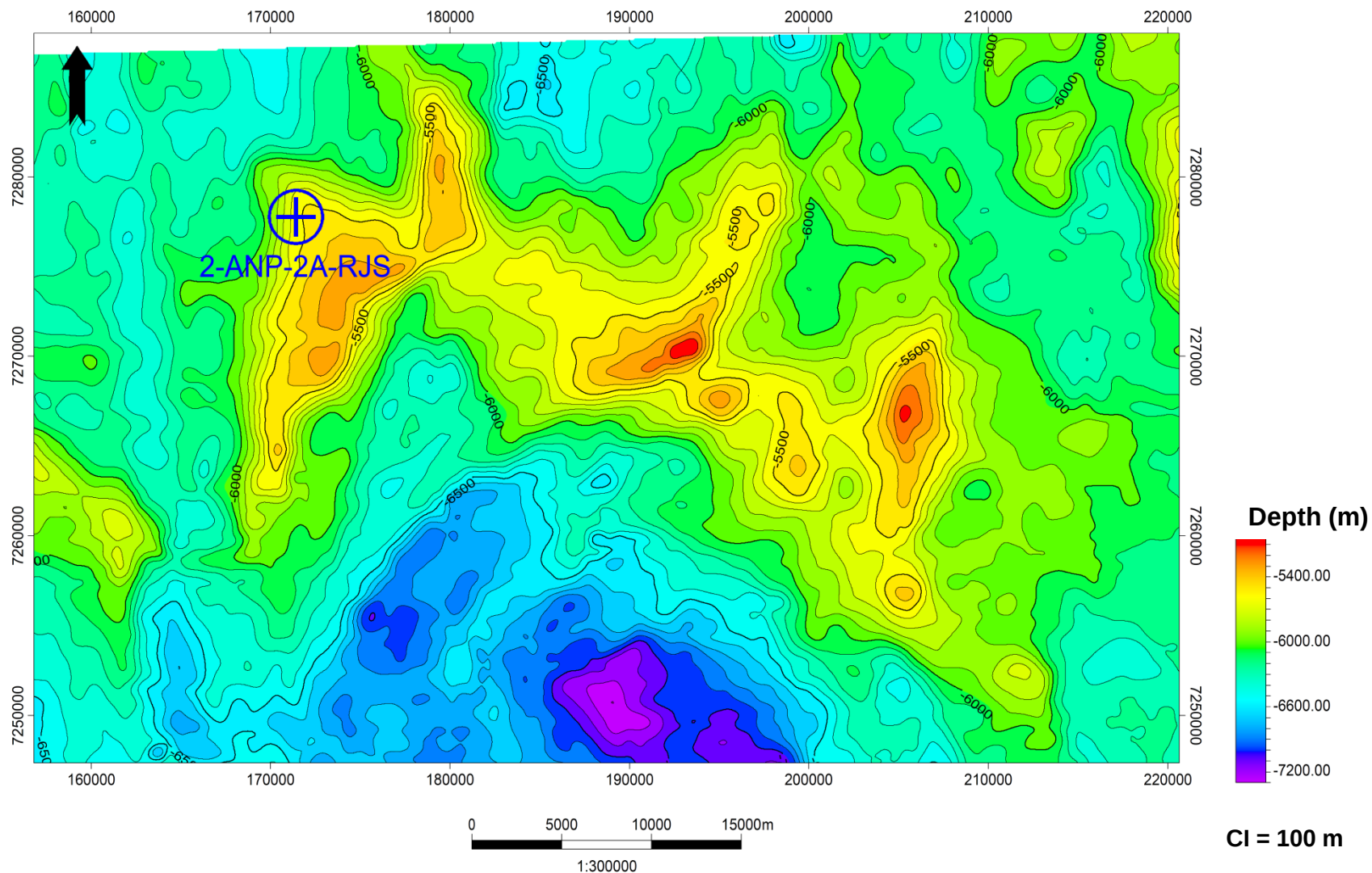


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Structural Map (depth) Base of Sag



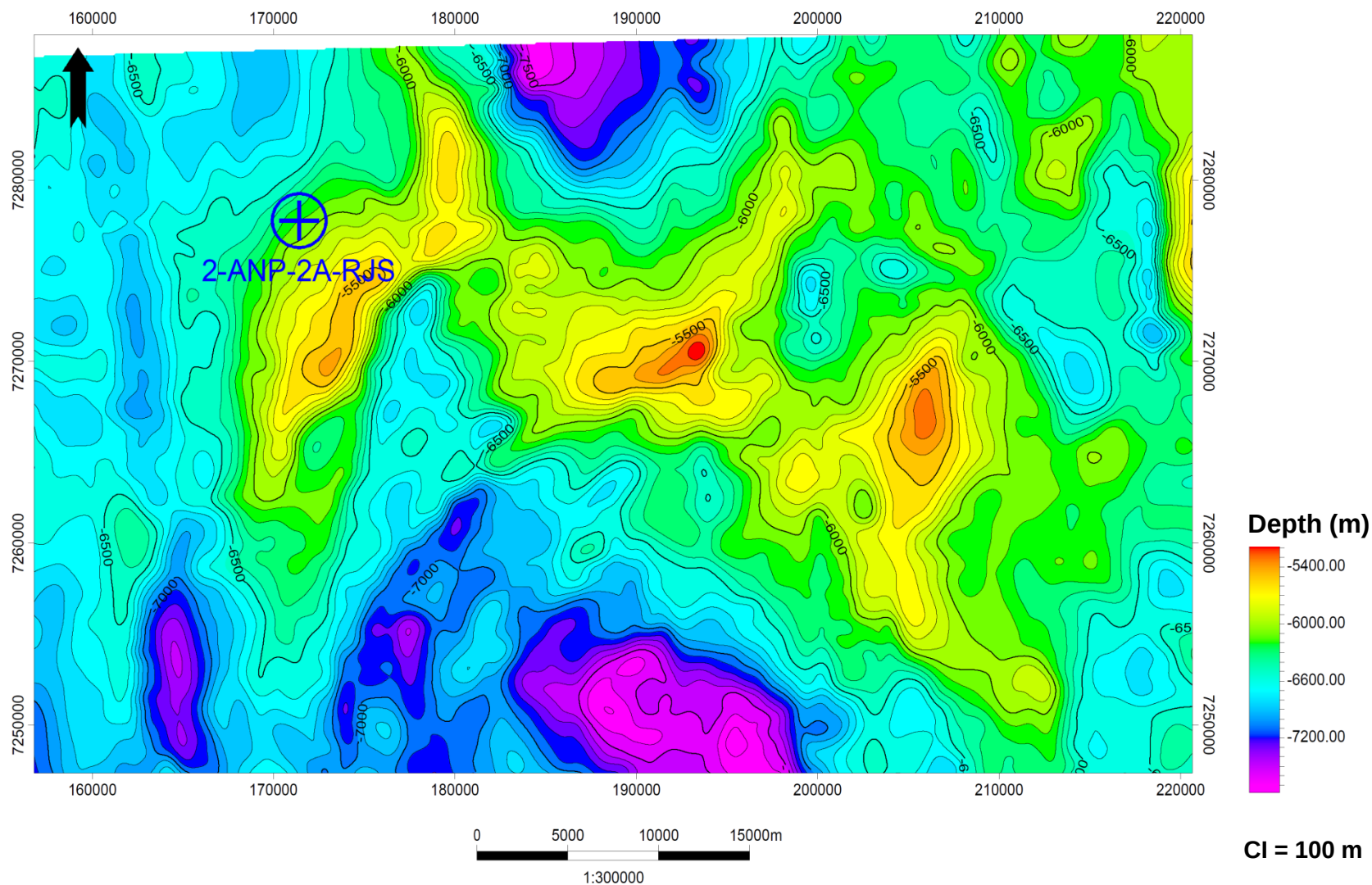


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Structural Map (depth) Intra-rift



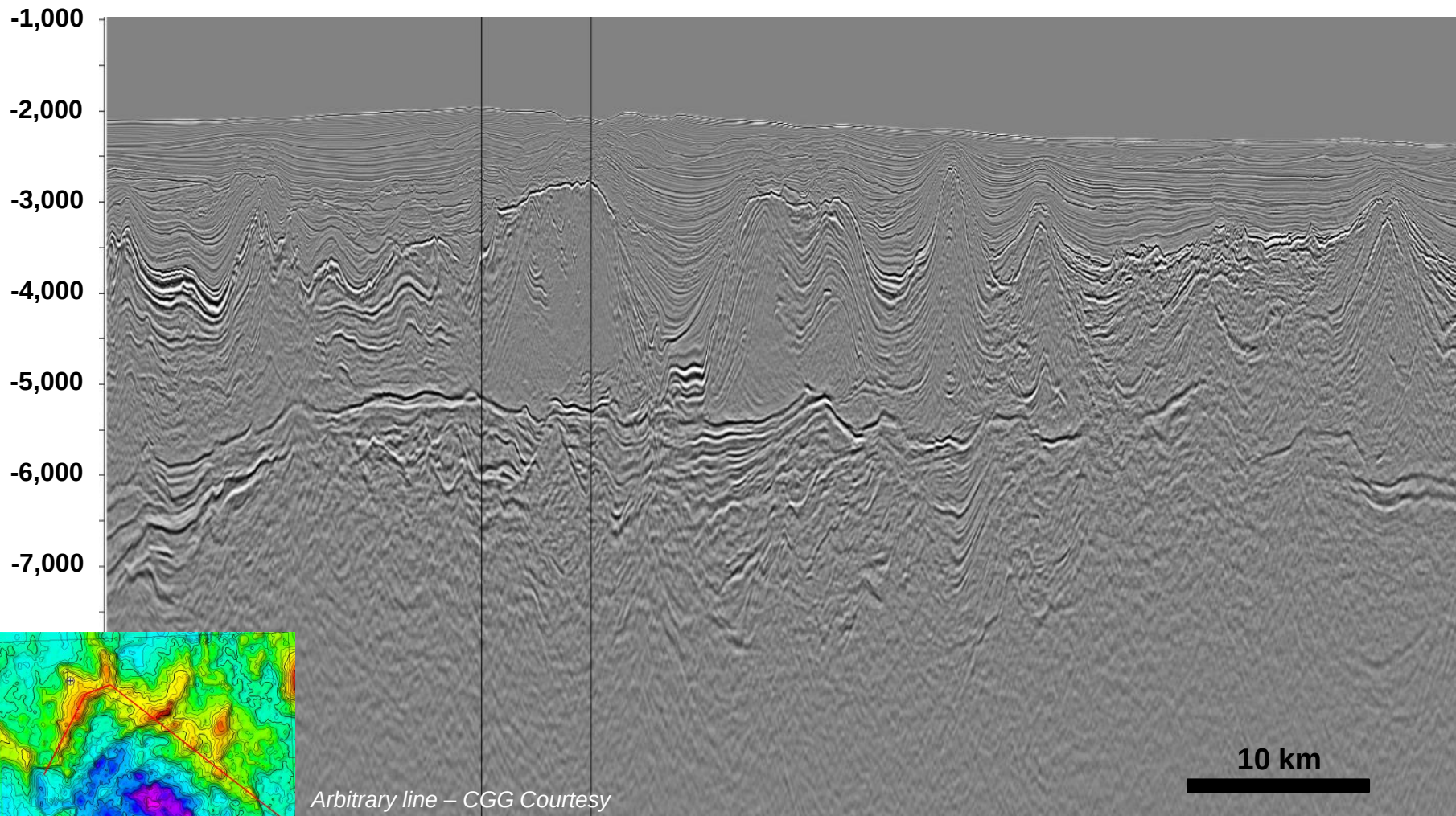


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Sea bottom

Top of salt

Base of salt

Base of sag

Intra-rift

Basement

Geological fault

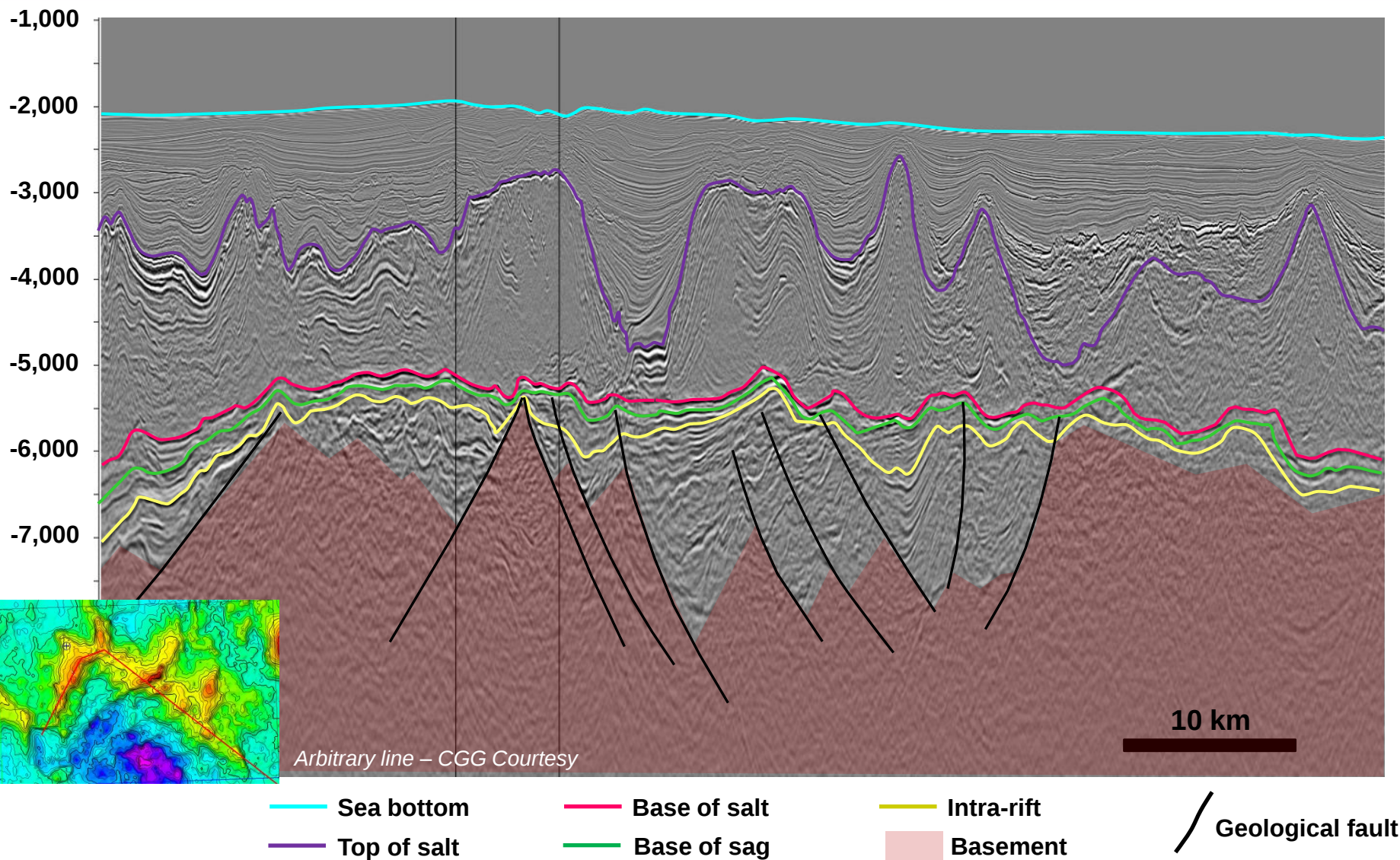


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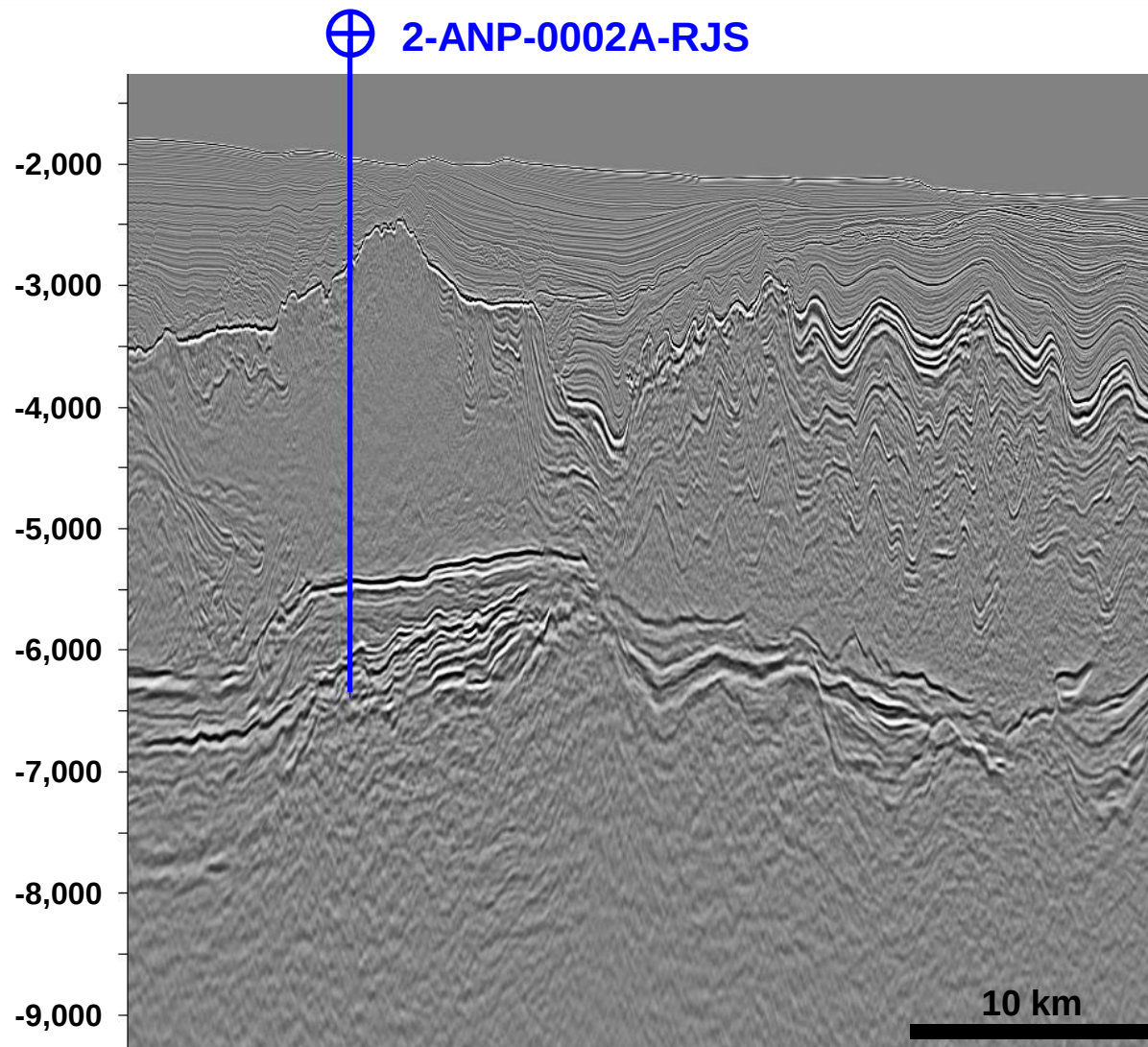


