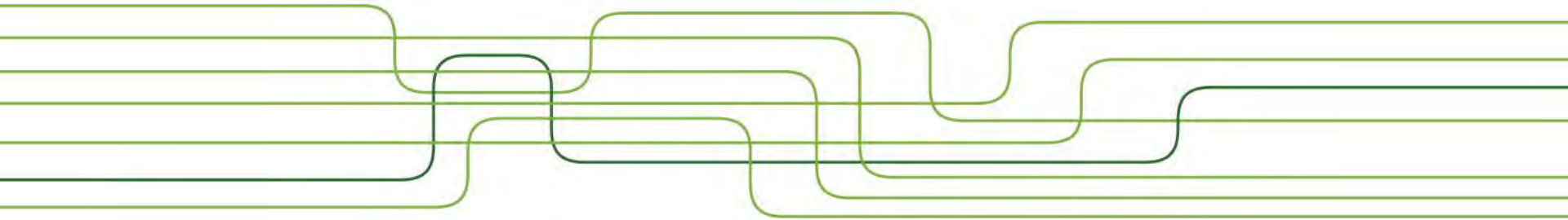


Brasil12thRound

Oil & Gas Bidding Rounds

Parana Basin

Rodrigo Fernandez



Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

Plays

Area on Offer

Final Remarks

Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

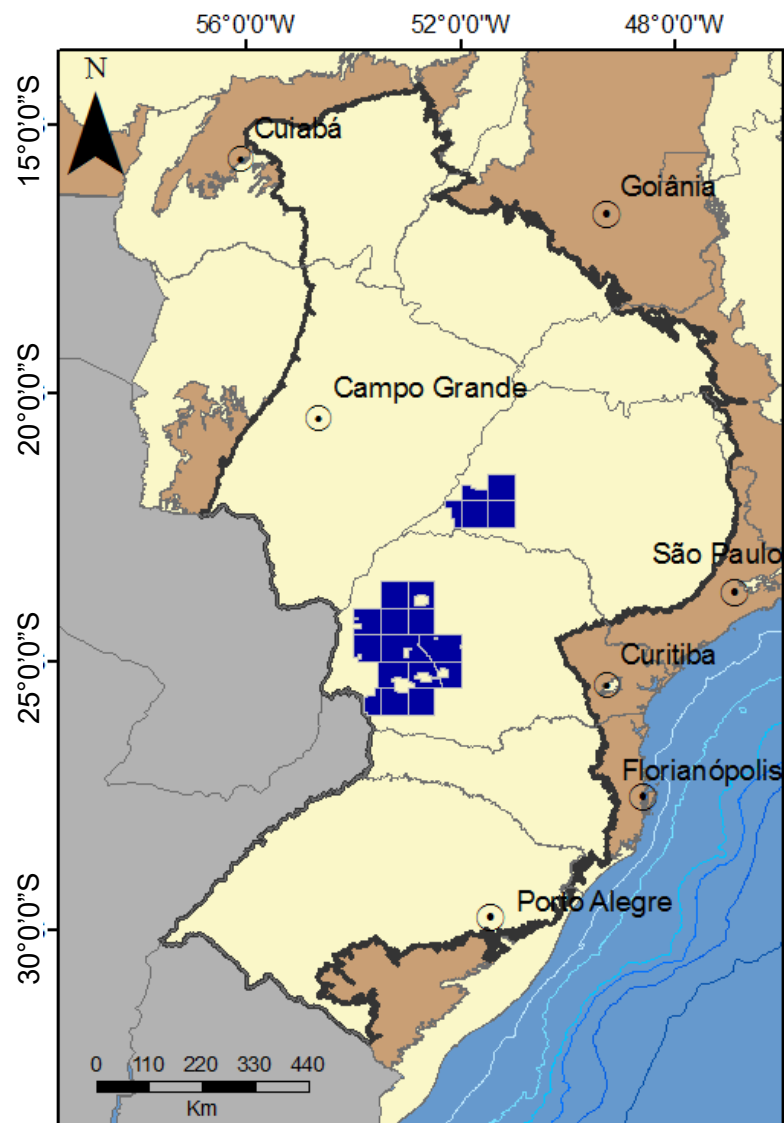
Petroleum Systems

Plays

Area on Offer

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Location









Paleozoic Basin

Intracontinental

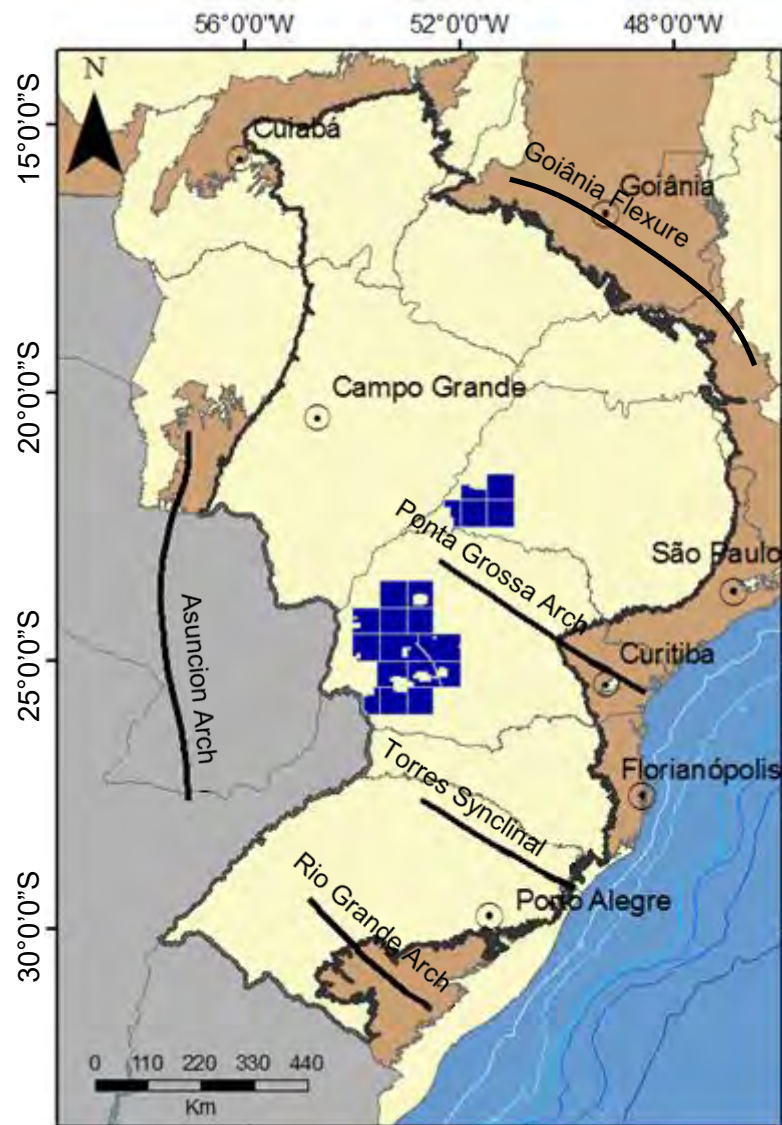
Centre-East of South America

**Depositional Thickness
> 7,000 m**

Legend

-  Capitals
-  Blocks on offer
-  State boundaries
-  Basement
-  Sedimentary basin
-  South America