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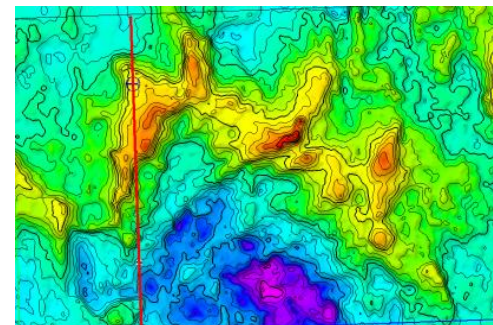
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Inline 1664 –CGG Courtesy



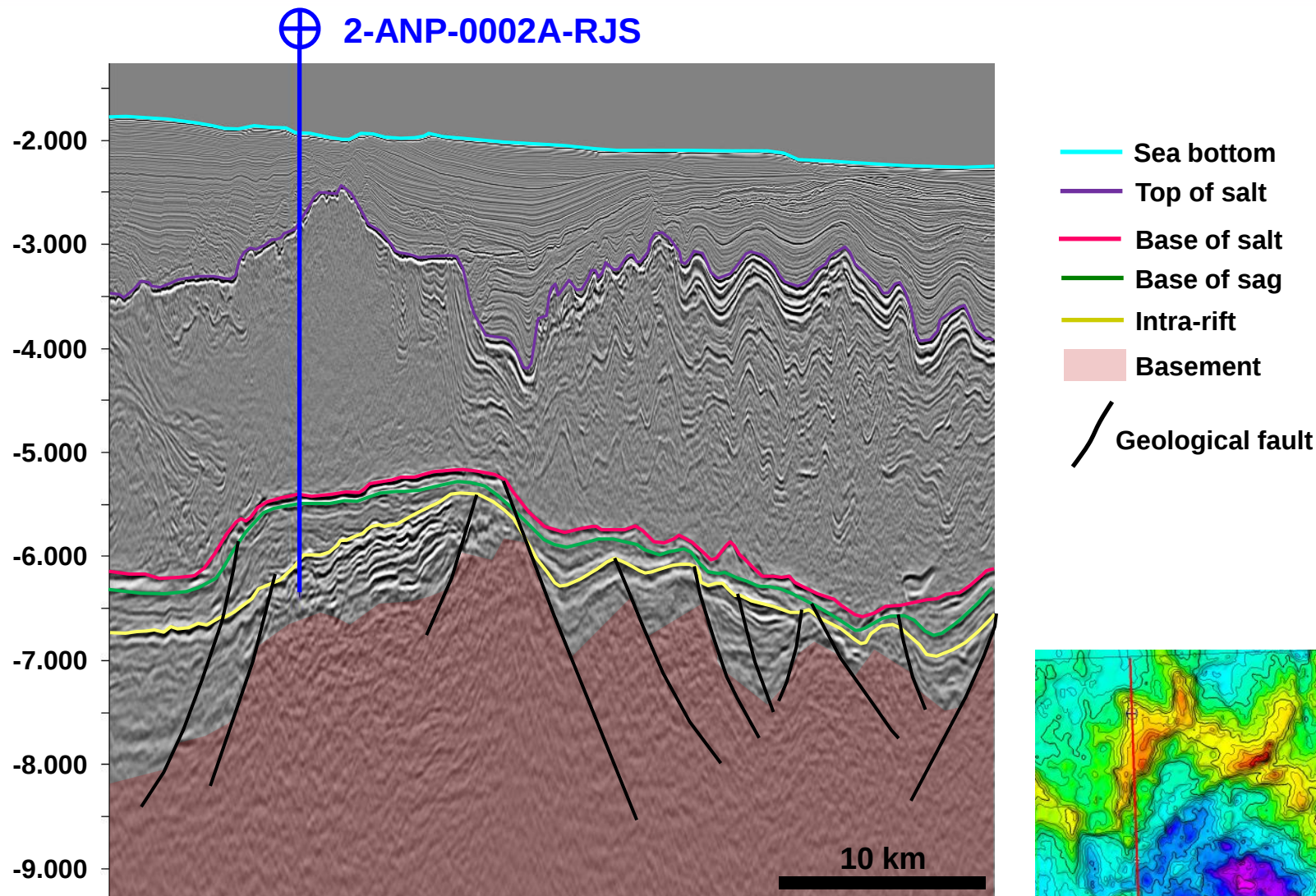


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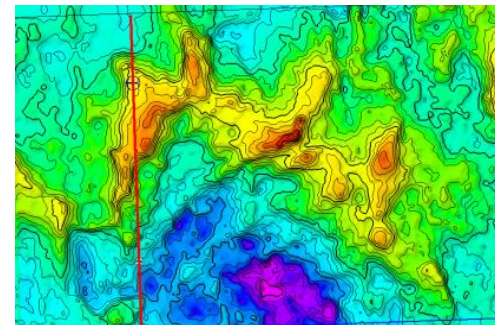
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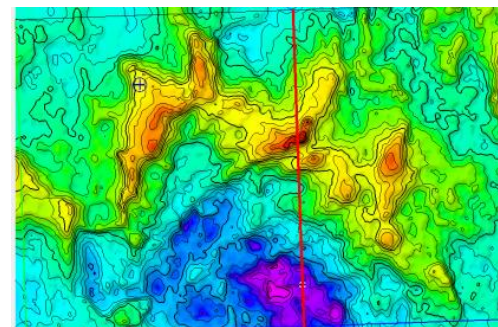
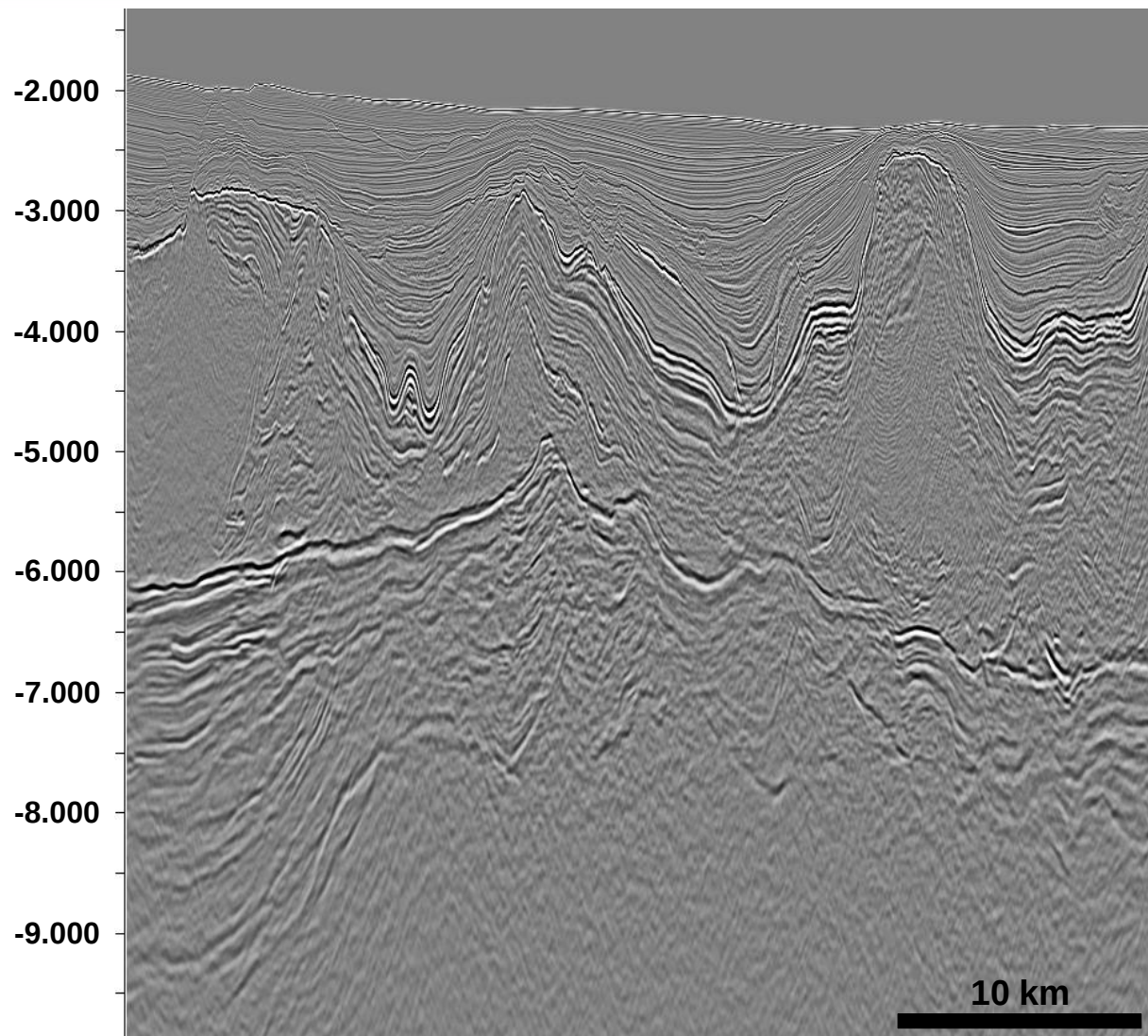




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Inline 3006 – CGG Courtesy

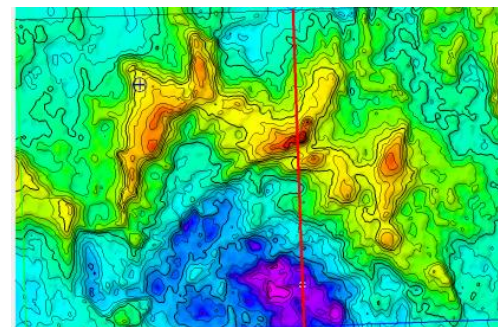
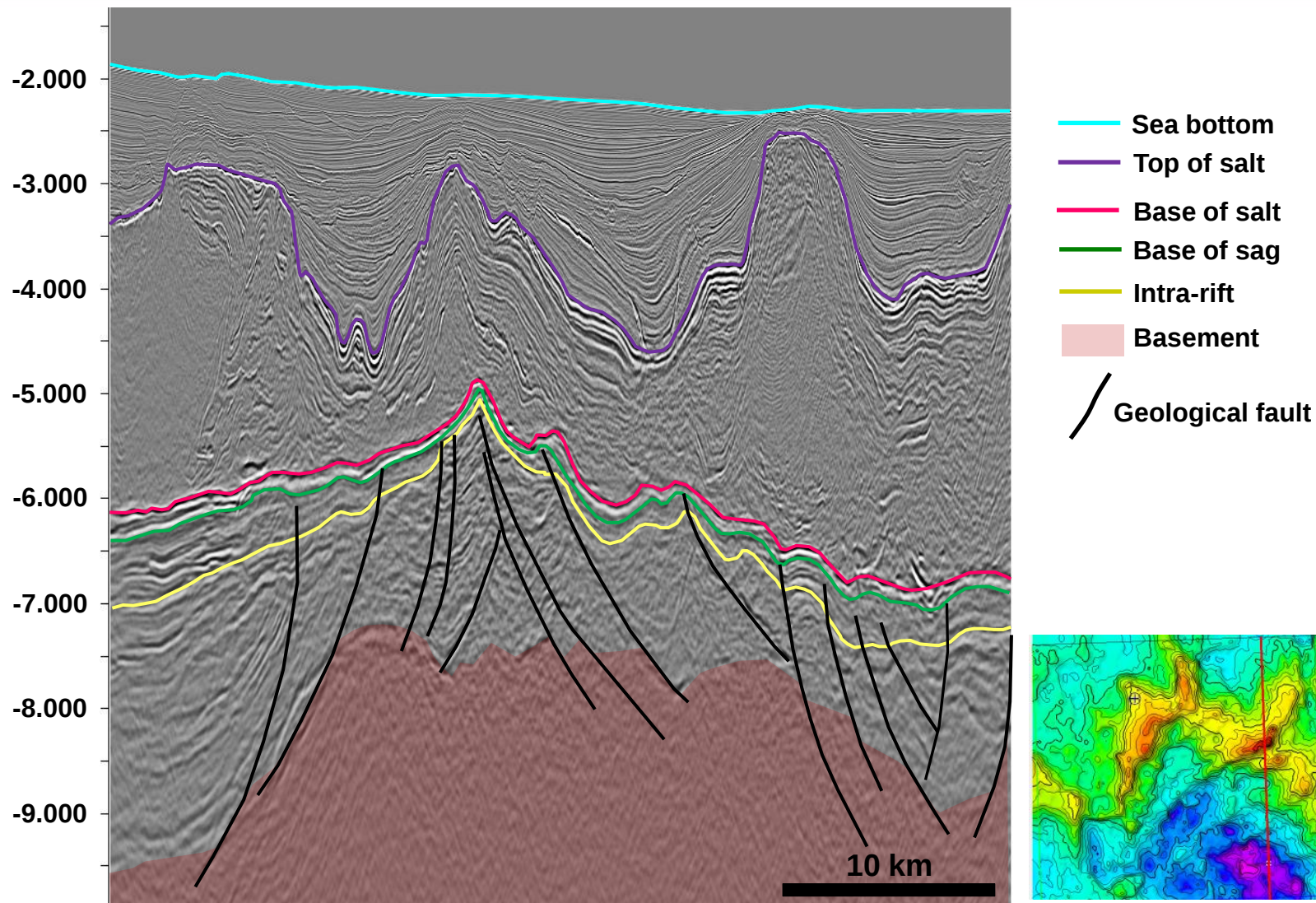


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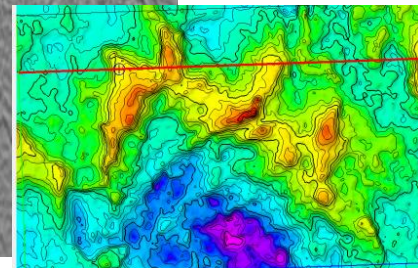
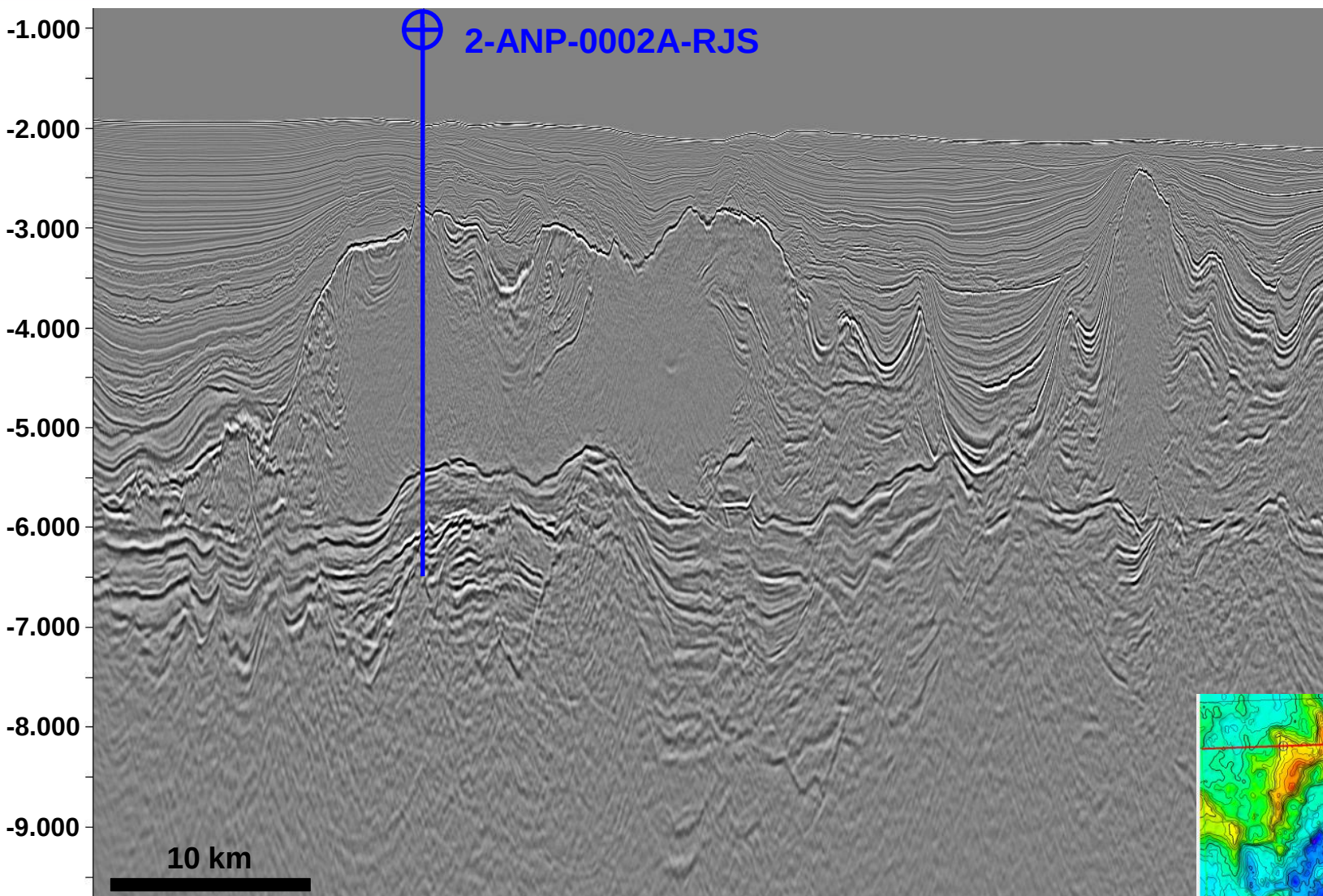