Area and Boundaries

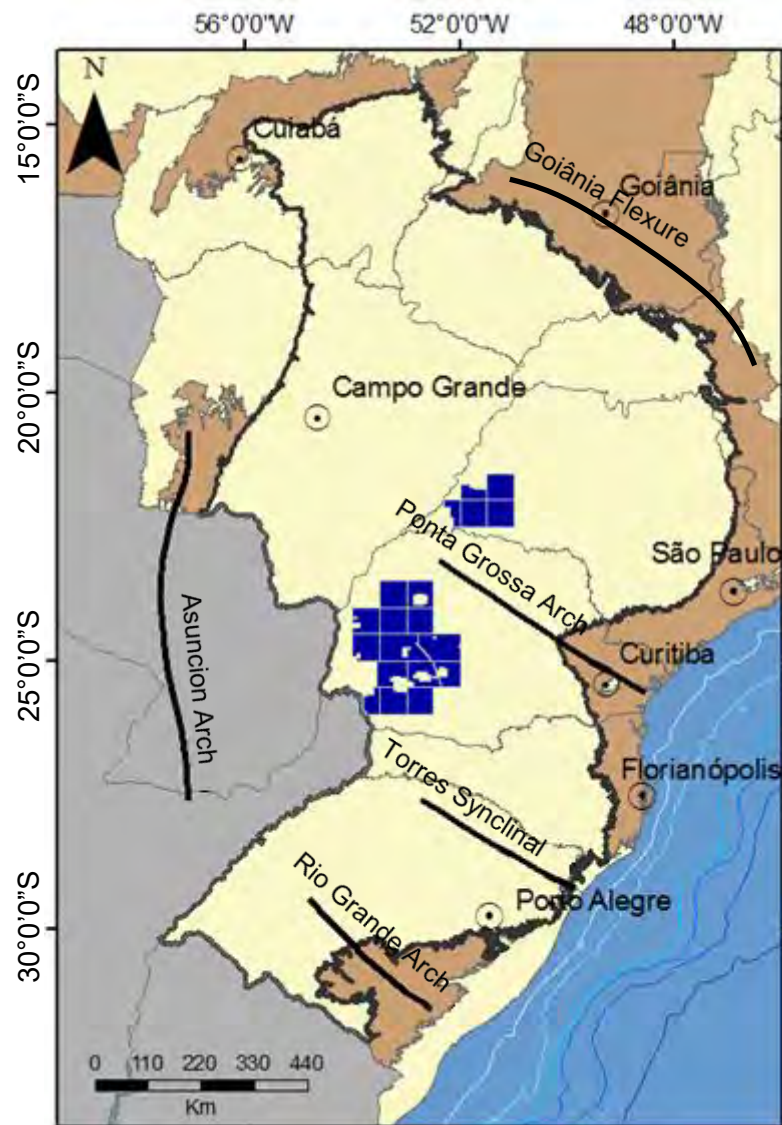


Oval Form
More Extensive Axis N-S

Area
Total: ~1.5 million km²
In Brazilian territory : ~1.1 million km²

Boundaries
Pinch-outs
Tectonic Features

Area and Boundaries



Northeastern Border
Guapiara Fault Zone
Goiania/Alto Parnaiba Arch

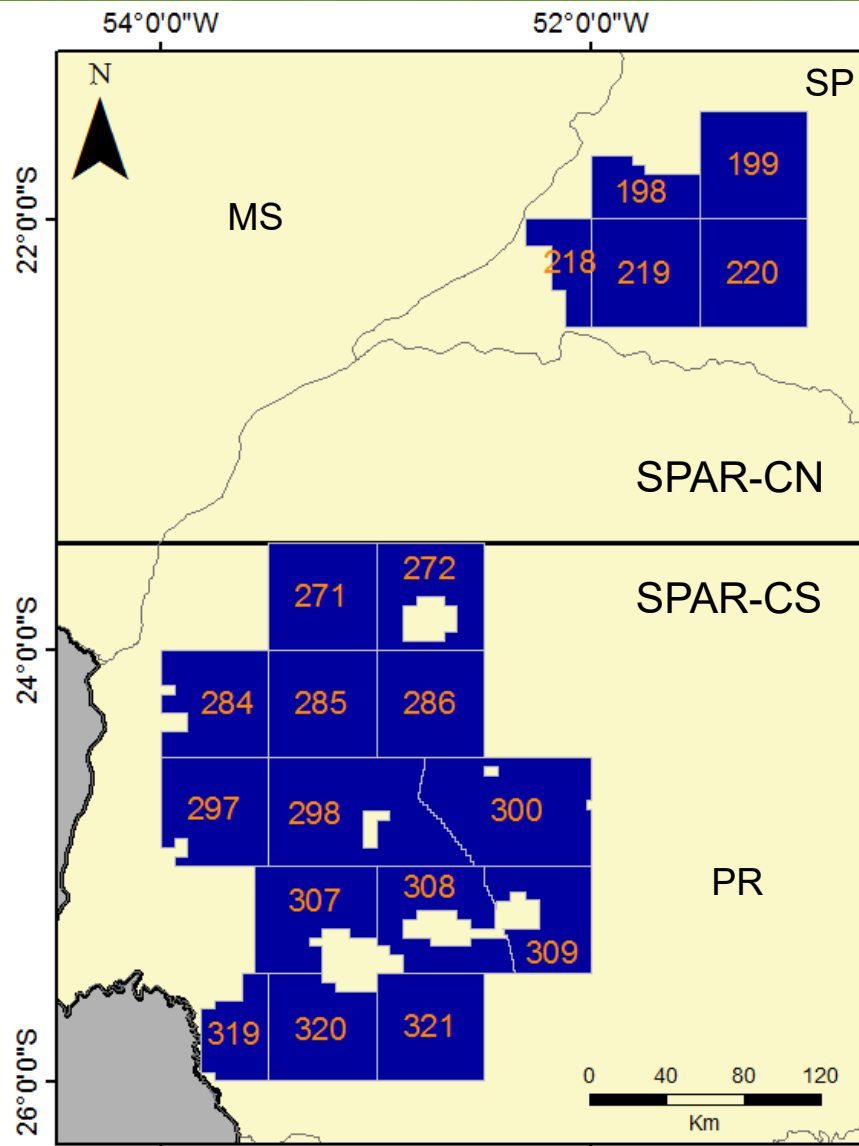
Northwestern Border
Pinch-outs
Paraguai/Araguaia Fold Belt

Western and Southern Borders
Tectonic Influence
Assuncion Arch (Early Devonian)

Northern Border
Tectonic Influence
Goiania/Alto Parnaiba Arch






Southeastern Border
Serra do Mar Uplift (Turonian)
Ponta Grossa Arch and Rio Grande Arch

Blocks and Sectors



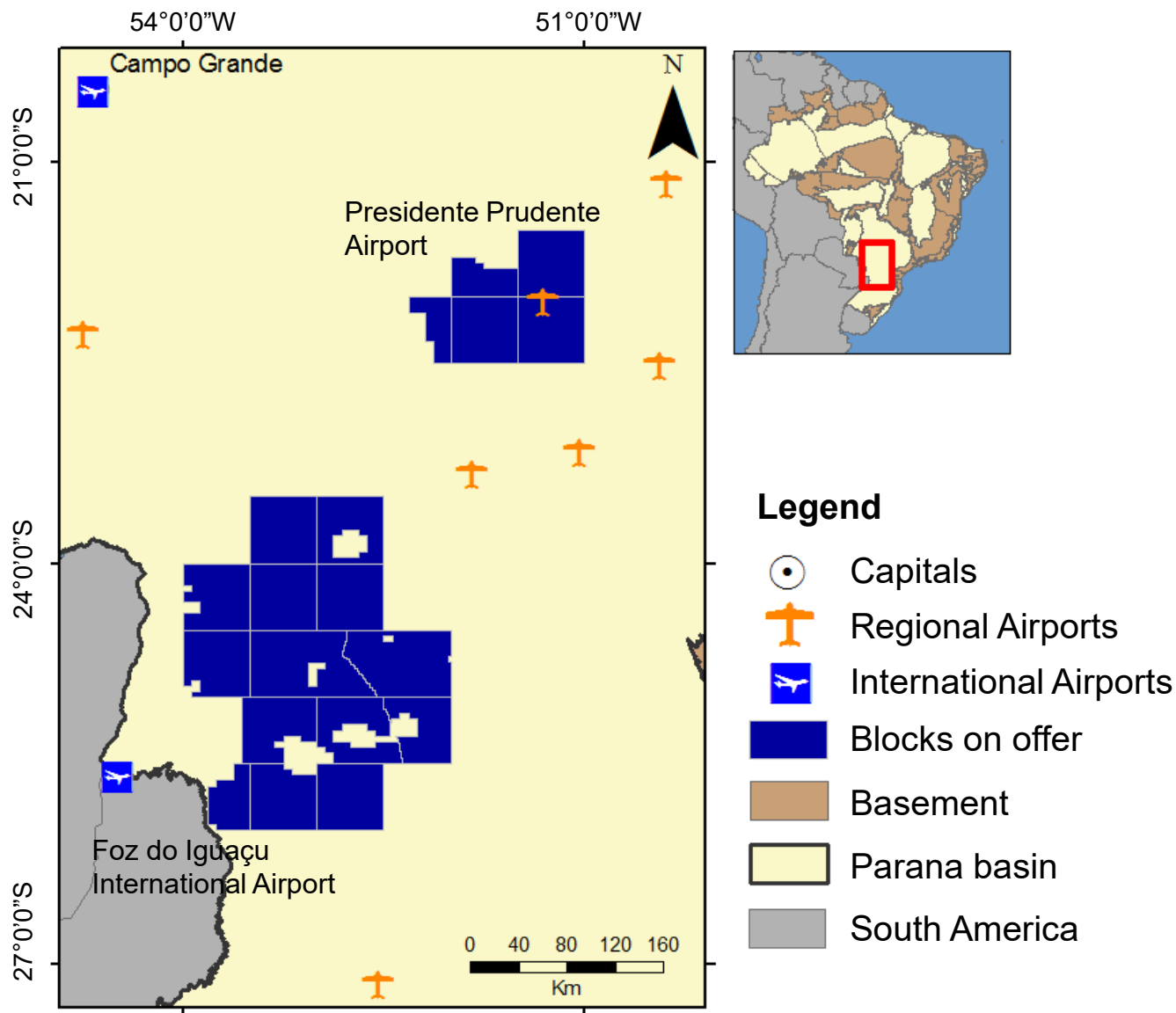
19 Exploration Blocks
SPAR-CN: 5 blocks
SPAR-CS: 14 blocks

Legend

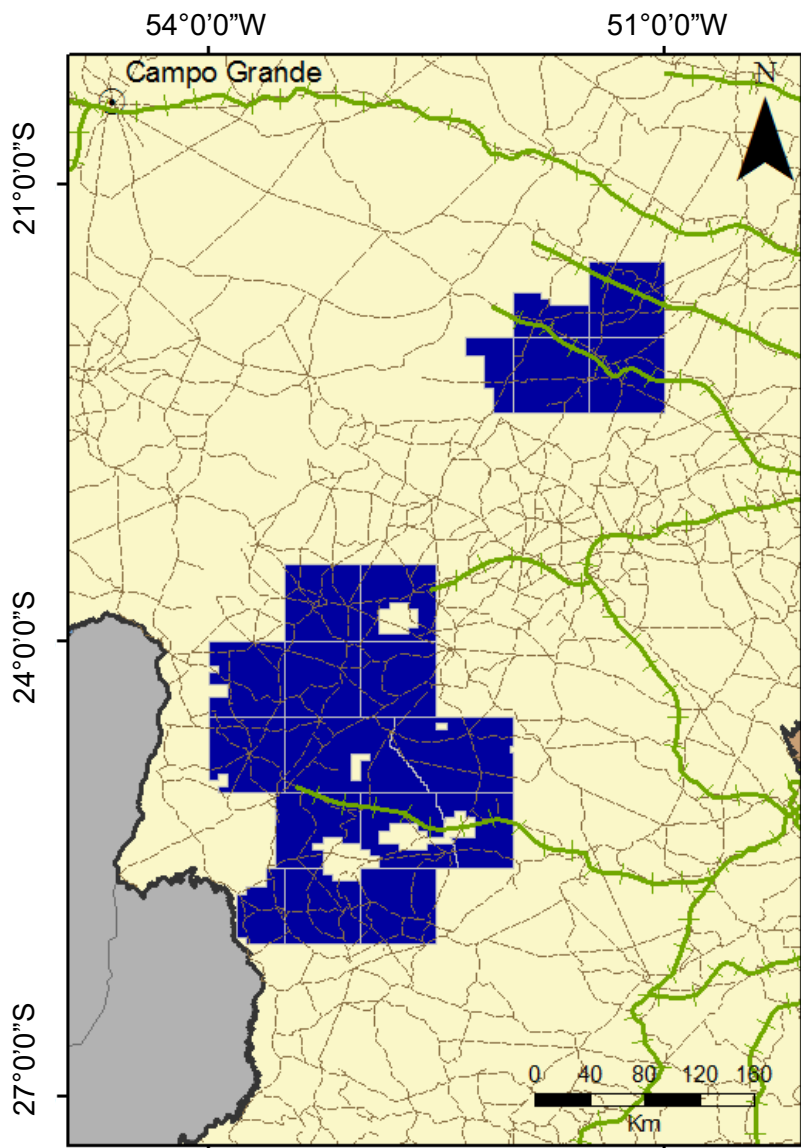
-  State boundaries
-  Sectors
-  Blocks on offer
-  Basement
-  Sedimentary basin
-  South America