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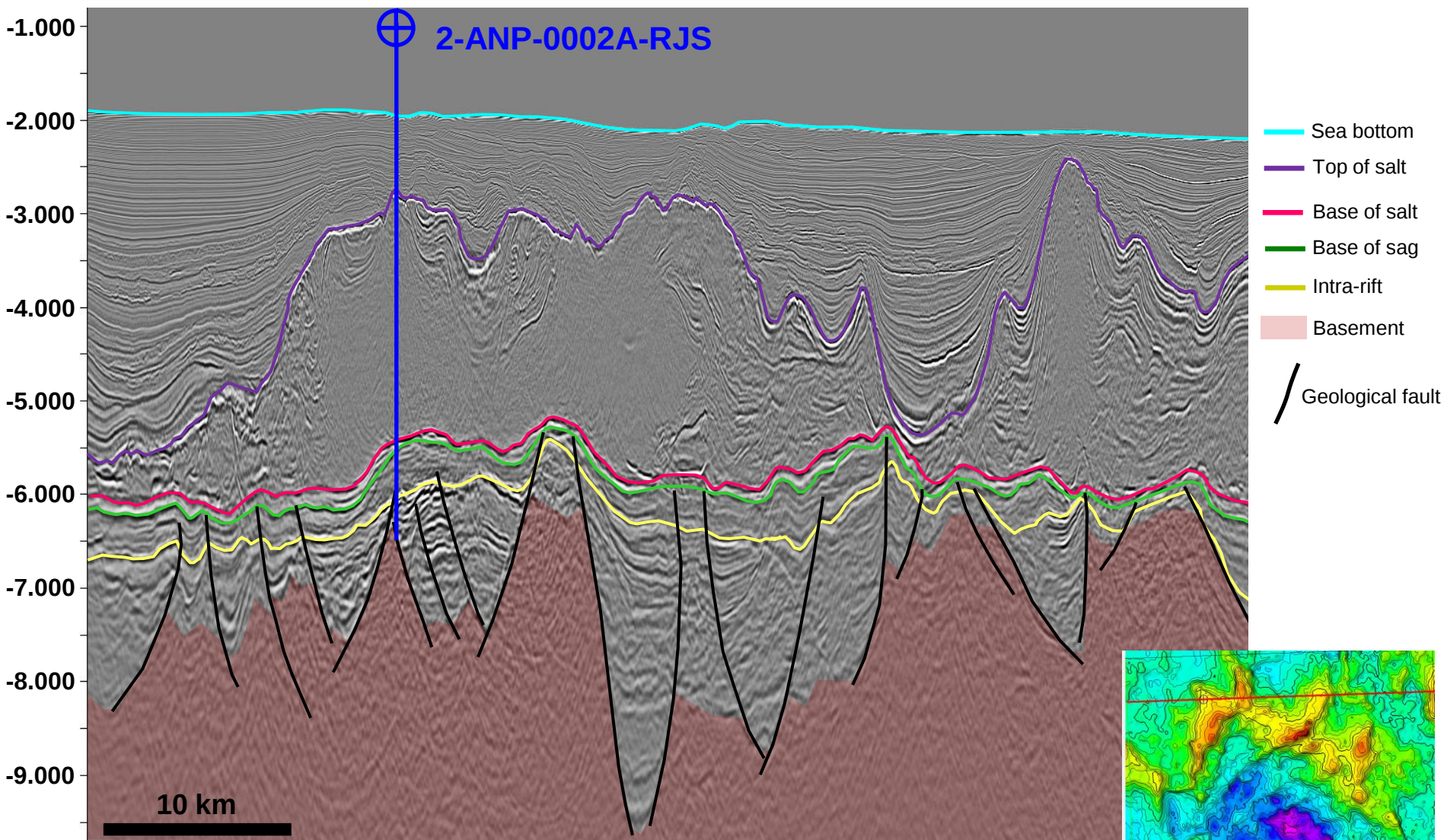


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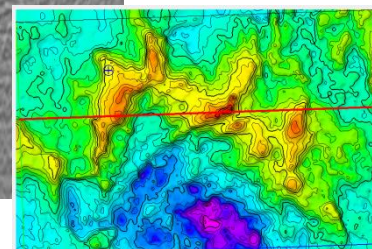
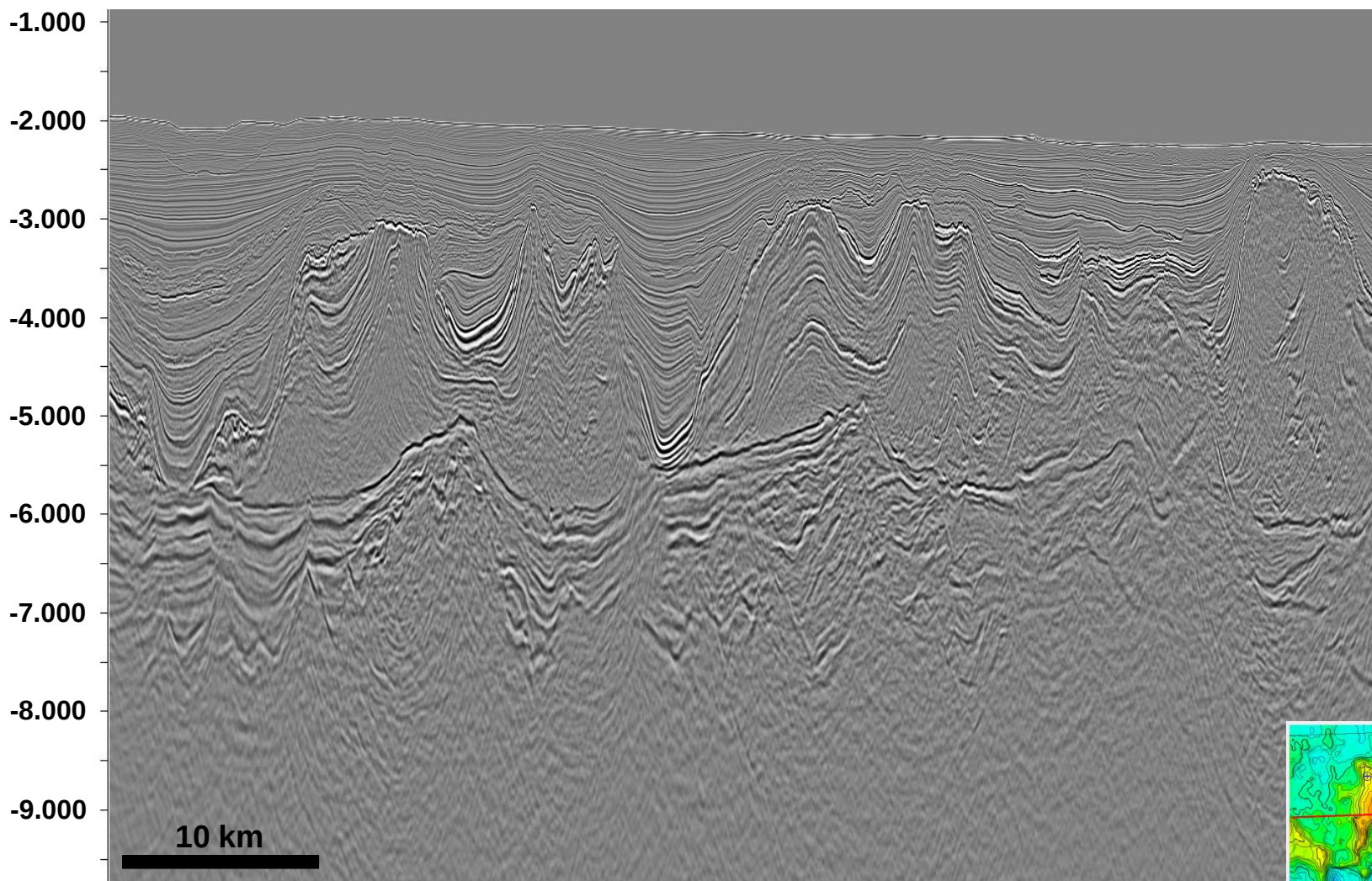
Crossline 6355 – CGG courtesy



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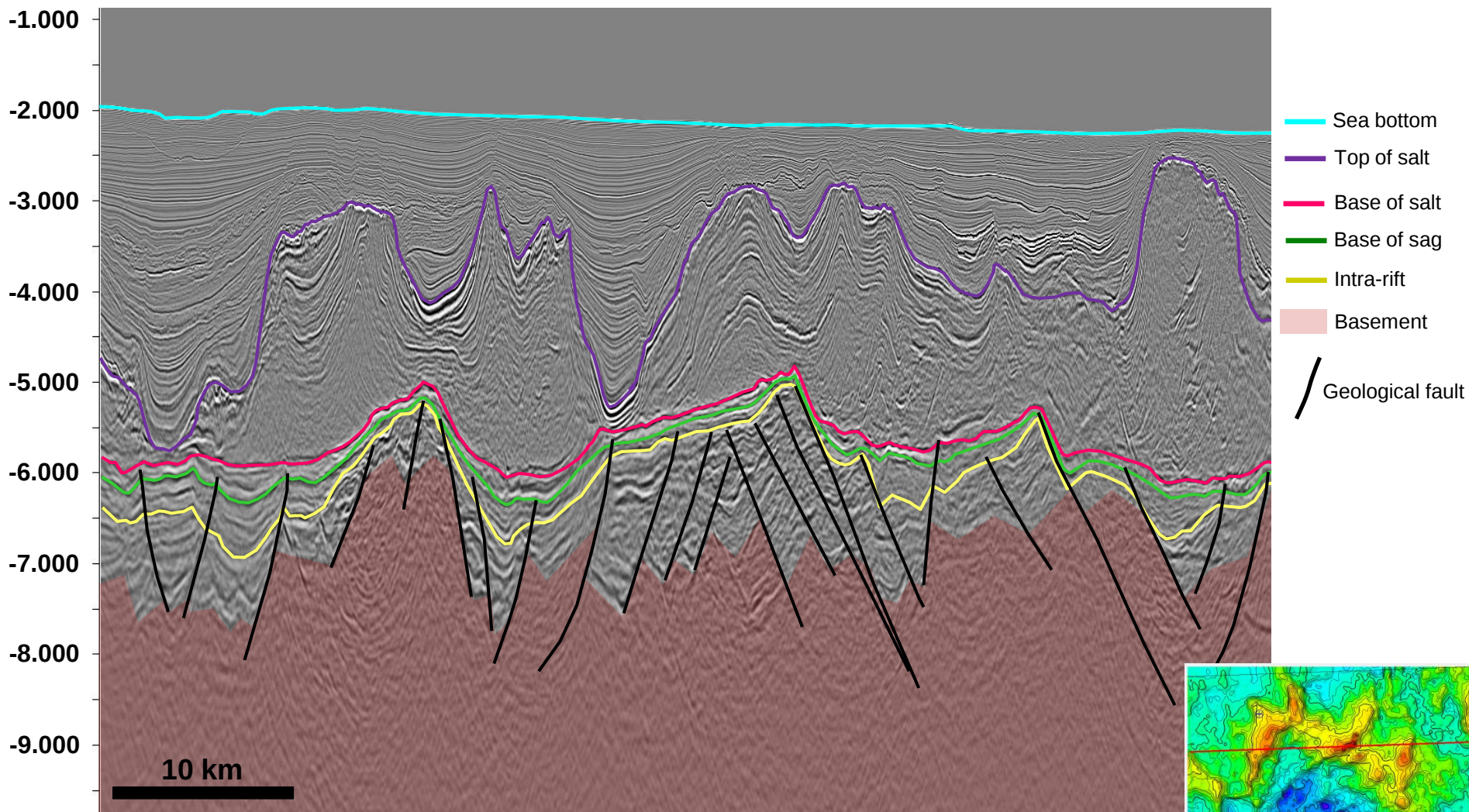


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Crossline 5011 – CGG courtesy



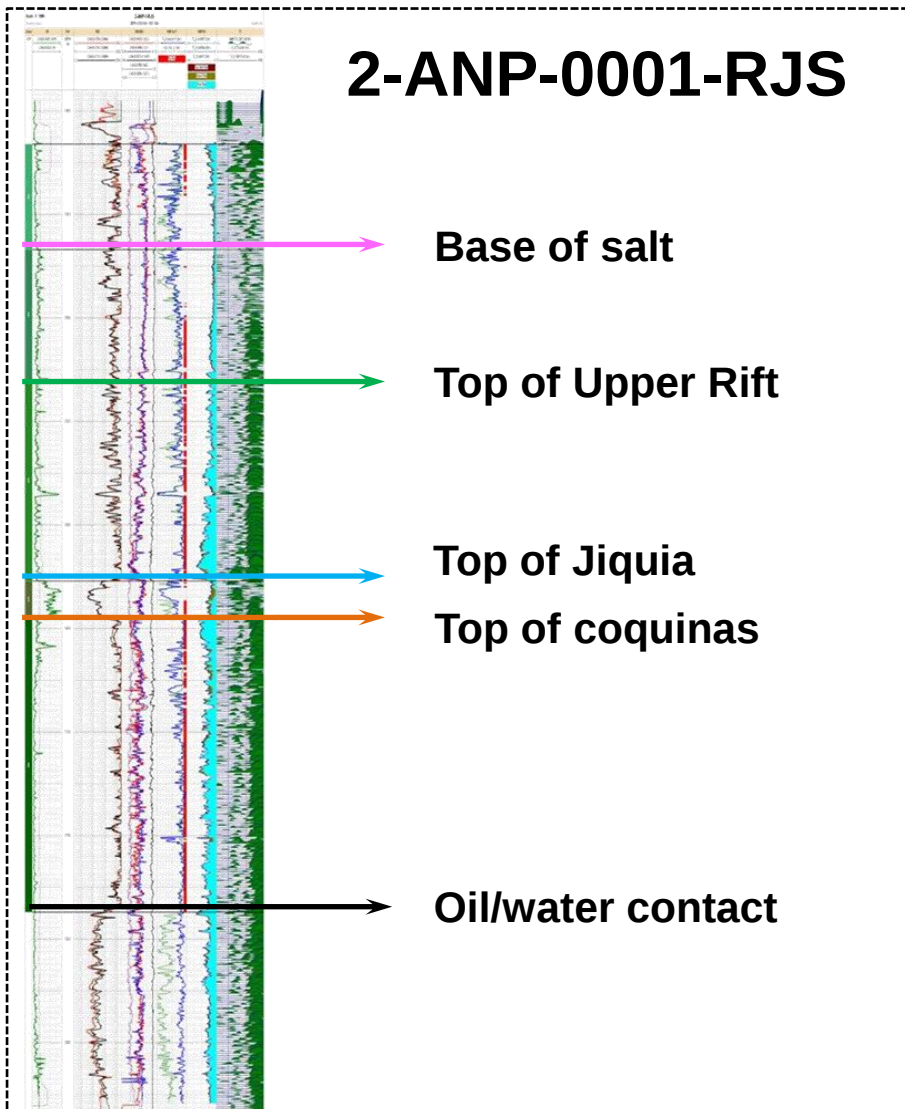
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Franco

2-ANP-0001-RJS



Base of salt

Top of Upper Rift

Top of Jiquia

Top of coquinas

Oil/water contact

Intervals

Area: ~400 km²

Sag: 5,416 – 5,530 m

Upper Rift: 5,530 – 5,627 m

Upper Rife (Coquinas) 5,627 – 5,787 m
(O/W)

Oil Saturation: 82.7%

Porous Vertical Thickness: 274.3 m

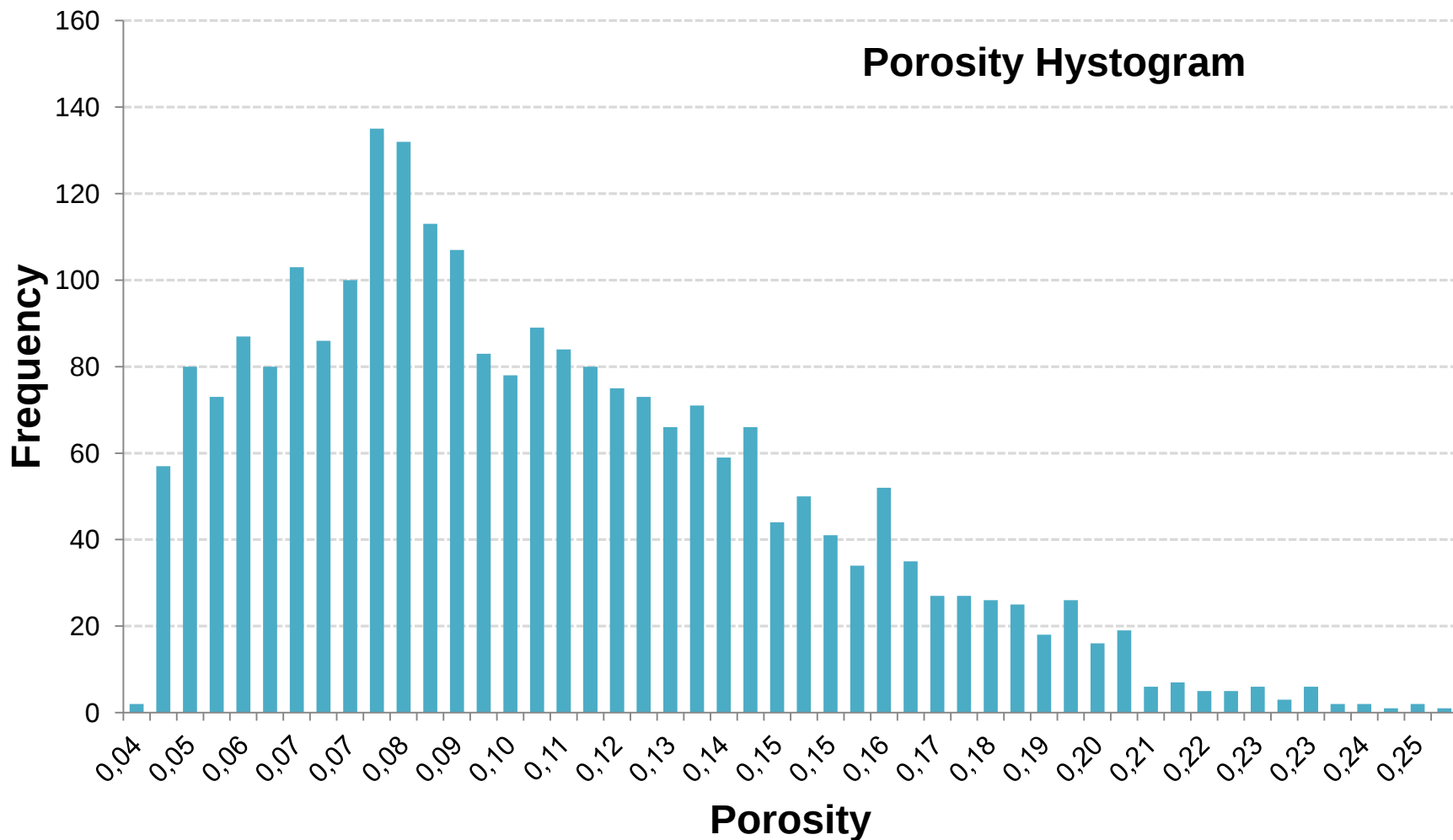


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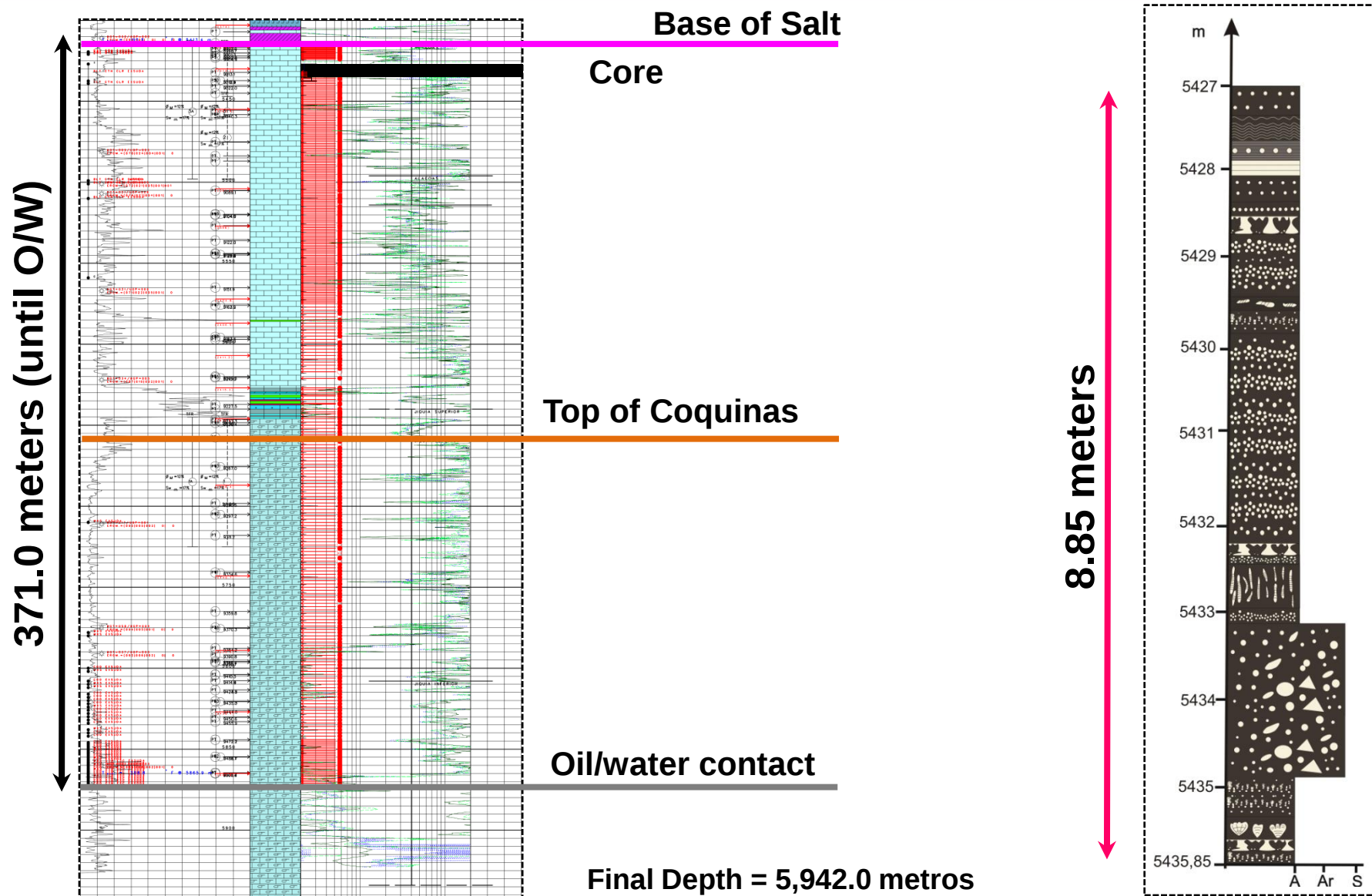
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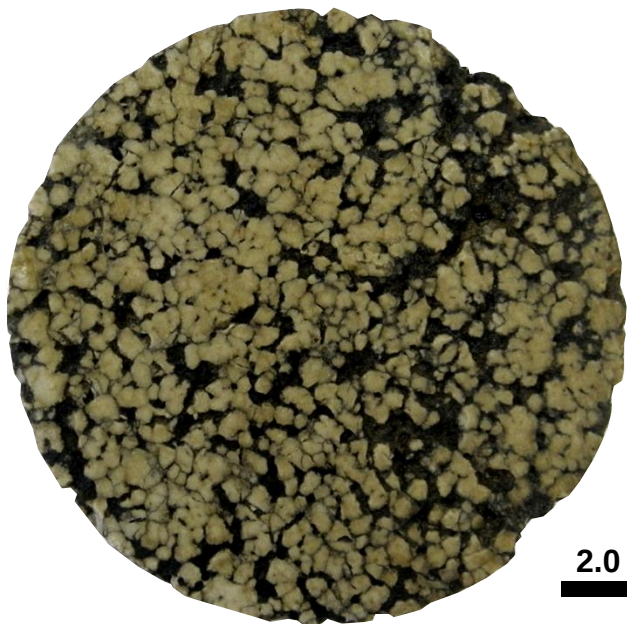


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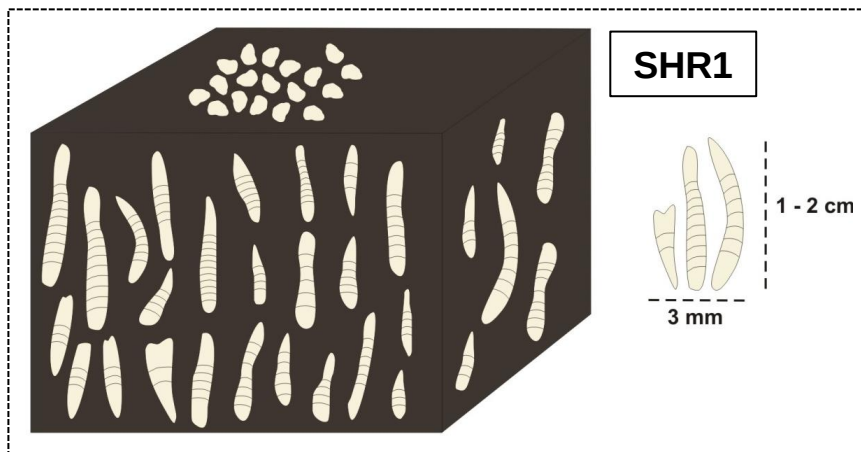
Franco



2.0 cm



2.0 cm



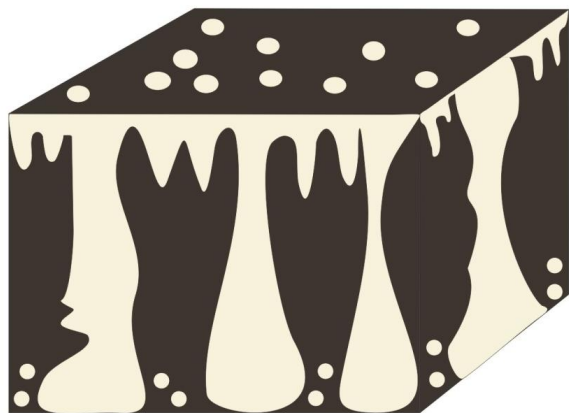
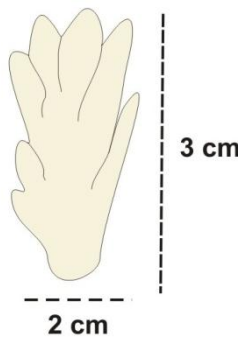


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Brasil 1
PRE-SALT

Franco

SHR2





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Brasil
PRE-SALT



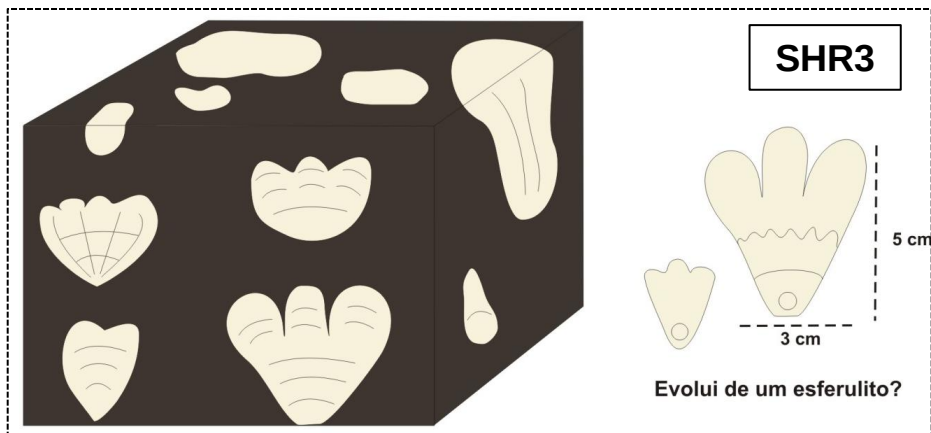
Franco



2,0 cm



2.0 cm





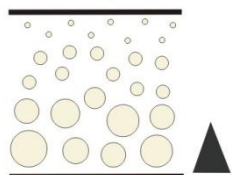
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Brasil
PRE-SALT

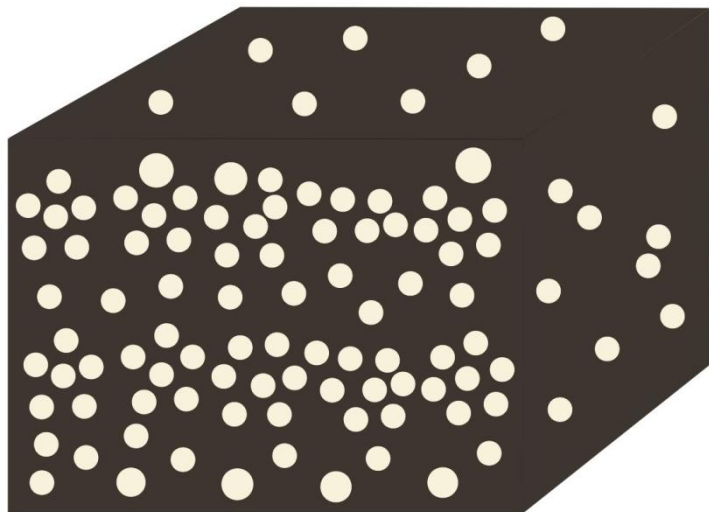


Franco

SPH1



Normal gradation
spherulite
cm-dm



2.0 cm



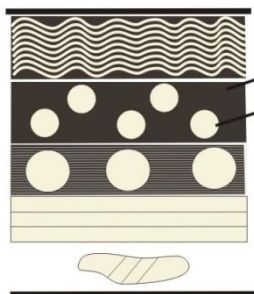
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Franco

SPH2



CLU + estevensite? (ritimite)

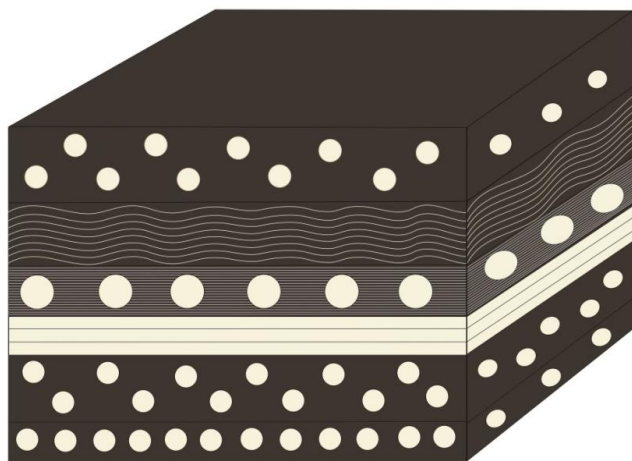
Si

Sph

Sph + microlamination

Laminated CLU

Silica nodule



2.0 cm



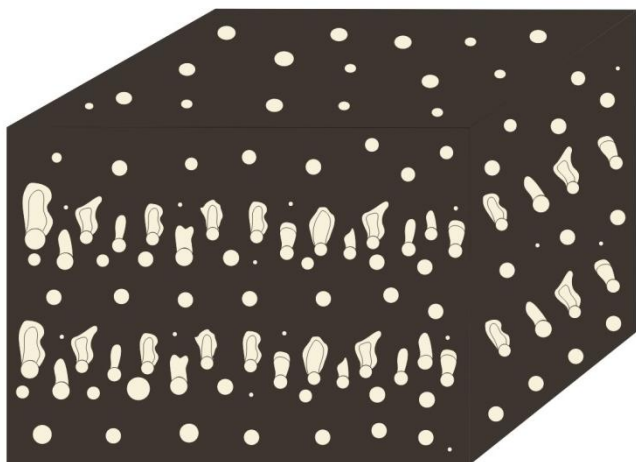
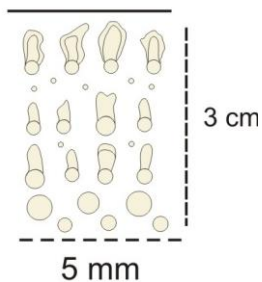
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Brasil
PRE-SALT



Franco

SHR/SPH



2.0 cm



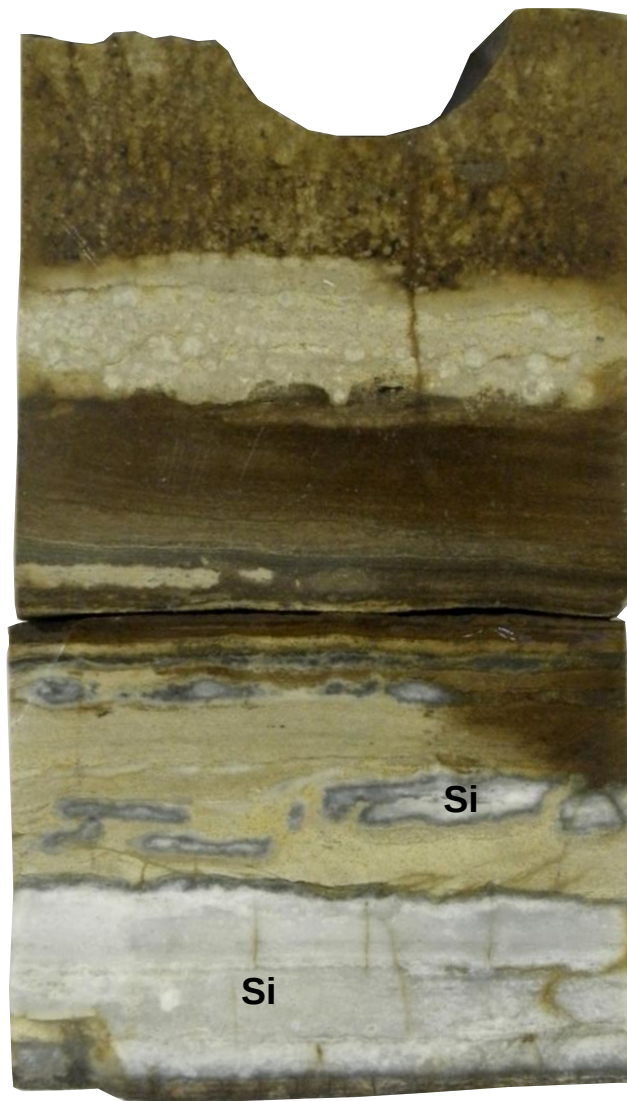
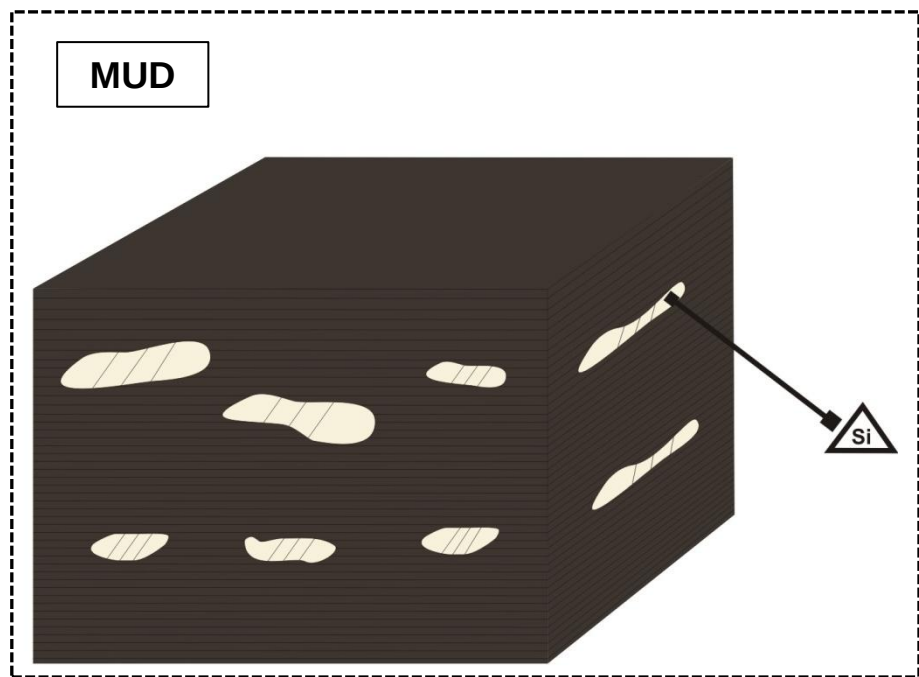
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PRE-SALT



Franco

Laminated calcilutite





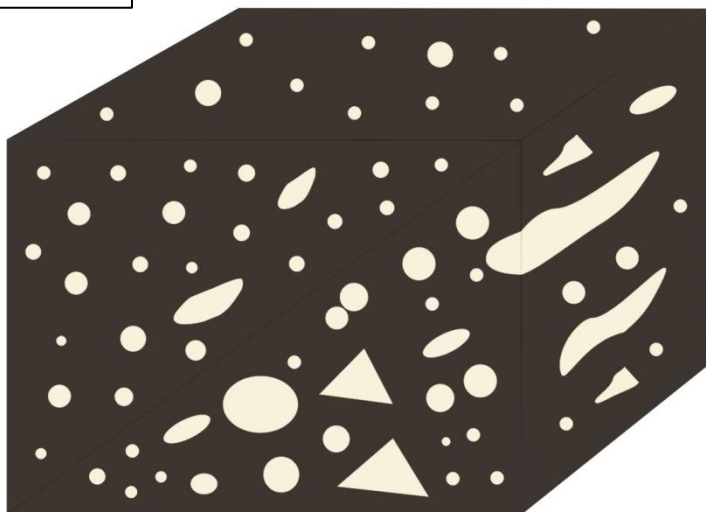
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Brasil 1
PRE-SALT