Infrastructure



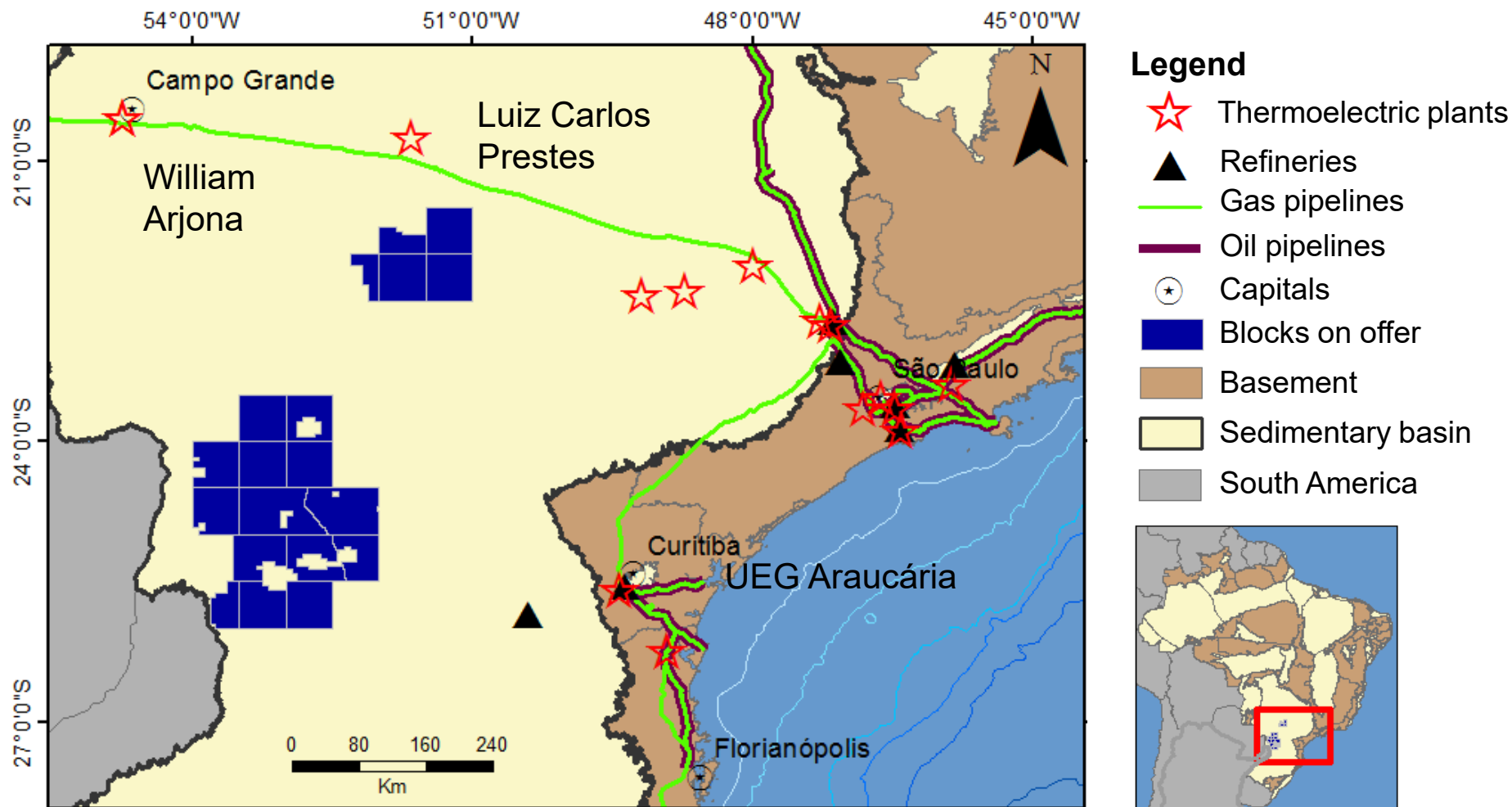
Infrastructure



Legend

-  Capitals
-  Highways
-  Railroads
-  Blocks on offer
-  Basement
-  Parana basin
-  South America

Infrastructure



Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

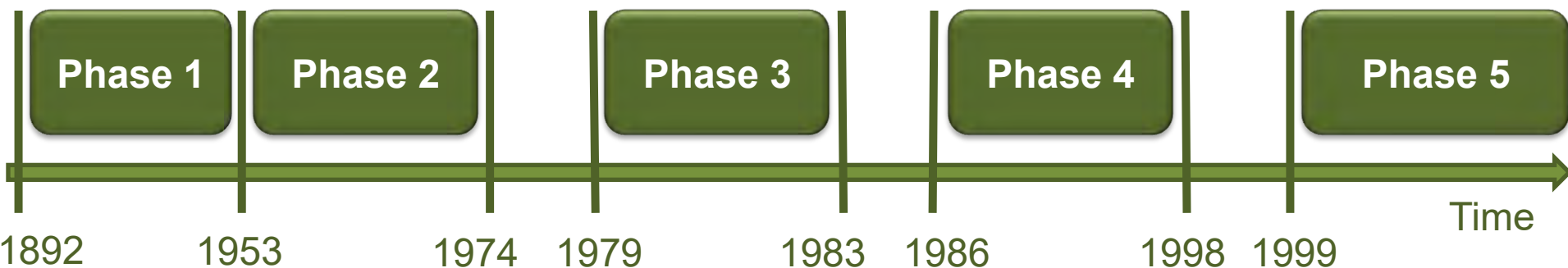
Plays

Area on Offer

Final Remarks

Exploration Overview

The interest for the hydrocarbon potential of the Parana Basin began in the late 19th century with the identification of tar sands in the eastern flank of the basin



Exploration Overview

Phase 1: First well for petroleum exploration drilled in Brazil, in Bofete (SP); Work developed by National Council of Petroleum (CNP)



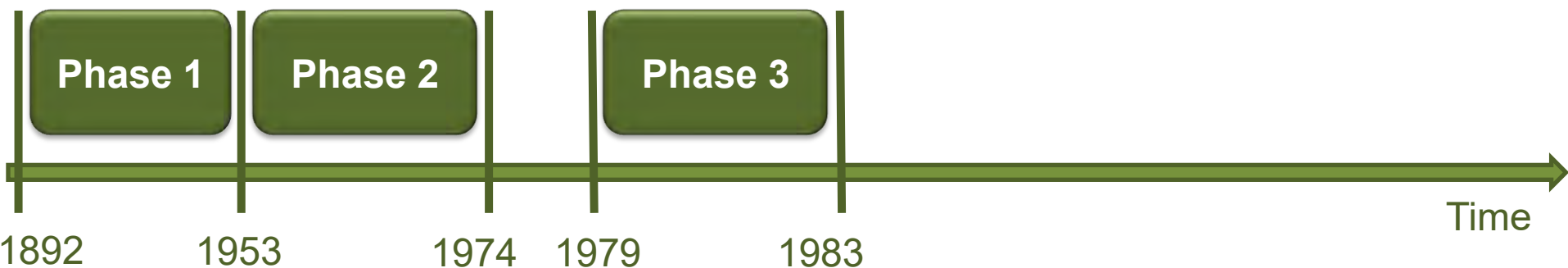
Exploration Overview

Phase 2: Petrobras foundation – 60 wells drilled based on geological mapping and geophysical surveys – 4 noncommercial oil accumulations discovered in Santa Catarina State



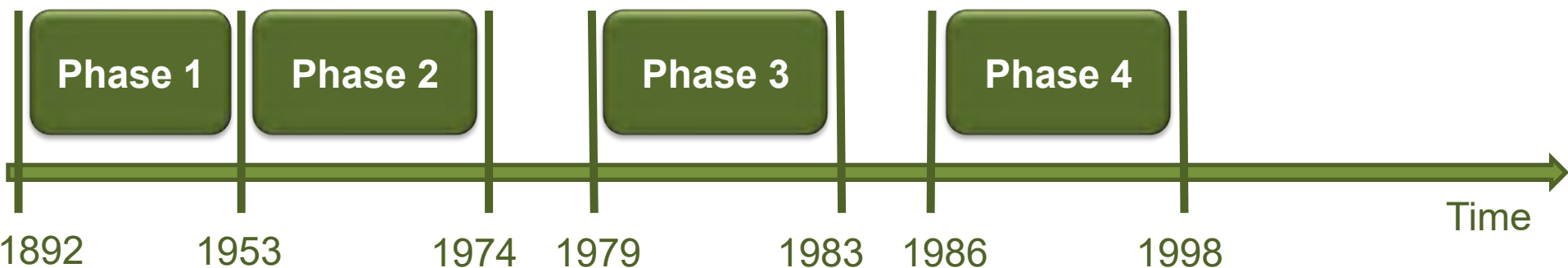
Exploration Overview

Phase 3: Risk contracts with Paulipetro and British Petroleum activities – 33 wells drilled and seismic data acquisition – Cuiaba Paulista and Chapéu do Sol noncommercial gas accumulations