Franco

**Calcareenite poorly
sorted**

CRE



5.0 cm



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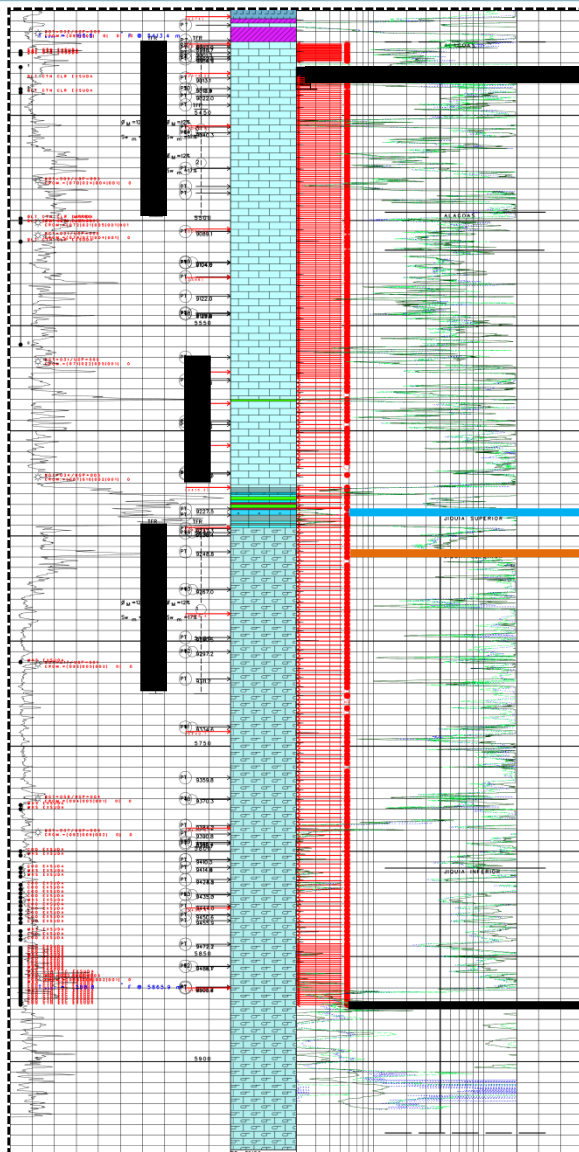


Franco

DST-03A
5415-5498 m

DST-4
5645-5725 m

DST-01A
5645-5725 m



Core

Top of Jiquia

Top of coquinas

Oil/water contact

Final Depth = 5,942.0 metros

2-ANP-0001-RJS		
Well model	VERTICAL WELL	
Storage model	CLASSIC STORAGE	
Reservoir model	HOMOGENEOUS IN 2 LAYERS WITH CROSS FLOW	
Limits model	INFINITE	
Downhole pressure gauge	Number	30016
	Type	Q15-CGM4-ML
Downhole pressure gauge depth	Mesured Depth(m)	5574,7
	Vertical Depth (m)	5574,7
	True Vertical Depth (m)	-5549,7
Build up Pressure EXTRAPOLATED (kgf/cm ²)		643,4
Bottom hole pressure (kgf/cm ²)		638,36
Oil rate (m ³ /day) - abt 28/64" SURGENT		553
Fluid		ÓLEO
Oil °API (60°F):		29,5
Maximum registered temperature (°C)		95,1
Pressure drop between build-ups (kgf/cm ²)		0
Produced volume (regarding the pressure drop) (m ³)		
Storage coefficient (m ³ /kgf/cm ²)		0,021
PI (mesured) (m ³ /D)/(kgf/cm ²)		109
Oil Transmissibility (mD.m/cP)		250835
Oil Mobility(mD/cP)		3135
Oil effective permeability (mD)		5017
Total pellicule effect		63
Damage Ratio - From Skin		10
Investigation Radius (m)		2100

DST-3A (5,415-5,498 m)

Barra Velha Formation (carbonate) – closed interval

DST-4 (5,565-5,625 m)

Barra Velha Formation (carbonate) – reservoir with high permeability, oil medium/light, damaged, high productivity index, harmed by the existing damage.

DST-1A (5,645-5,725 m)

Itapema Formation (coquinas) – 29,5°API oil.

Reservoir with high permeability, medium oil with excellent productivity index.



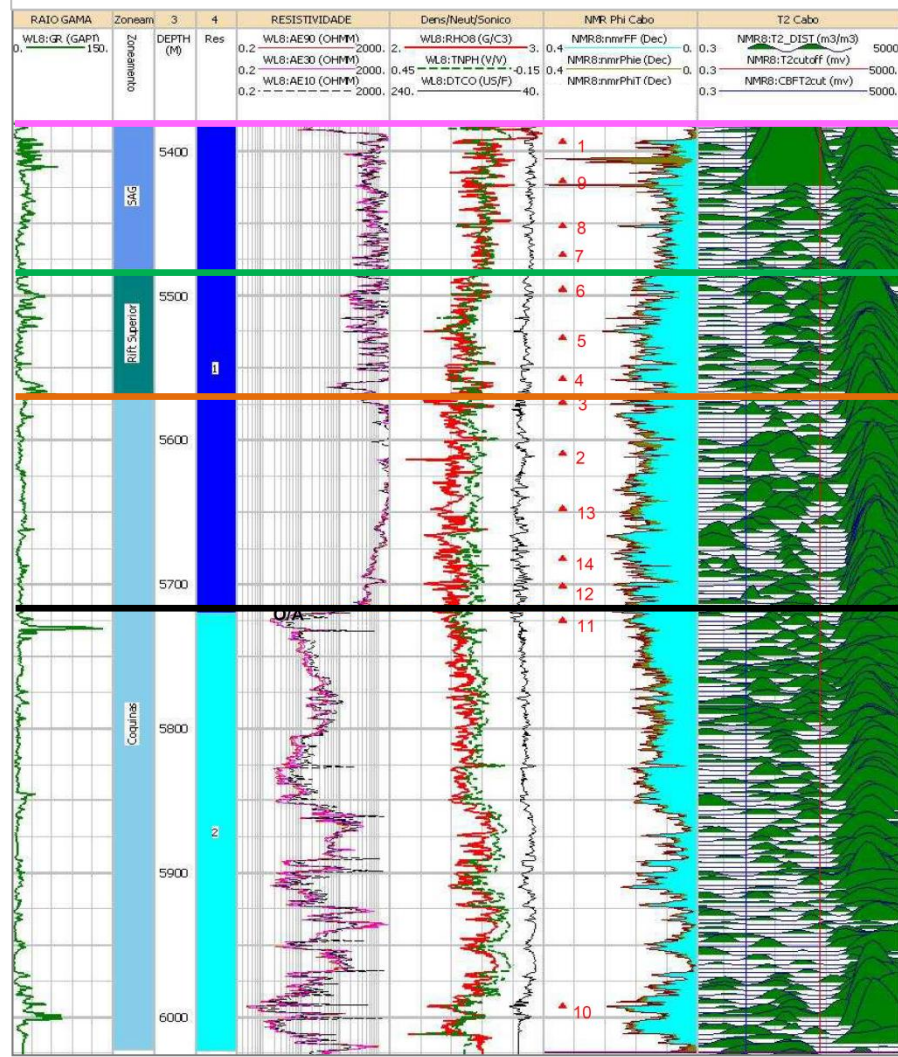
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Libra

2-ANP-0002A-RJS

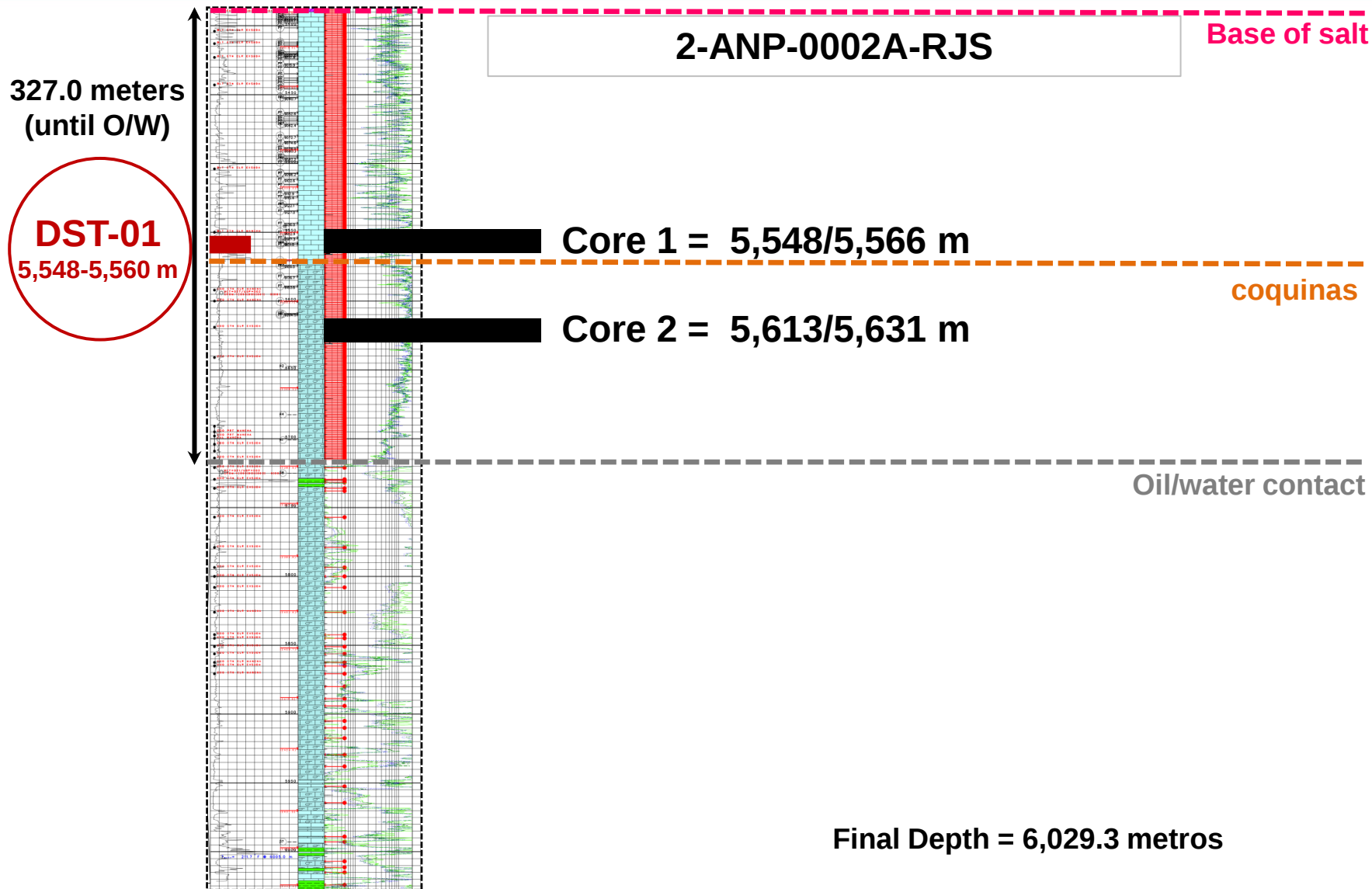


Base of Salt

Top of Upper Rift

Top of coquinas

Oil/water contact





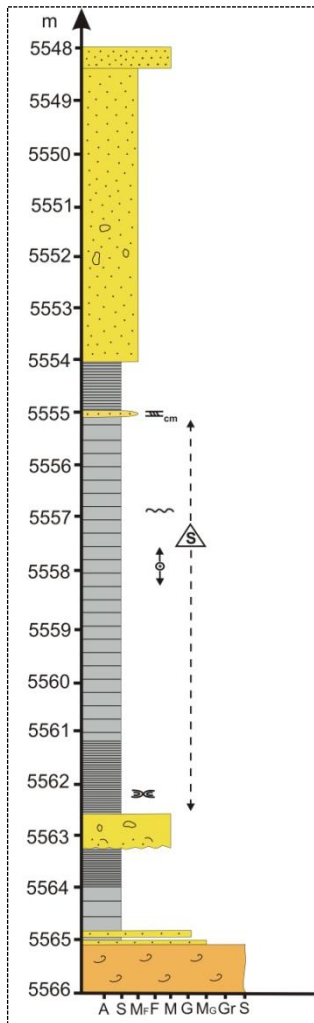
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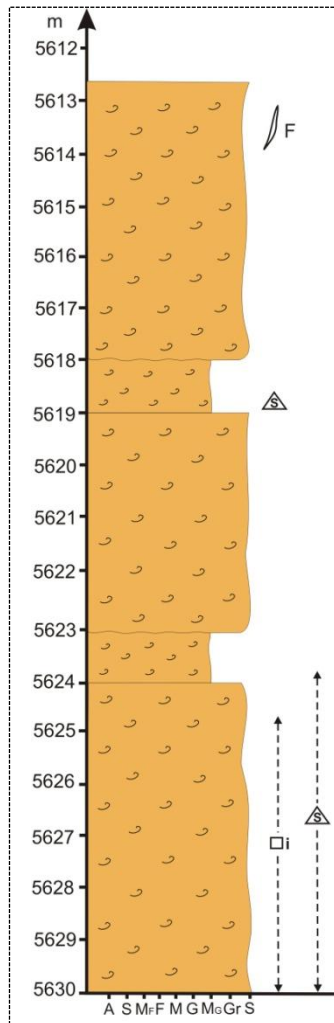


Libra

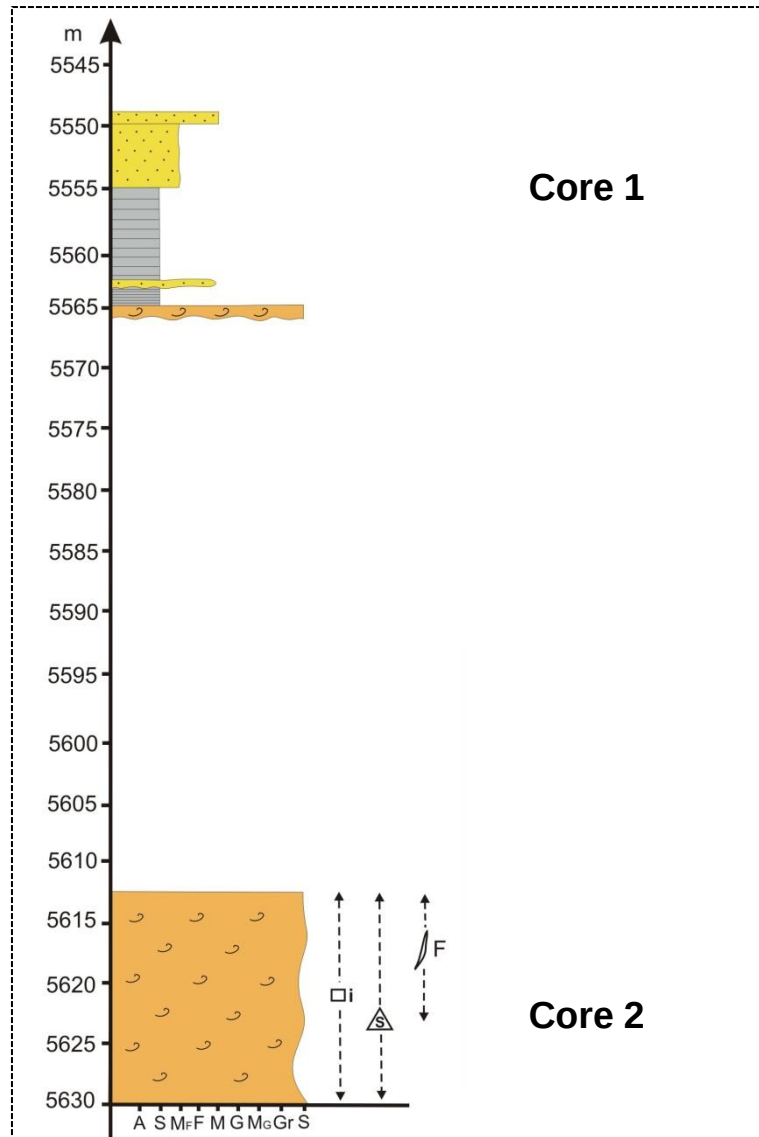
Core 1



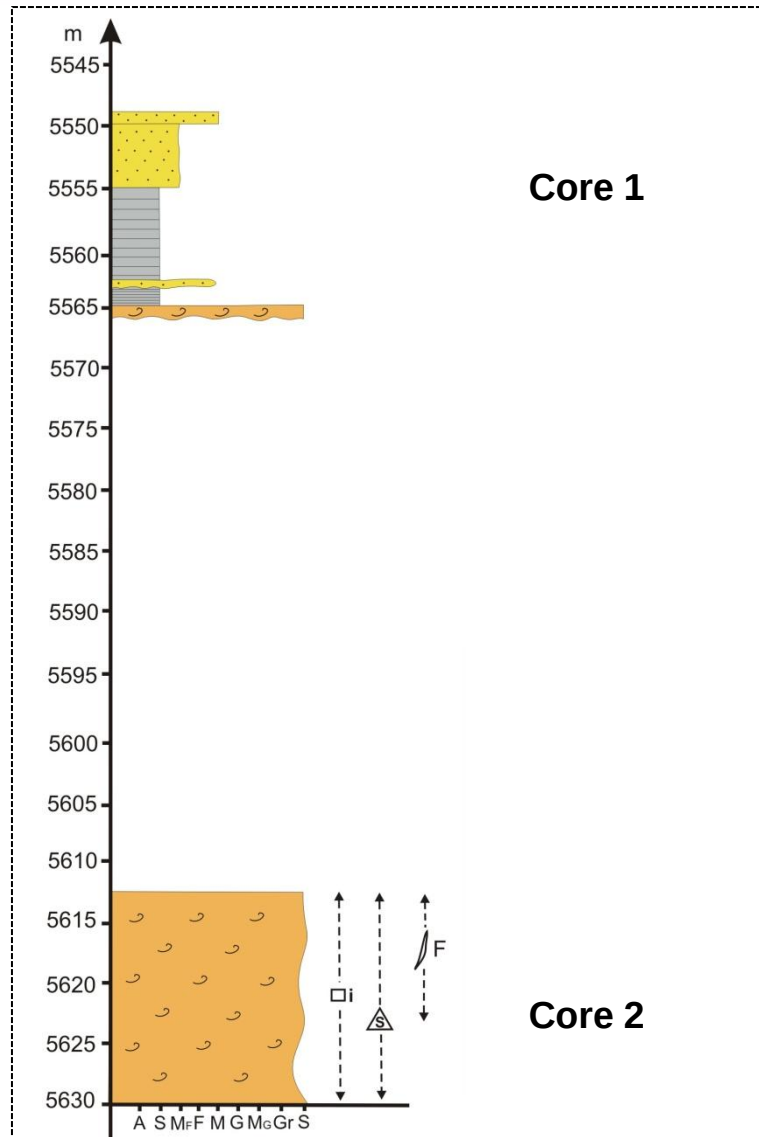
Core 2



Core 1



Core 2



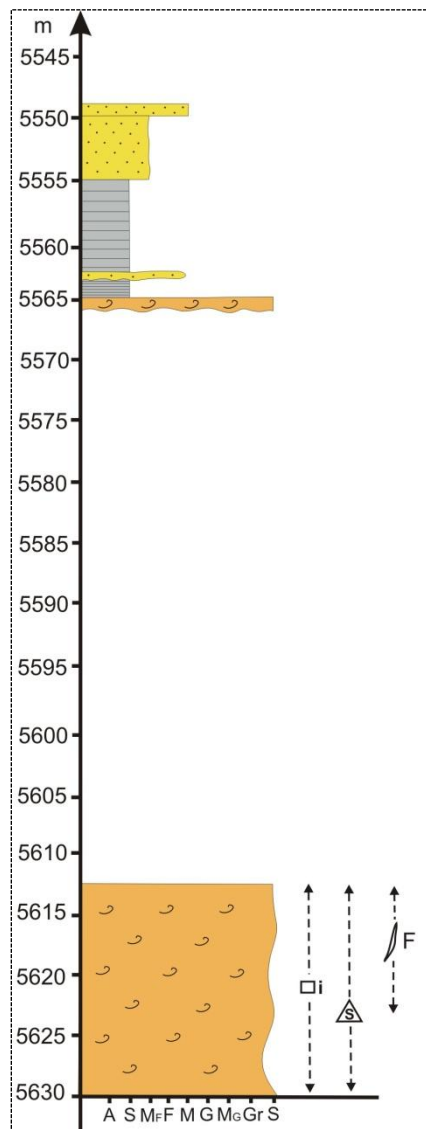
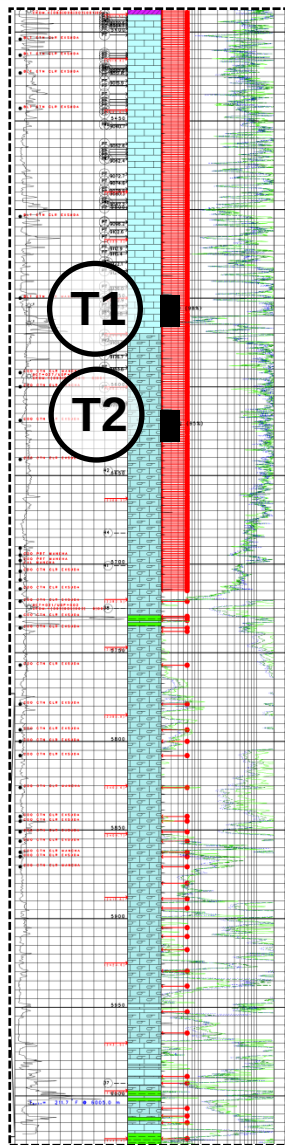


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Libra



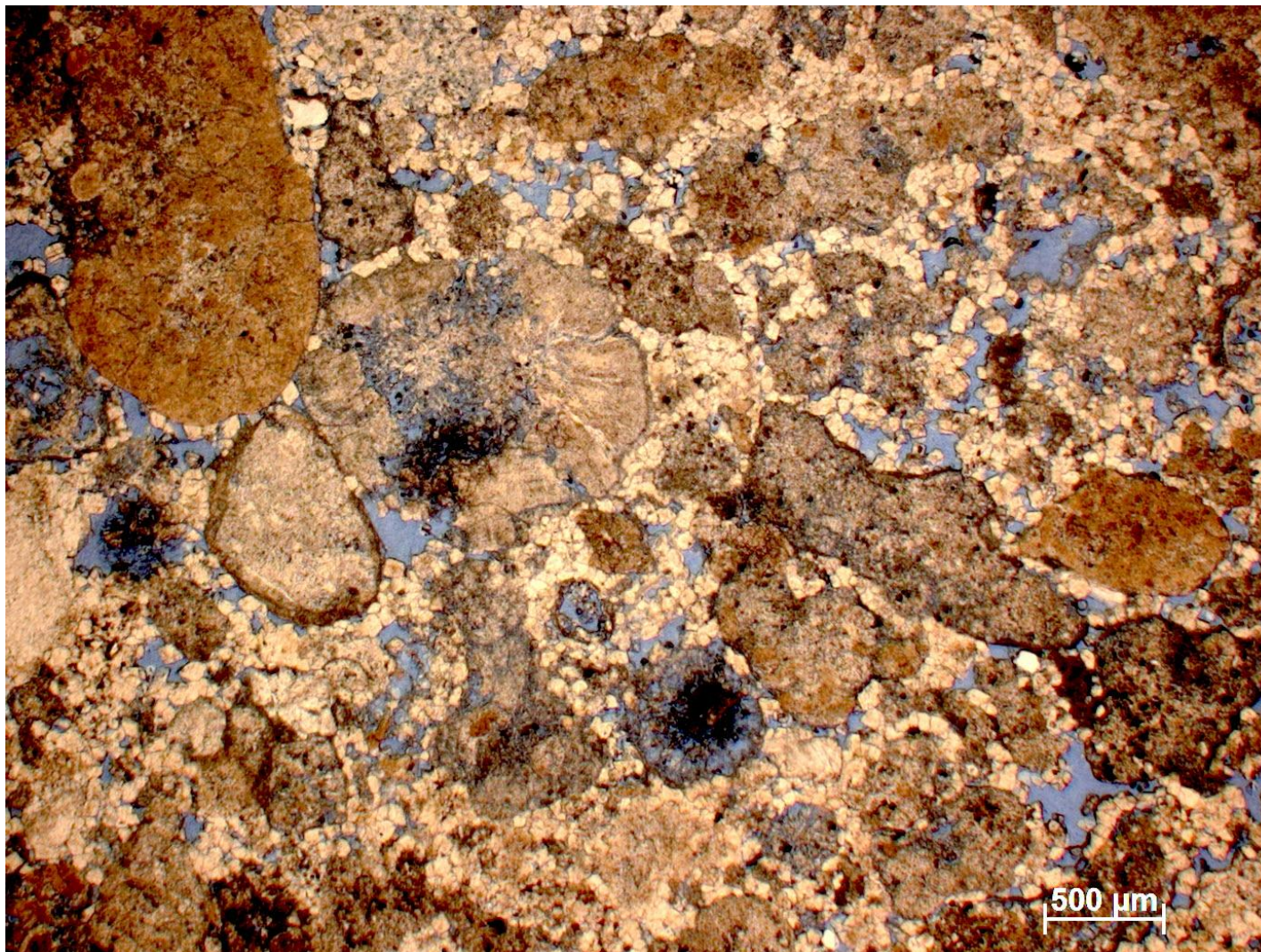
calcareenite



3.0 cm

Libra

Coarse Calcareenite



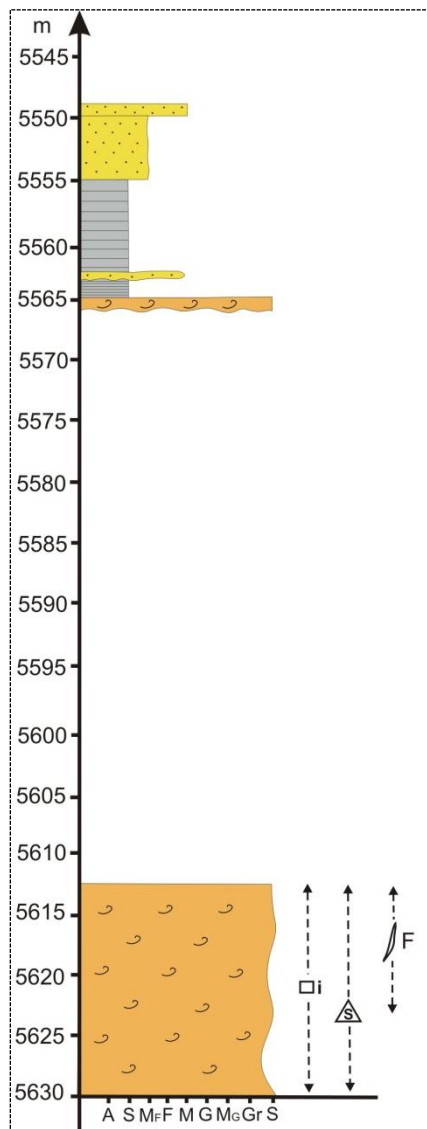
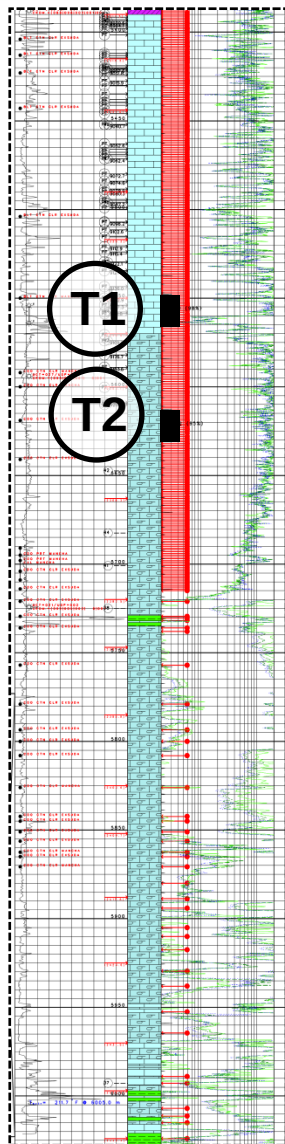


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Libra



Fine calcarenite



2.0 cm

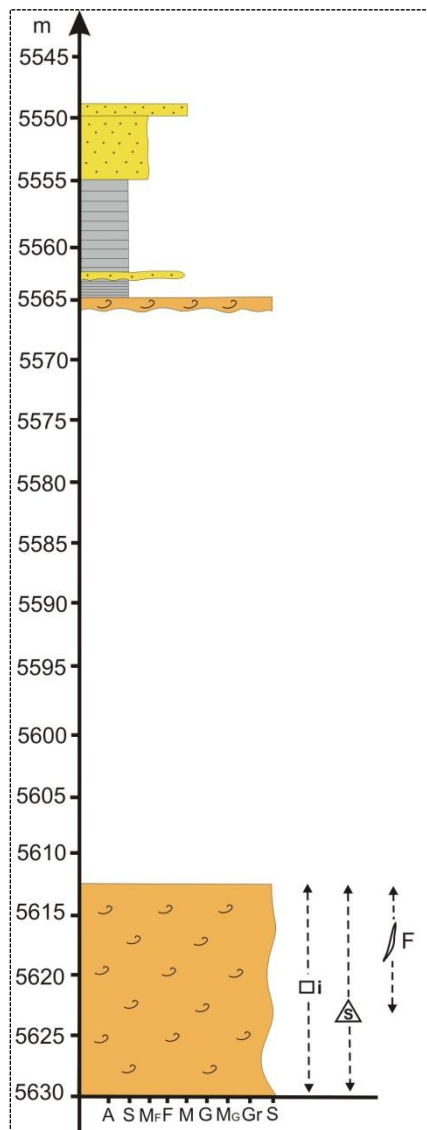
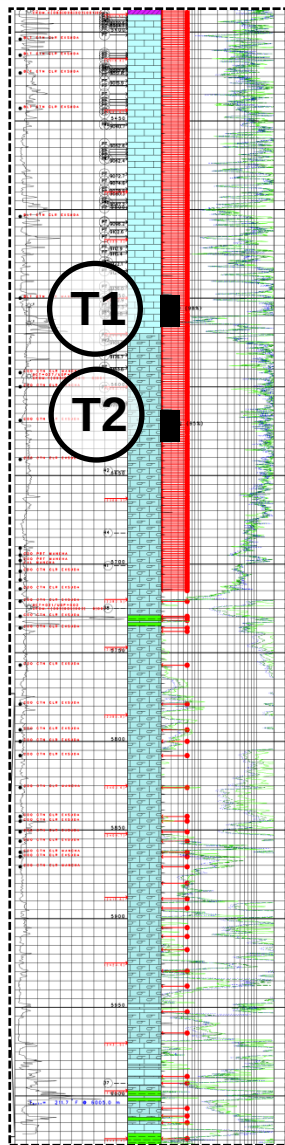


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Libra



Laminated calcilutite



3.0 cm

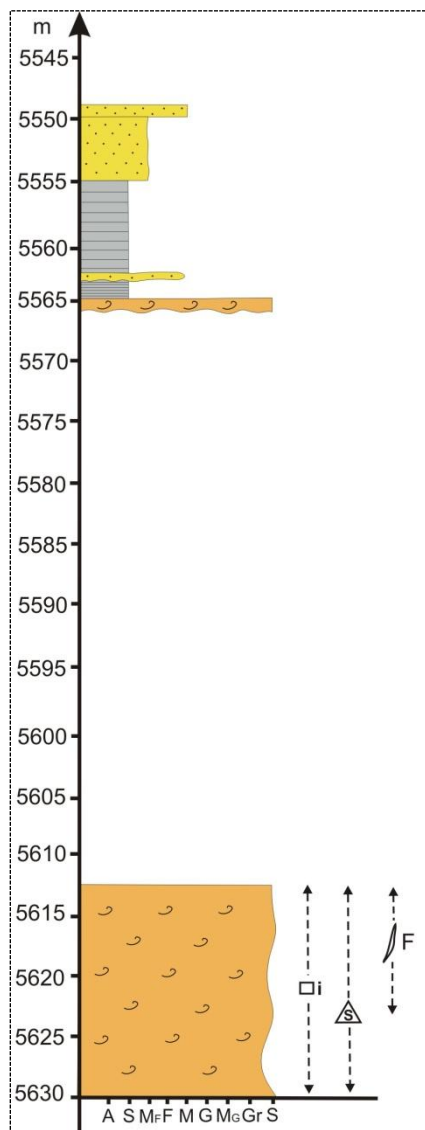
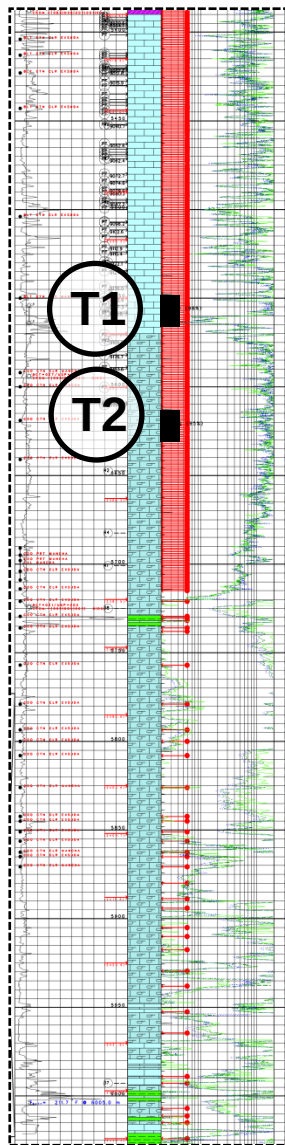


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Libra



**Massive
calcilutite**

3.0 cm

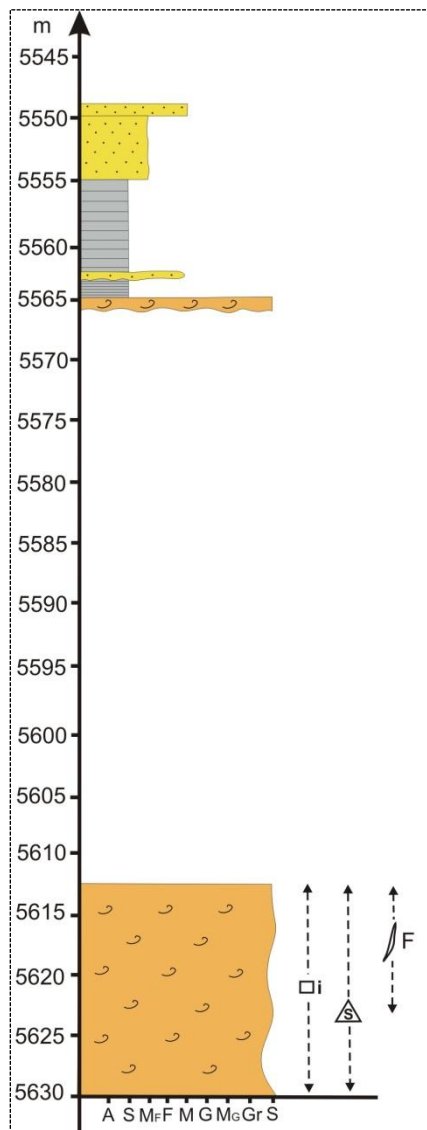
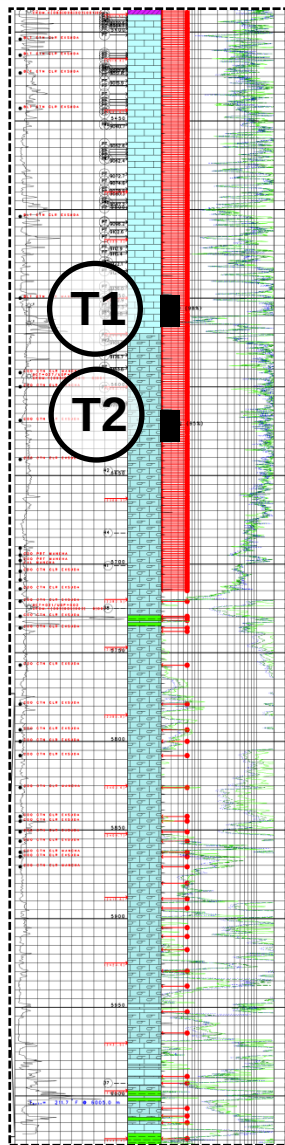