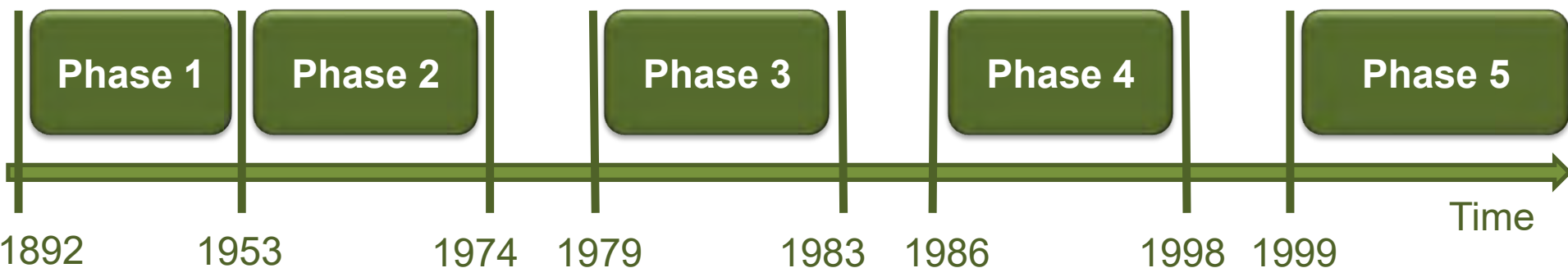
Exploration Overview

Phase 4: Petrobras resumes studies in the basin with 18,000 km of seismic data acquisition and 7 wells drilled – Barra Bonita commercial gas accumulation (1996) and Mato Rico accumulation (1998)



Exploration Overview

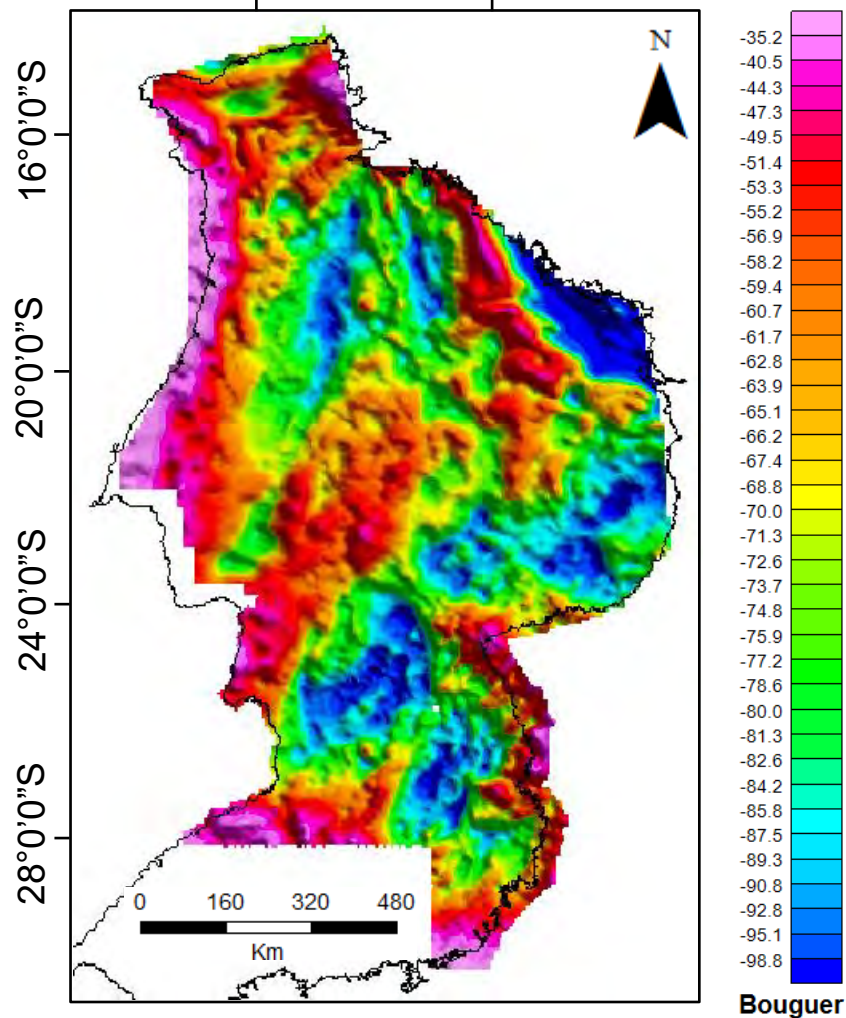
Phase 5: ANP action with blocks offered in Bid Rounds 1, 2, 3 and 10 – Gravimetry, magnetometry and seismic surveys by the ANP's Pluriannual Plan of Geology and Geophysics



Available Data

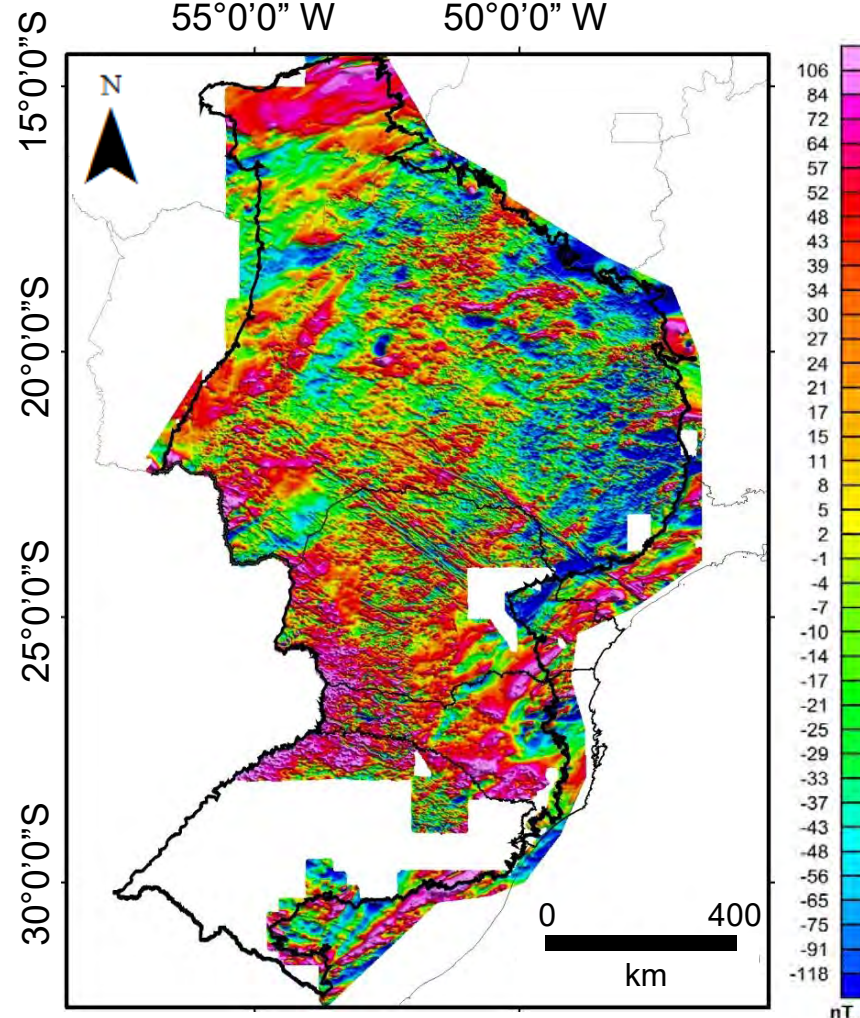
Bouguer Anomaly

54°0'0" W 50°0'0" W

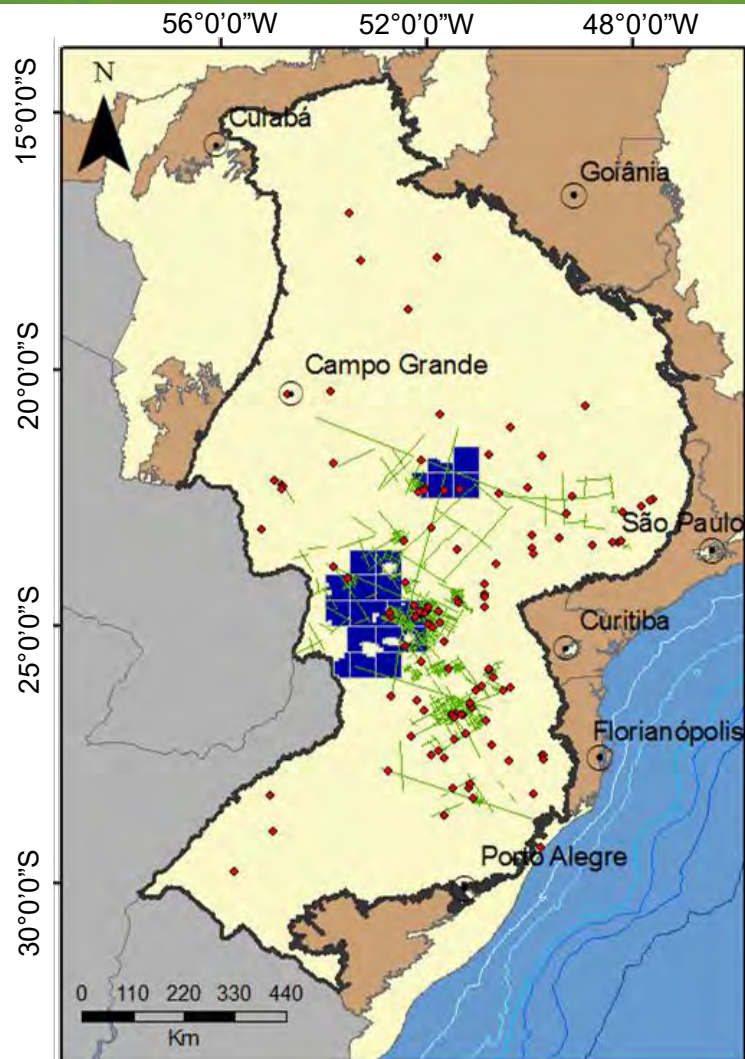


Magnetic Anomaly

55°0'0" W 50°0'0" W



Available Data



124 wells drilled

1 well/ ~10,000 km²

28% of wells with positive results

22 with gas or oil shows

10 uncommercial accumulations

**Barra Bonita commercial accumulation with 2
wells that produced gas during test**

Legend



Capitals



Exploration wells

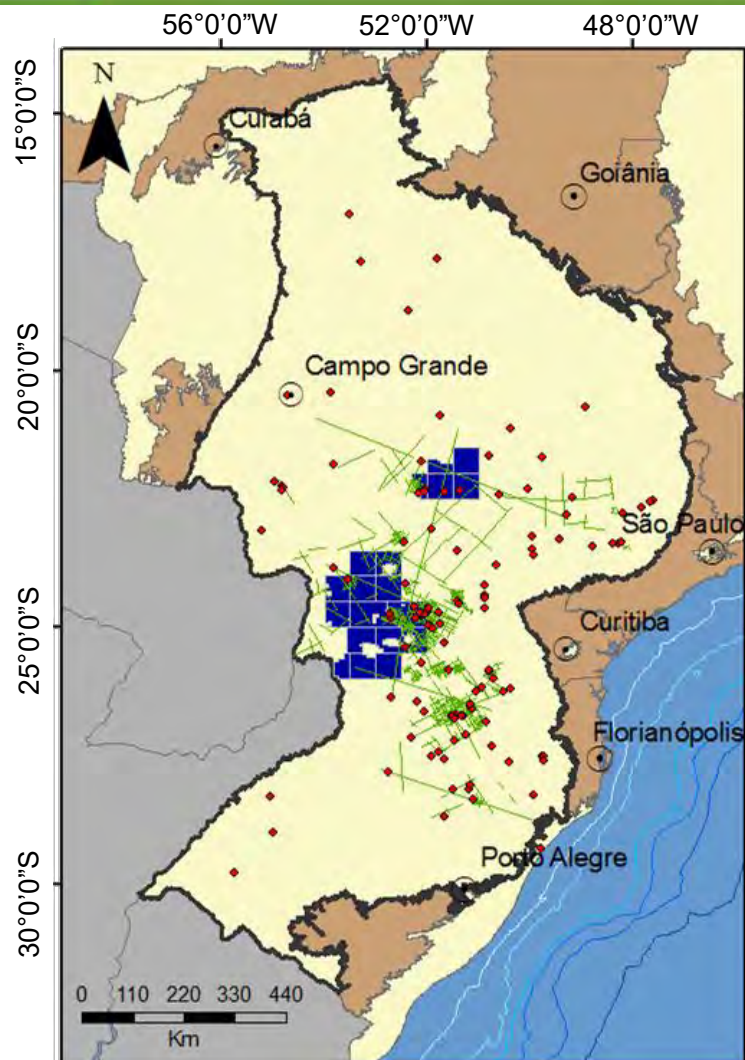


2D Public Seismic



R12 blocks

Available Data



2D Public Seismic (Post-Stack): 22,805 km

3D Public Seismic (Post-Stack): 175 km²

Legend



Capitals



Exploration wells

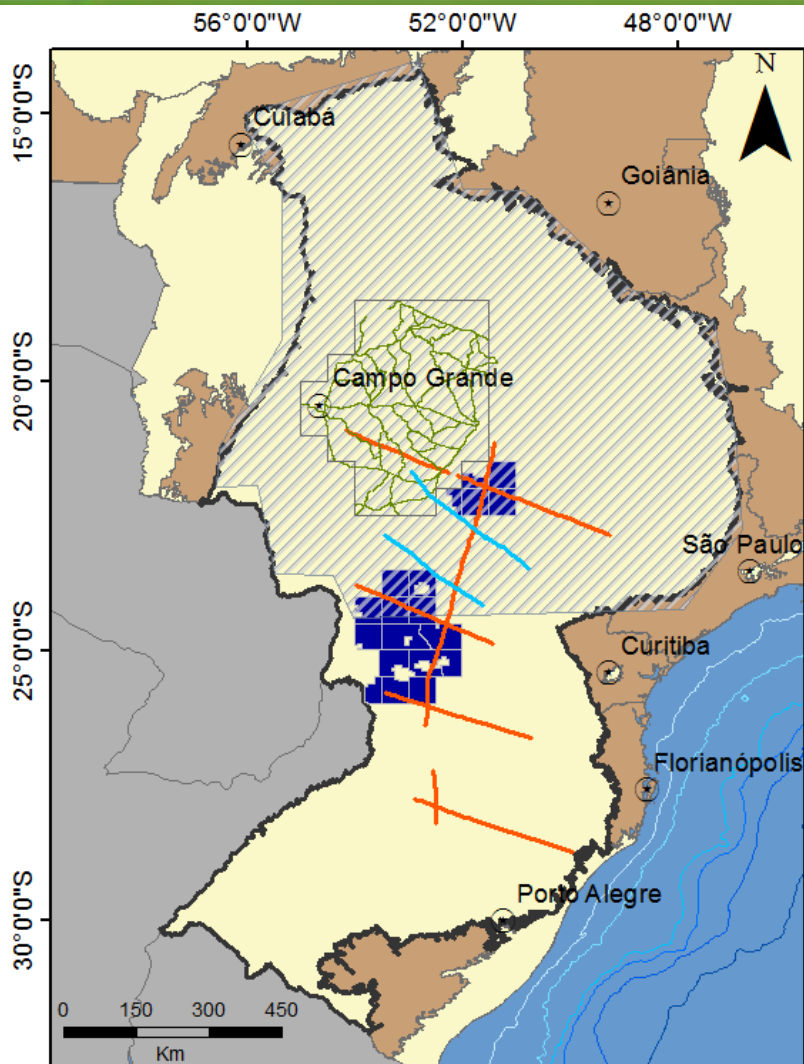


2D Public Seismic



R12 blocks

Pluriannual Plan and ANP Investments












Investments: ~ R\$ 165 millions

2D Seismic: ~ 2,120 km

Airbone Surveys: ~ 892,000 km²

Legend

-  Capitals
-  Magnetotelluric (in progress)
-  Vibroseis 2D Seismic (in progress)
-  2D Seismic (completed)
-  Airbone surveys
-  Blocks on offer
-  Basement
-  Parana basin
-  South America

Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

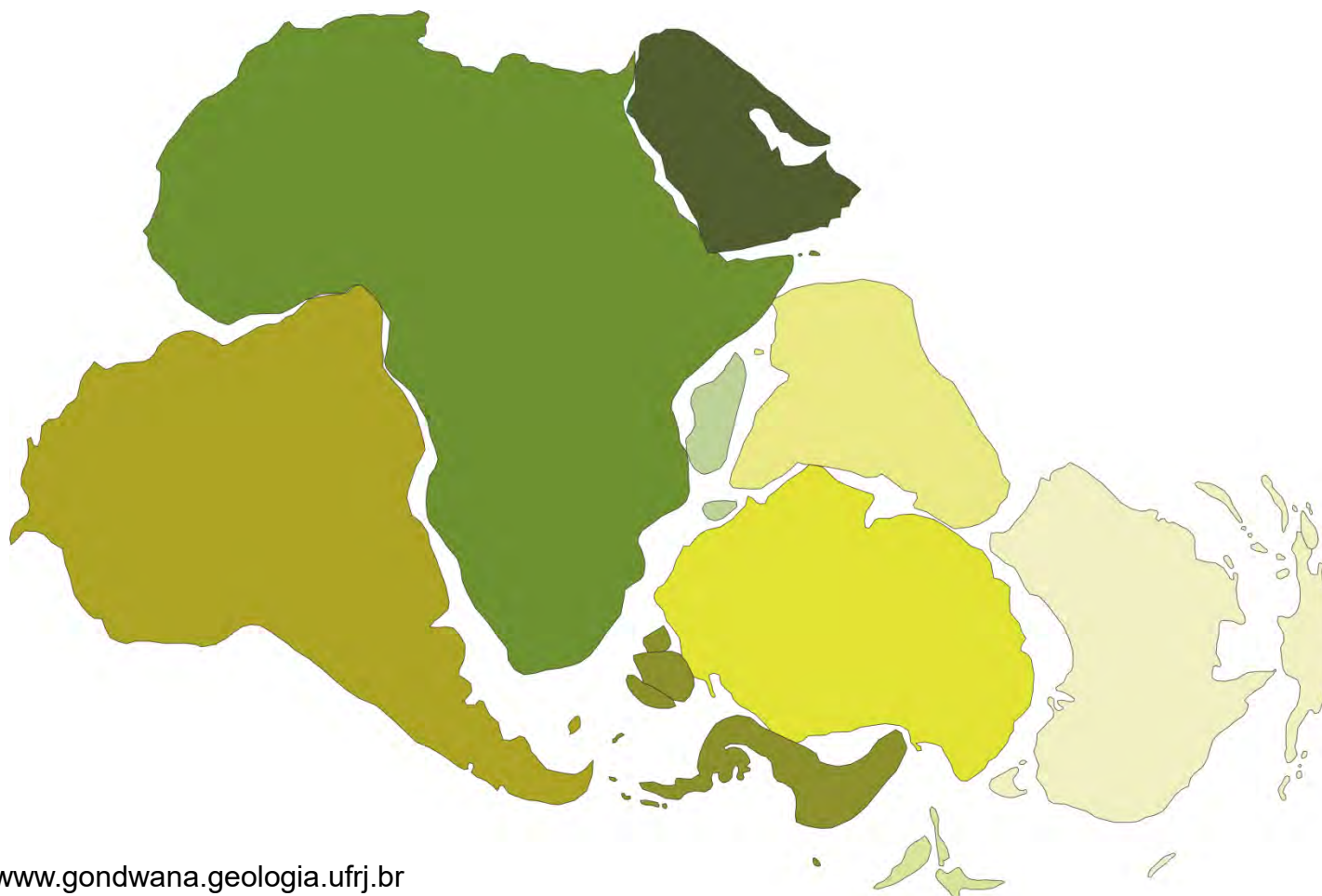
Plays

Area on Offer

Final Remarks

Gondwana Paleocontinent

Cycles of basin subsidence are related to orogenic episodes

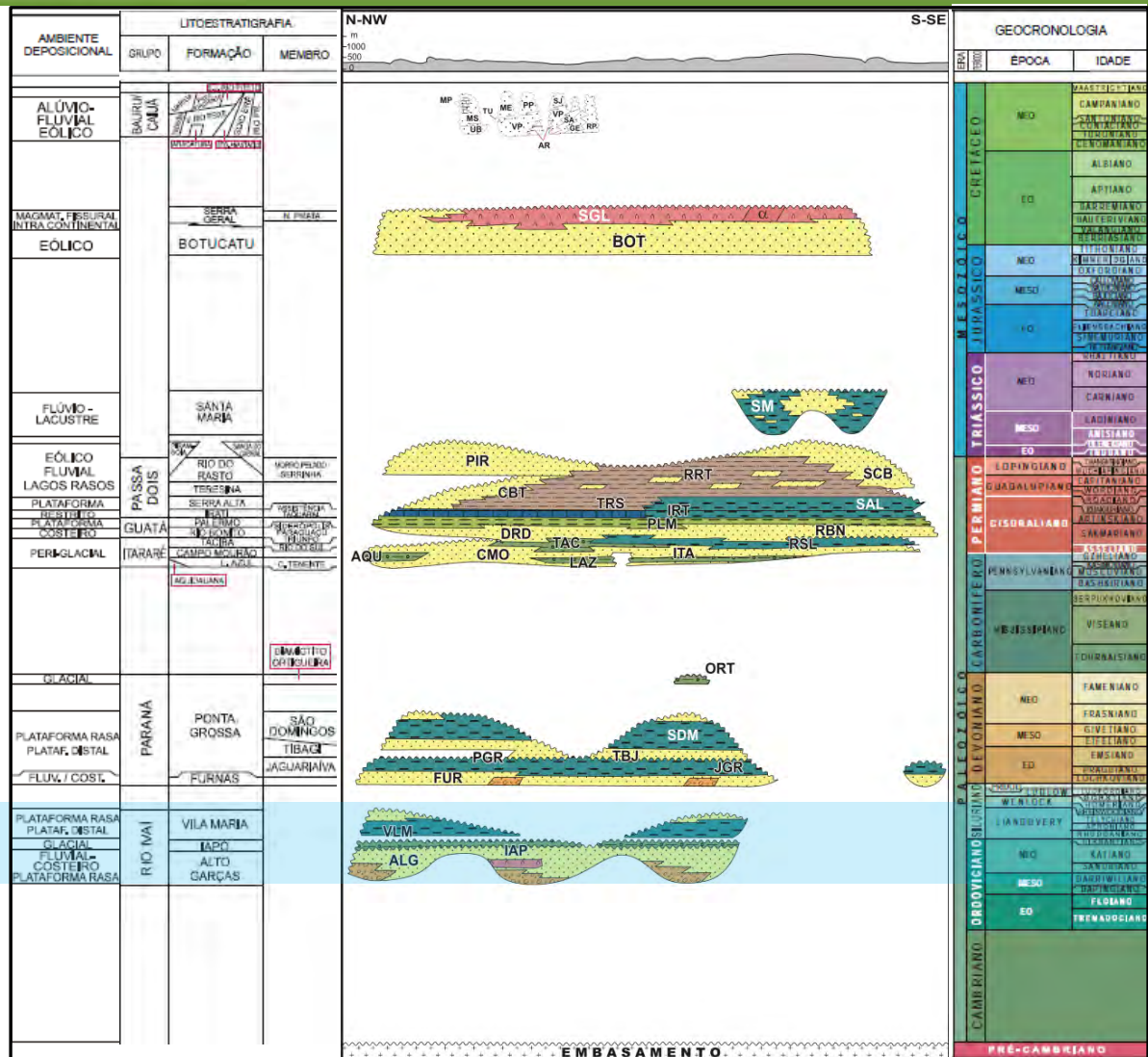


Stratigraphic Evolution

First Transgressive-Regressive Cycle

Mainly Marine Sedimentation

Rio Ivai Supersequence
(Ordovician/Silurian)





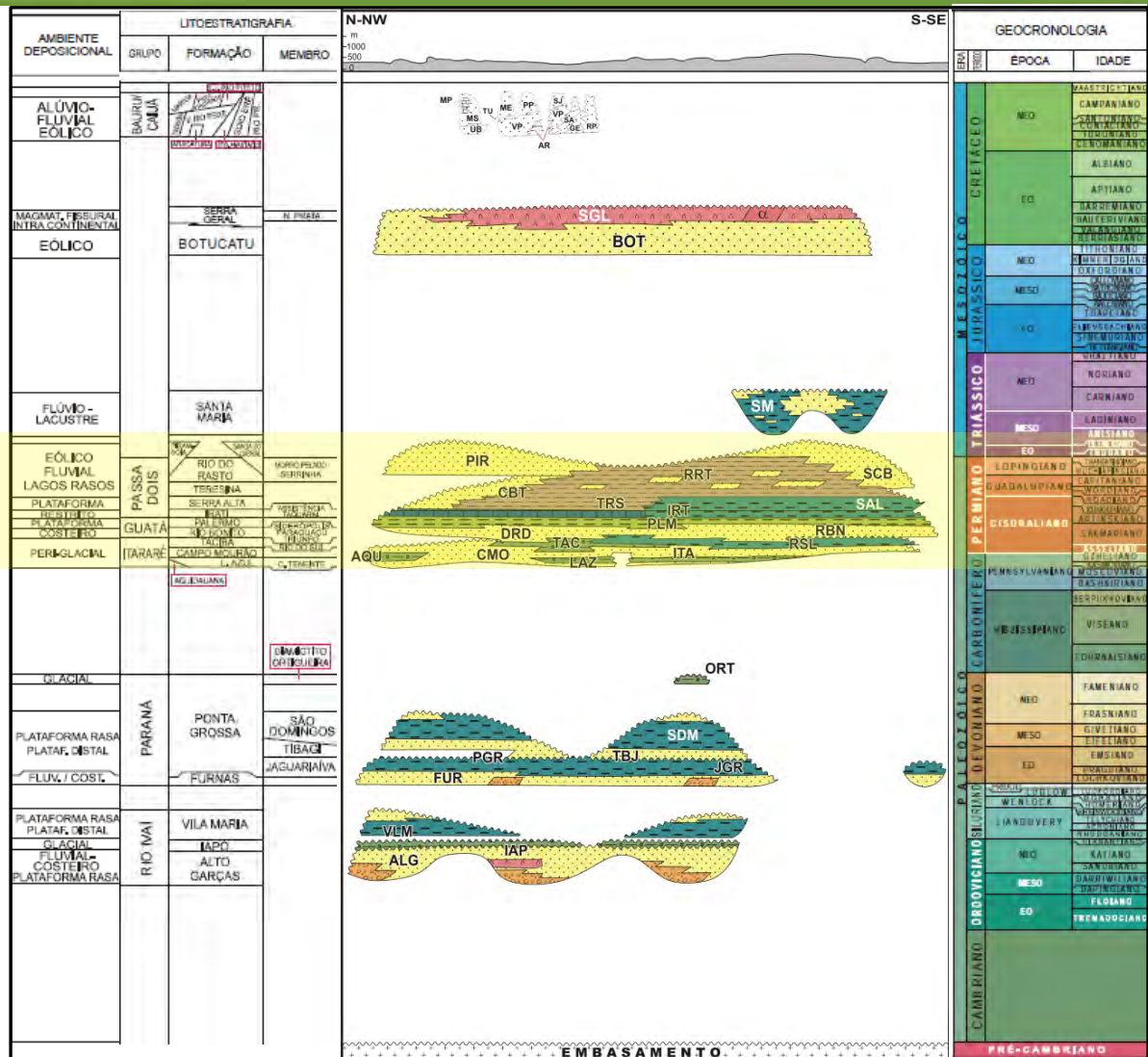
Stratigraphic Evolution

Inland Sea

Beginning of Continentalization

Gondwana I Supersequence

(Permian/Carboniferous)