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Libra



Crenulated lamination calcilutite



3.0 cm



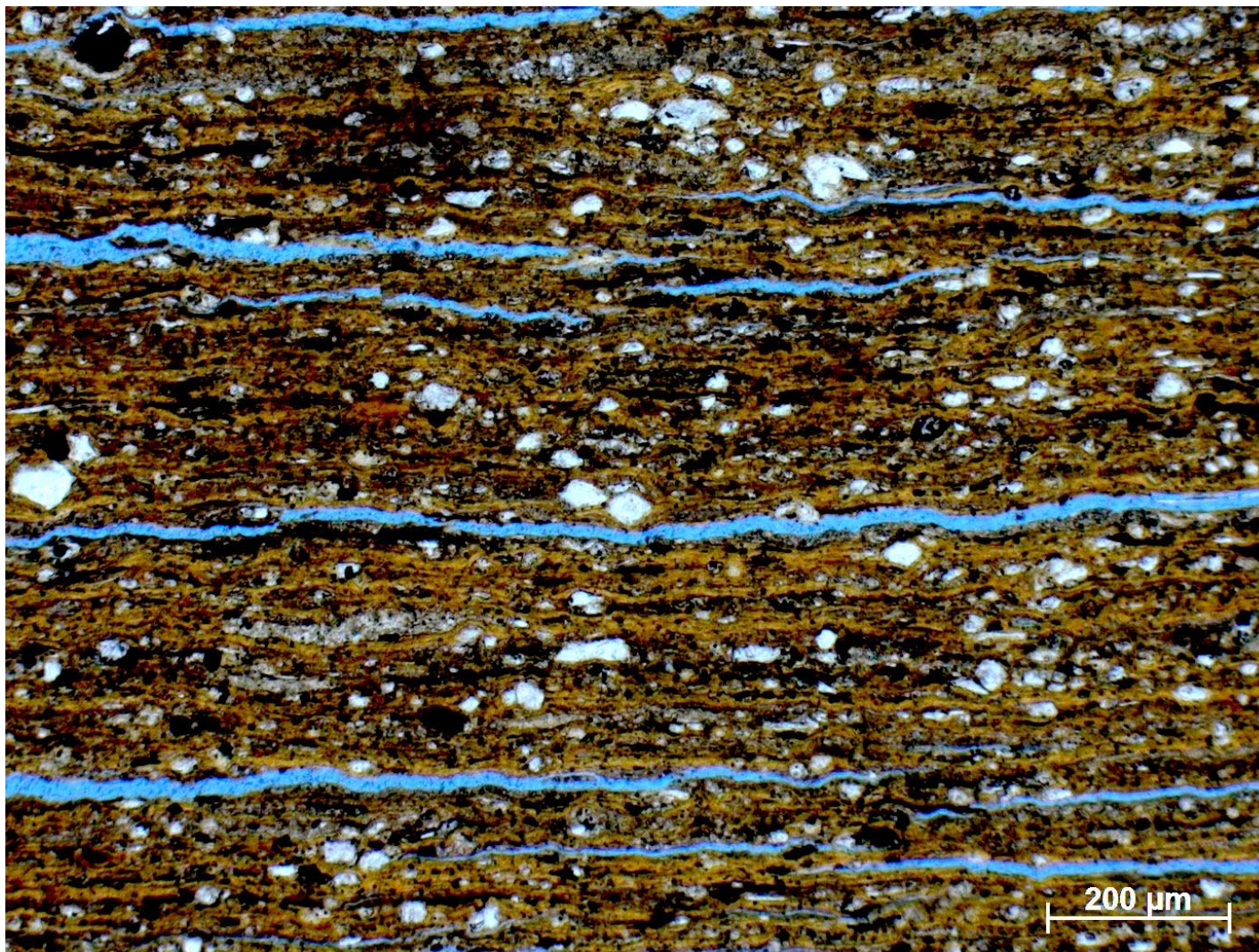
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Libra

Laminated Calcilutite



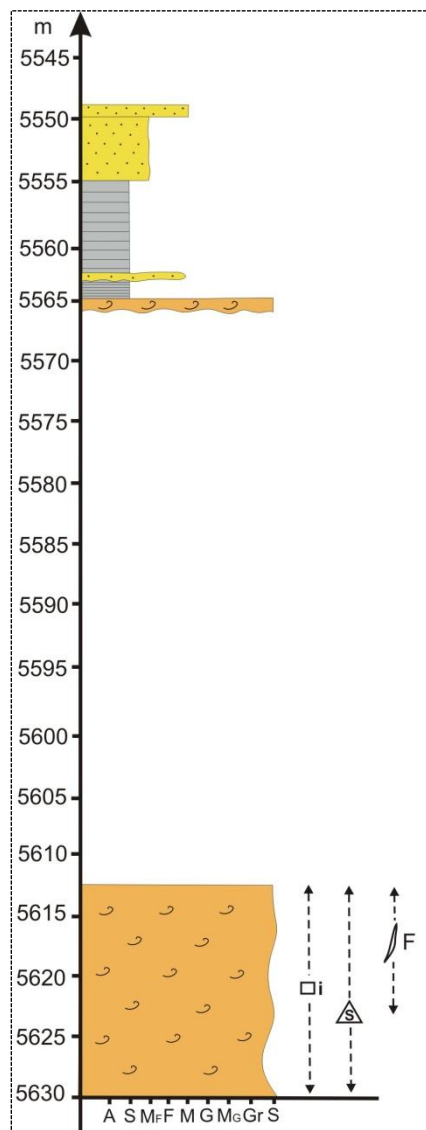
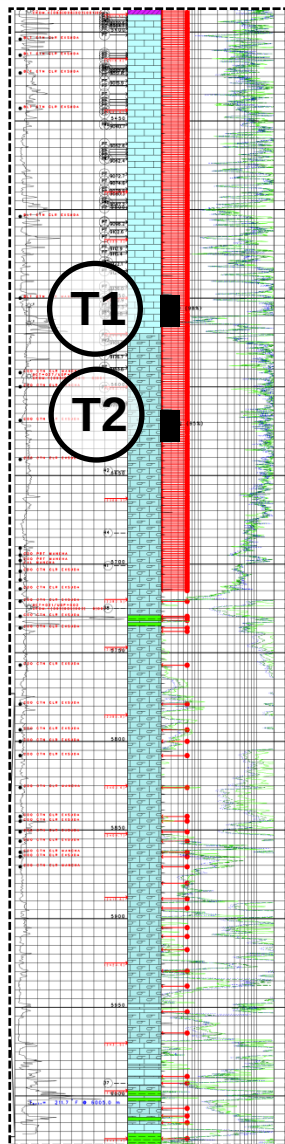


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Libra



Laminated spherulitic calcarenite



2.0 cm



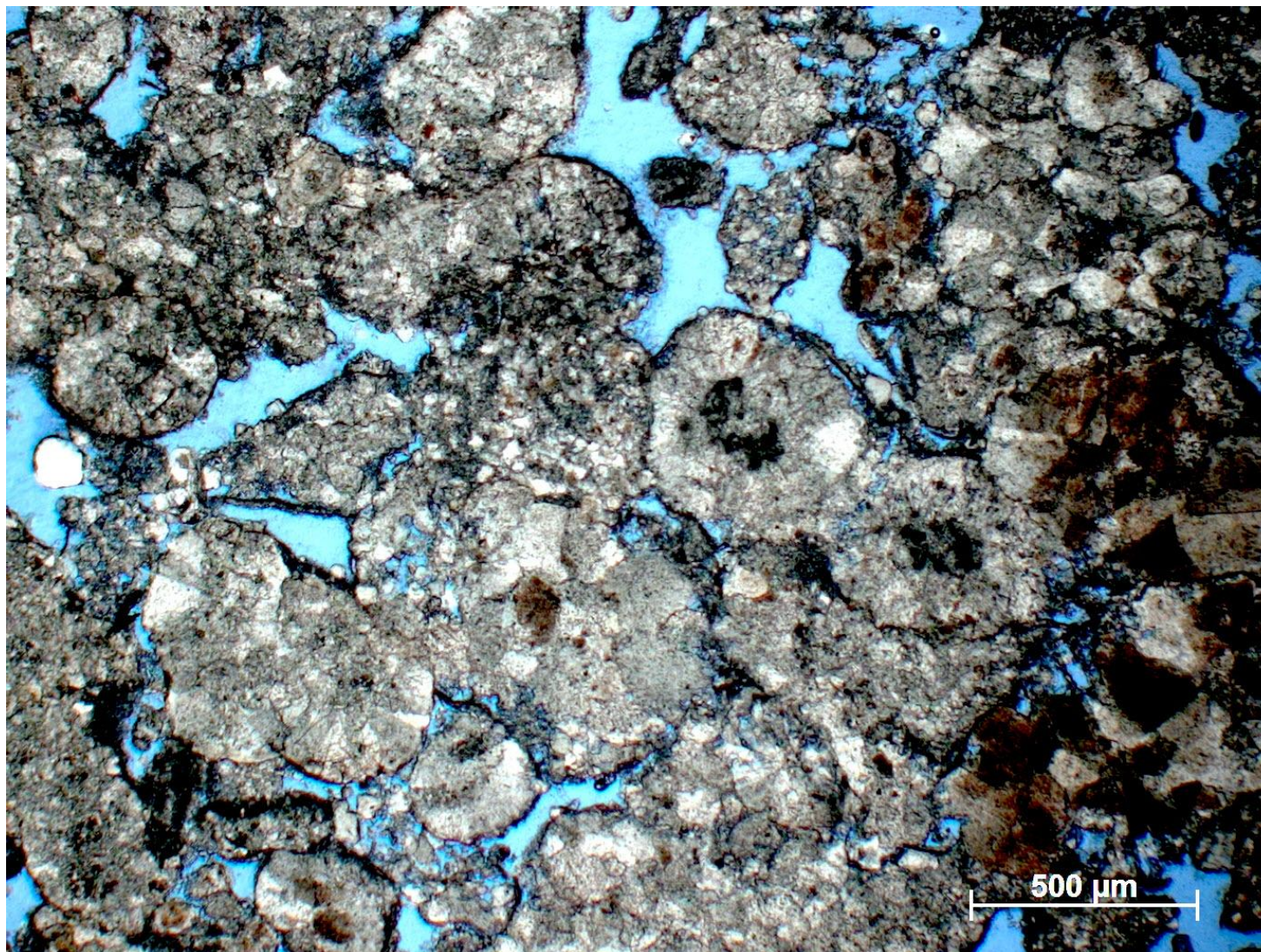
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Libra

Spherulitic Calcareenite



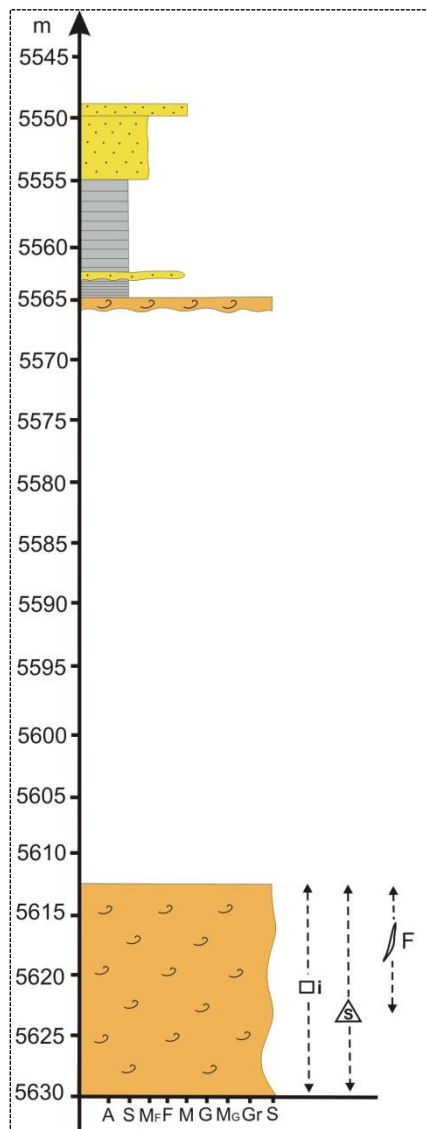
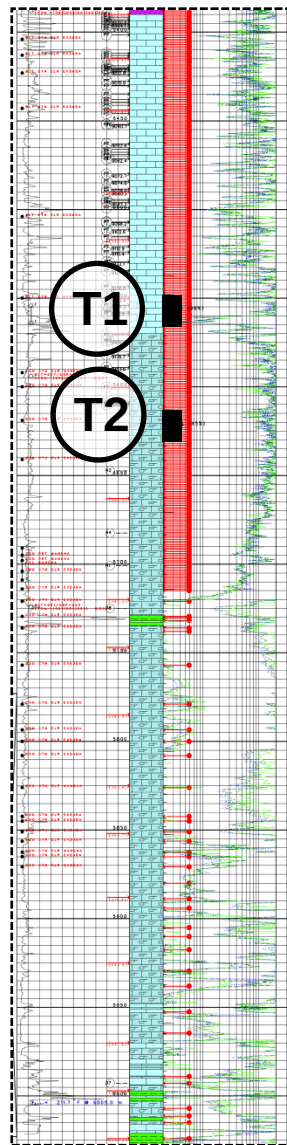


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Libra



Calcarenite

**Coquinas pebbles
and intraclasts**

5.0 cm

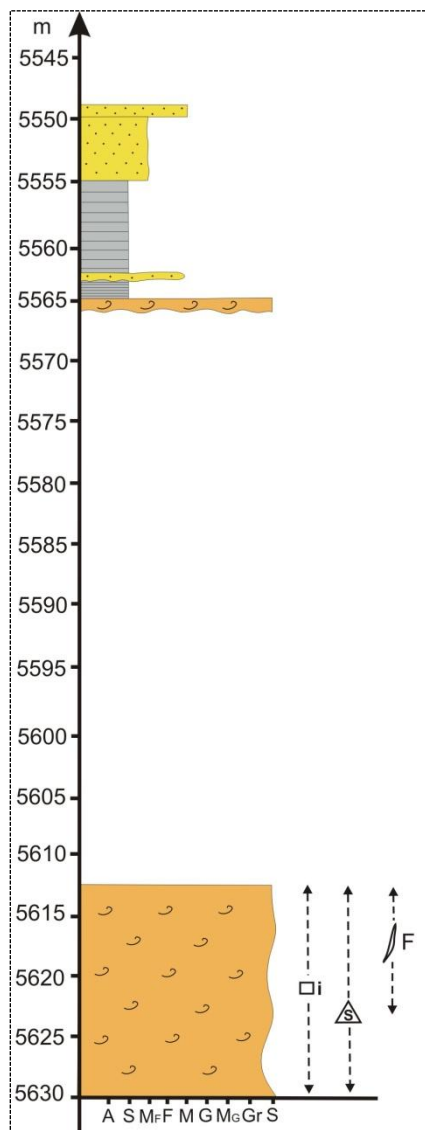
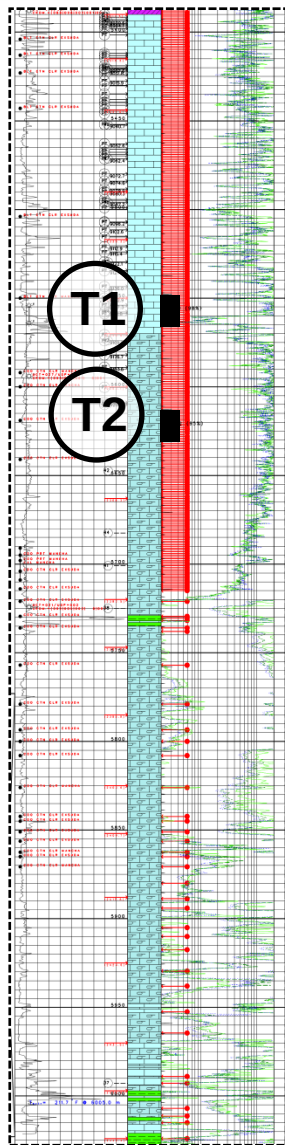