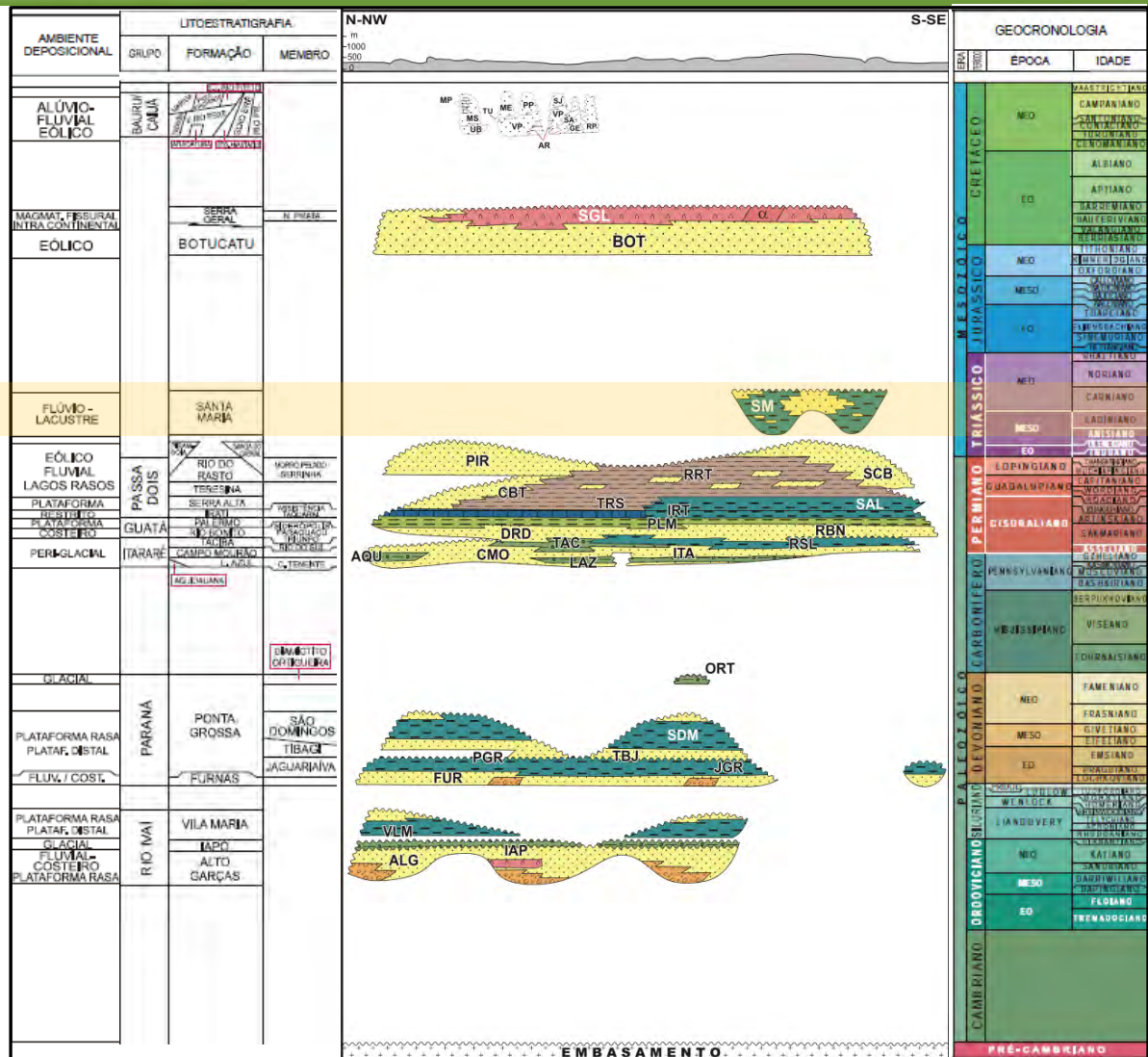


Stratigraphic Evolution

Intracratonic Basin

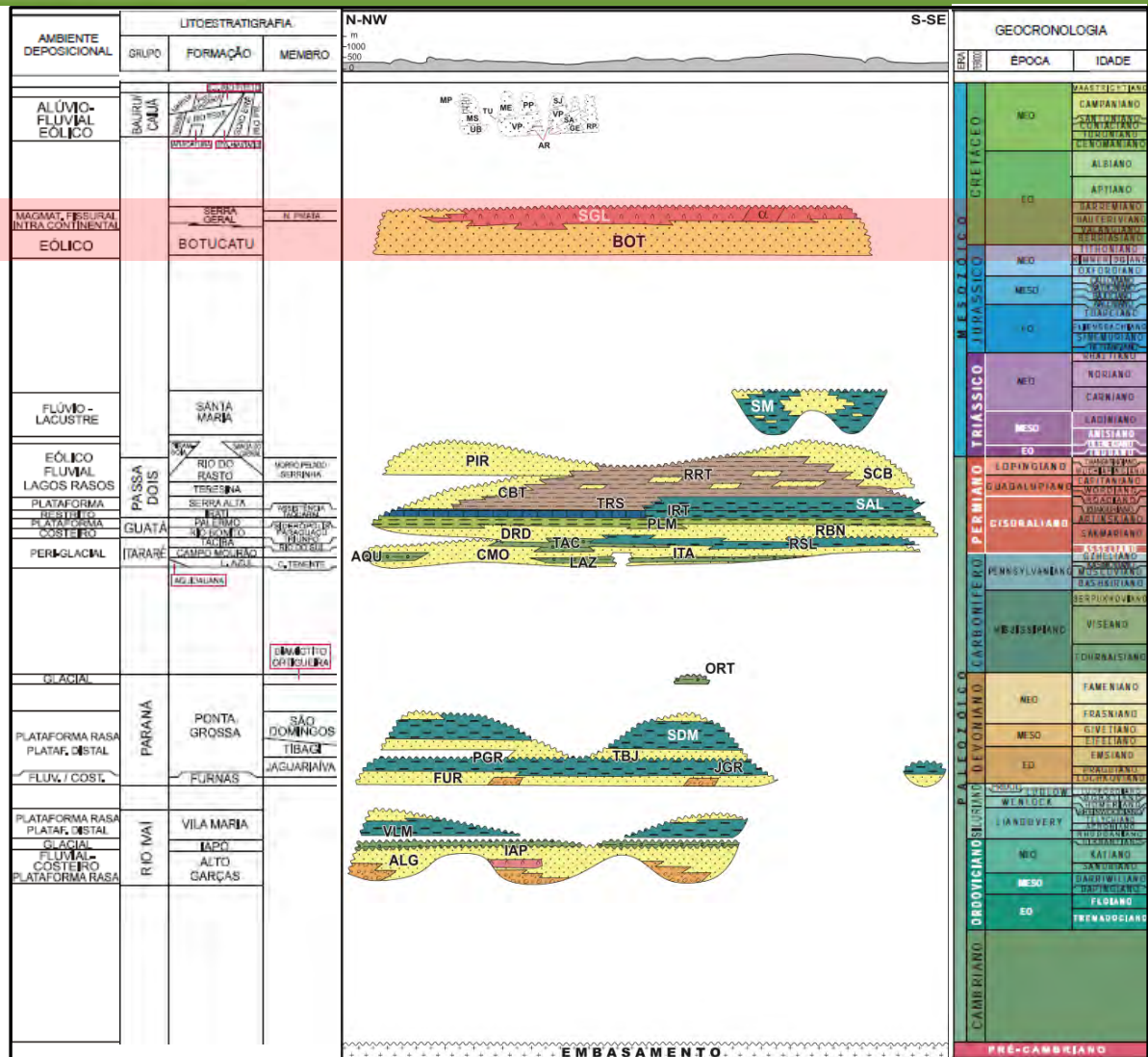
Gondwana II Supersequence

Triassic



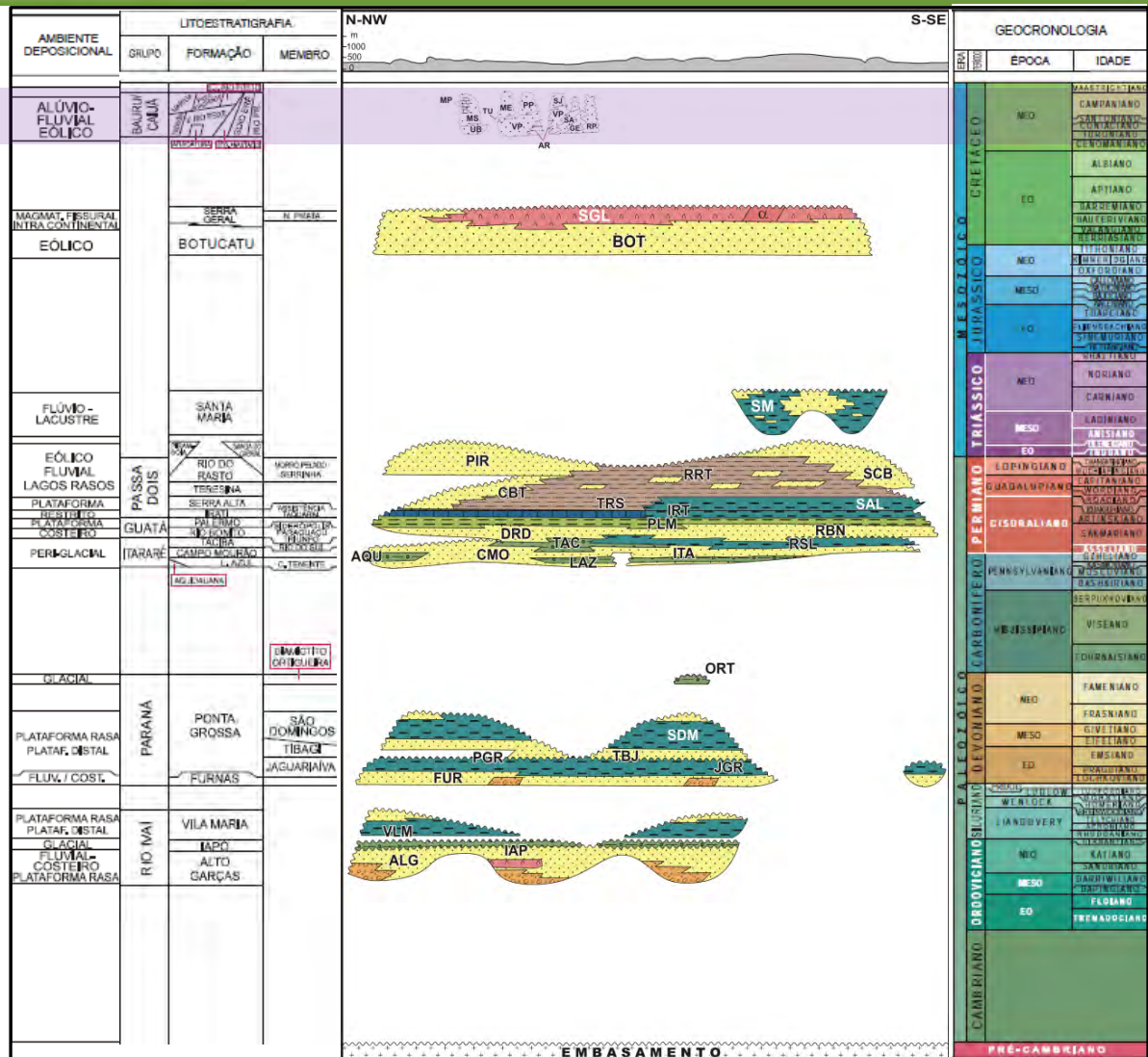
Stratigraphic Evolution

Gondwana III Supersequence (Jurassic/Early Cretaceous)