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Libra



Calcirudite



4.0 cm

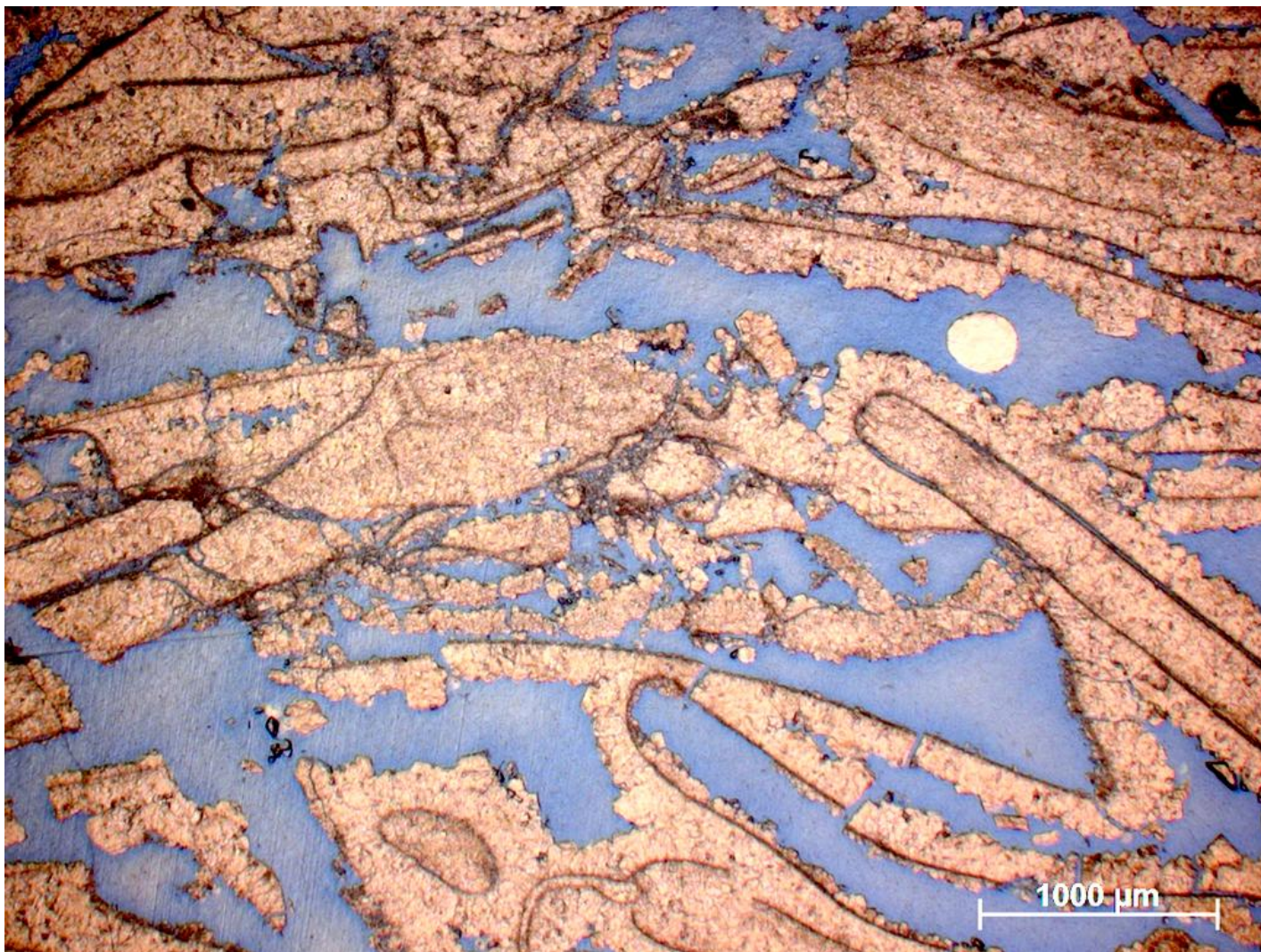


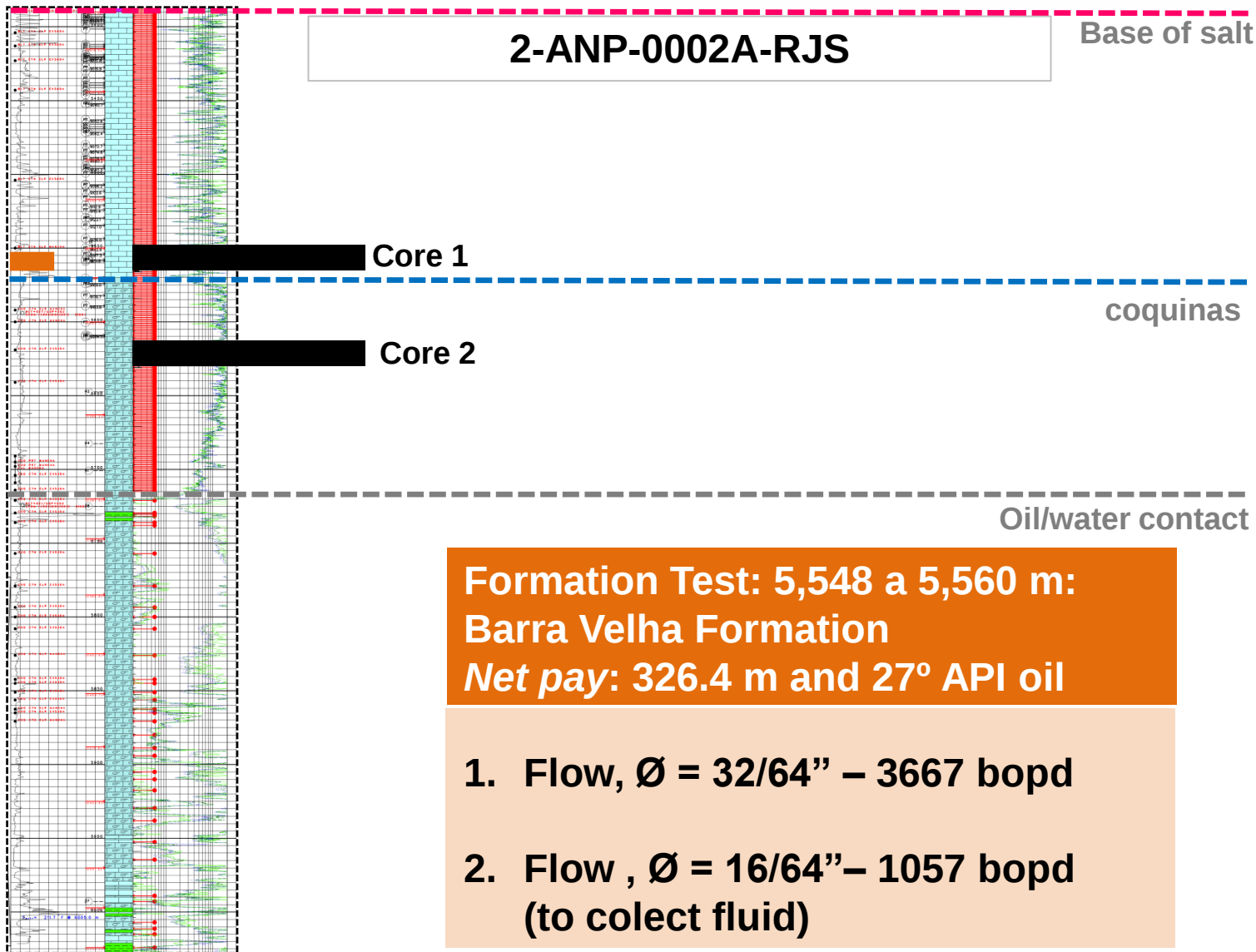
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Calcirudite







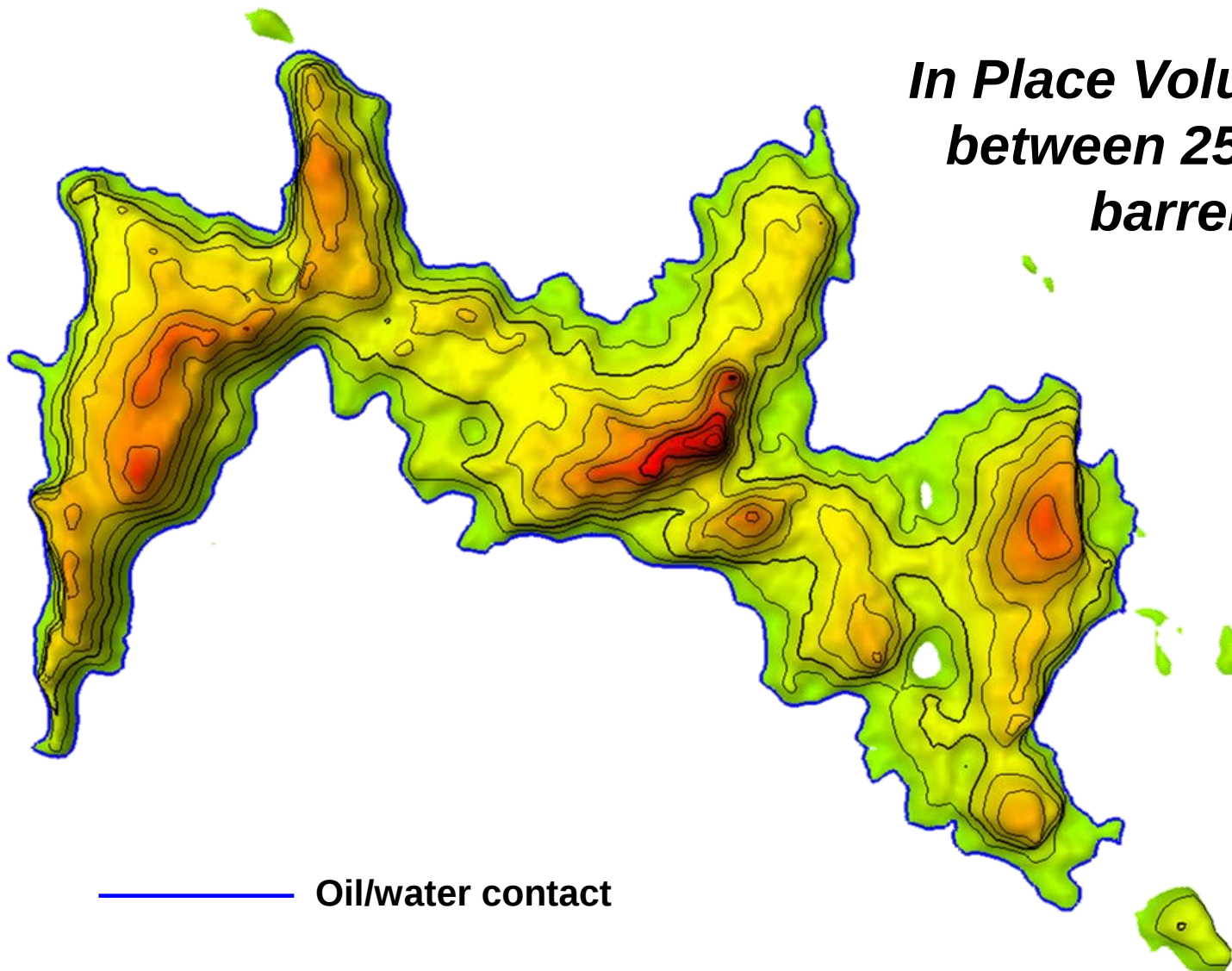
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Libra

*In Place Volume estimated
between 25 to 40 billion
barrels of oil*



Oil/water contact

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Final Remarks



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Aspectos Contratuais

Libra

Minimum Exploration Program

1,547 km² 3D seismic/ 2 exploration wells

Contractual Period

35 years

Exploration Phase

4 years

Local Content

37% Exploration Phase

55% Development Phase (until 2021)

59% Development Phase(after 2021)

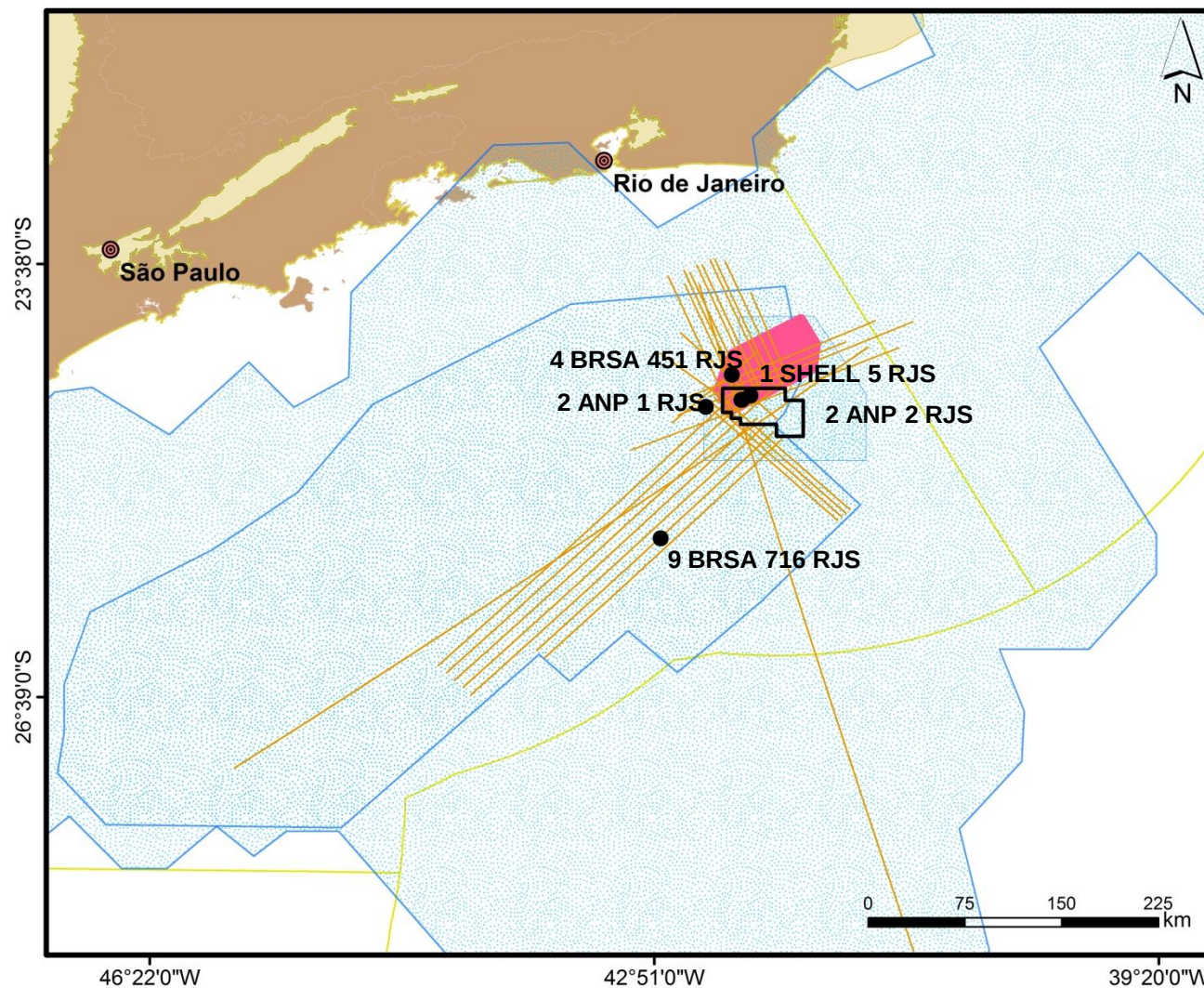
Signature Bonus

R\$ 15 Billion

**Minimum Depth
(Main Objective)**

Barremian (Itapema Formation)

Data Package



5 wells
2D seismic
3D seismic
Potential methods
Well geochemistry
Technical studies

- Well
- Grav/mag survey
- 3D seismic survey
- 2D seismic survey

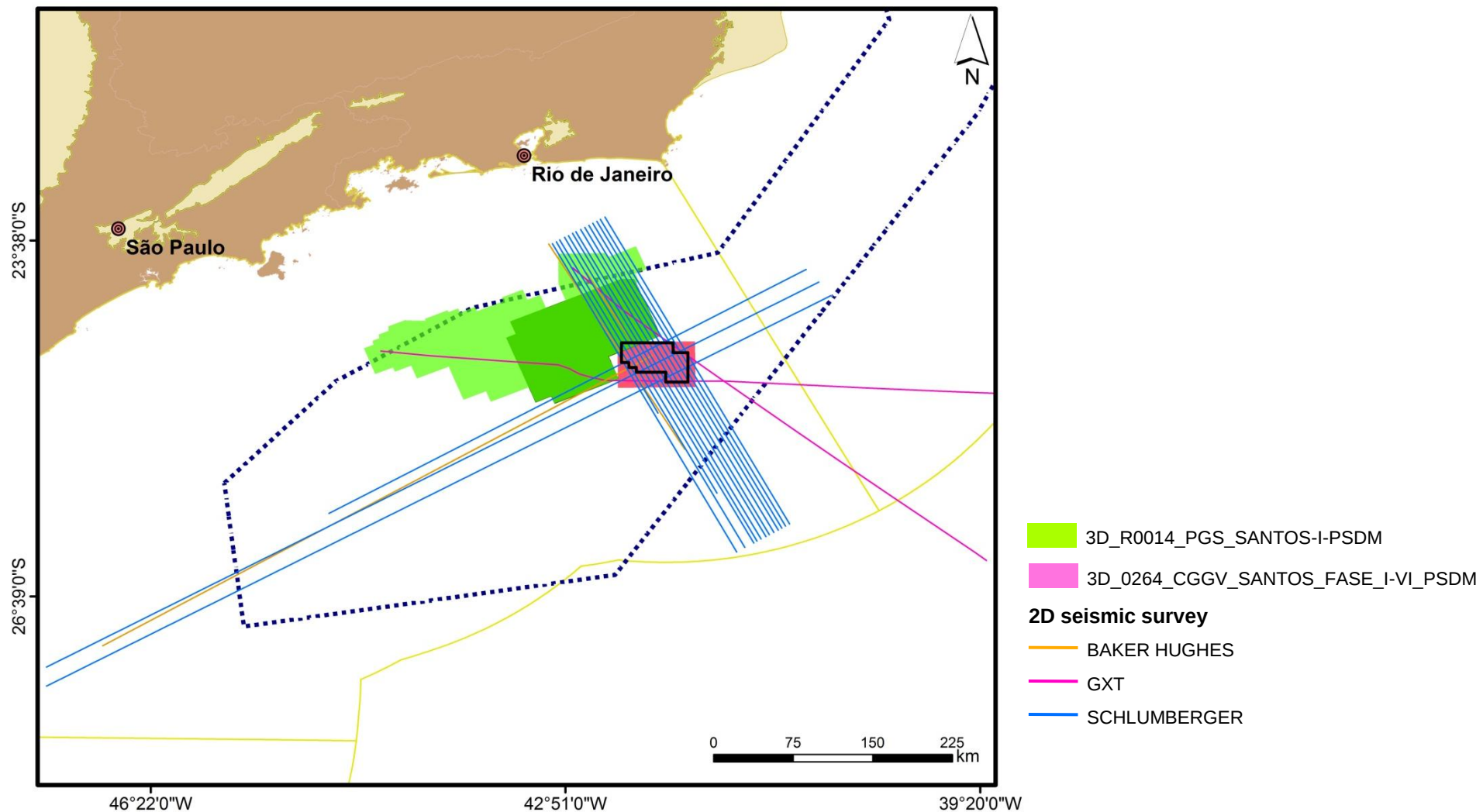


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SPEC Data



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Guidelines for carrying out the bidding for exploration blocks

***“Art. 2º. National Agency of Petroleum - ANP - should obey the
following guidelines,...: ”***

***V – Select areas for bidding rounds, accepting possible exclusions of
areas by environmental restrictions, based on joint declaration of
ANP, Federal Environmental Agency (“Instituto Brasileiro do Meio
Ambiente e dos Recursos Naturais Renováveis – IBAMA”) and State
Environmental Agencies...”***

GTPEG – Interinstitutional working group for activities related to Oil and Gas E&P



- ***Absence of conflict between Libra prospect and conservation units or other environmental protected areas;***
- ***Regarding the environmental licencing, several studies about environmental impact has been realized in the area, these studies may act as the basis for impact evaluation in future ventures in the area of Libra;***
- ***Environmental risks coming from the E&P activities in Libra area will be managed adequately during the environmental licencing.***



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Schedule

Technical-Economic-Financial qualification: July 10th to September 24th

Bid bonds: up to October 7th

Submission of bids: October 21st

Signing of contract: November, 2013

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Final Remarks

- *Brazil will promote the first bid round including pre-salt areas under production sharing regime;*
- *In this opportunity the Libra prospect (500 km² area) will be auctioned . This prospect was tested by the 2-ANP-2A-RJS well which tested the reservoir (327 meters of net pay and 27° API oil);*
- *It's a unique opportunity, with in place volumes estimated between 25 to 40 billion barrels of oil;*
- *Technical studies promoted by ANP subsidized the volume appraisal;*
- *The auction will take place in 10/21/2013.*



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