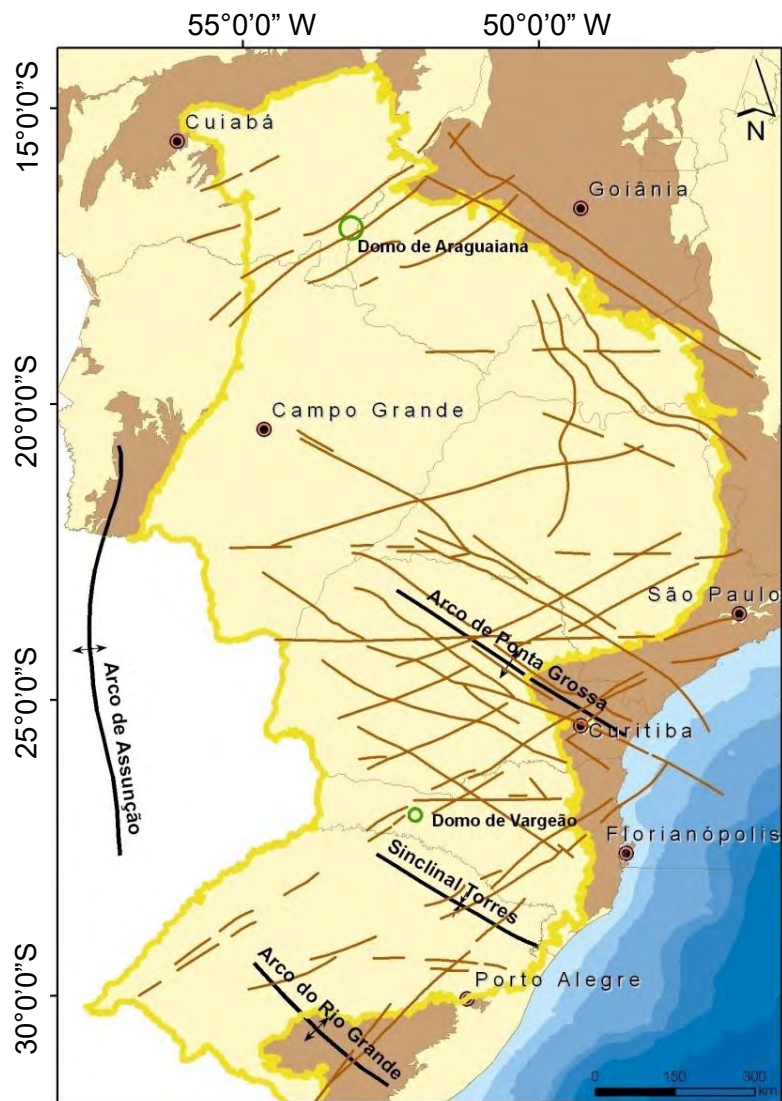


Stratigraphic Evolution

Bauru Supersequence Cretaceous



Structural Geology



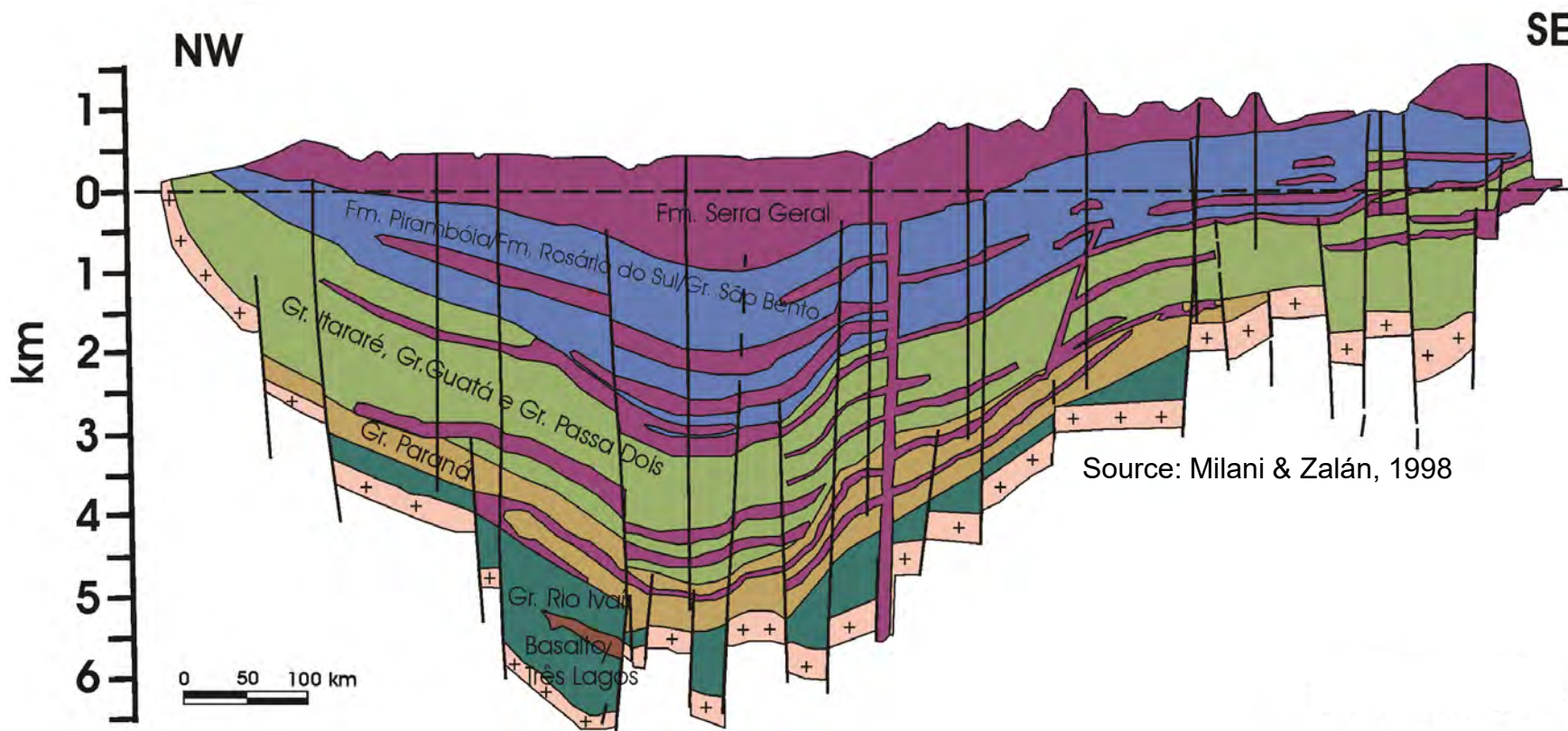
Structural lineaments (Zalán, 1990)

Surrounded by Arches

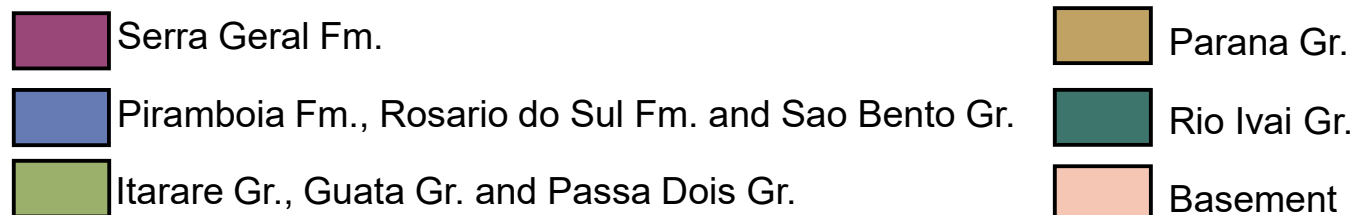
**Predominant Fracture Zones in NW-SE
and NE-SW Directions**

**E-W Lineaments Formed
Later**

Schematic Geological Section



Source: Milani & Zalán, 1998



Agenda

Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

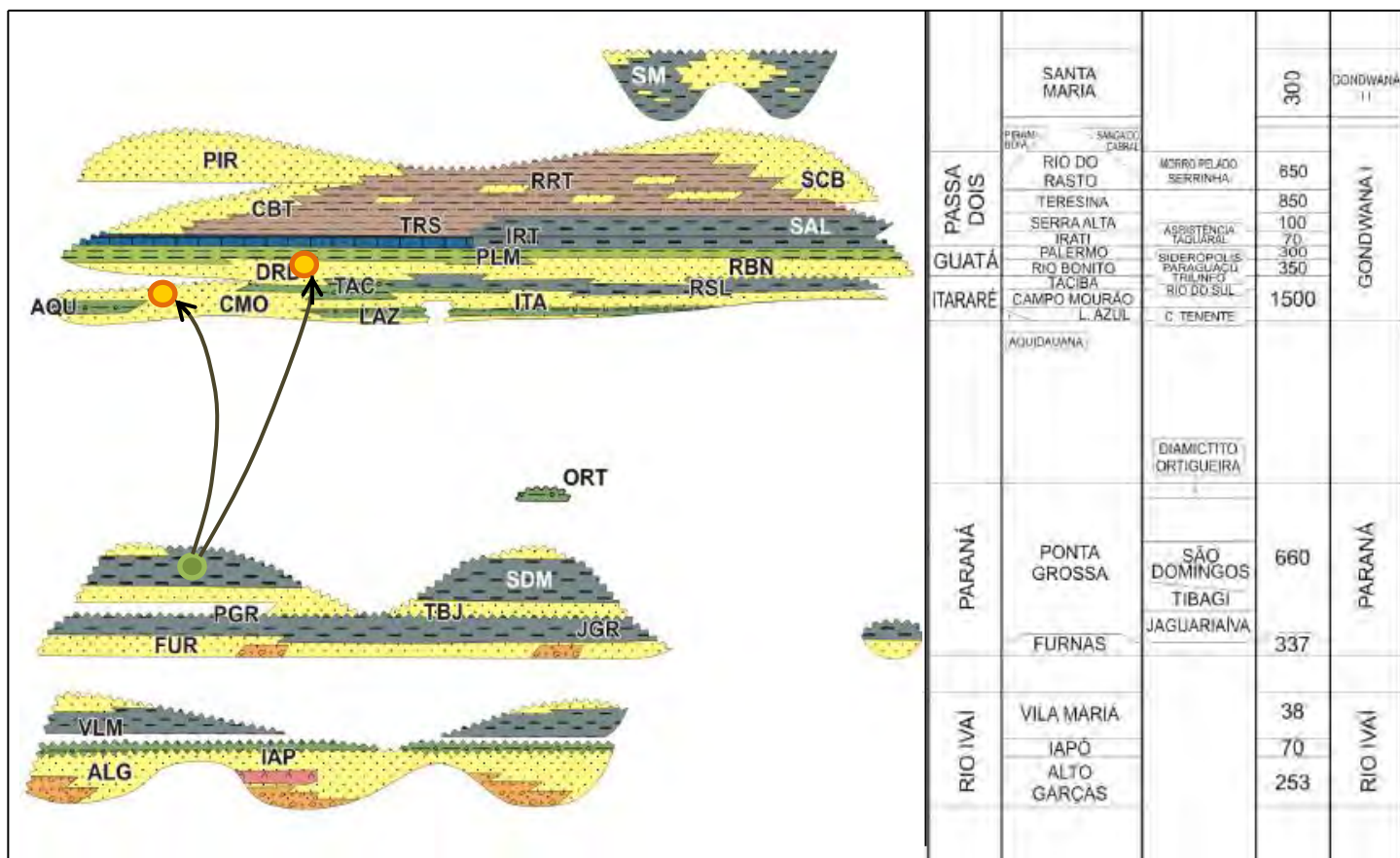
Plays

Area on Offer

Final Remarks

Petroleum Systems

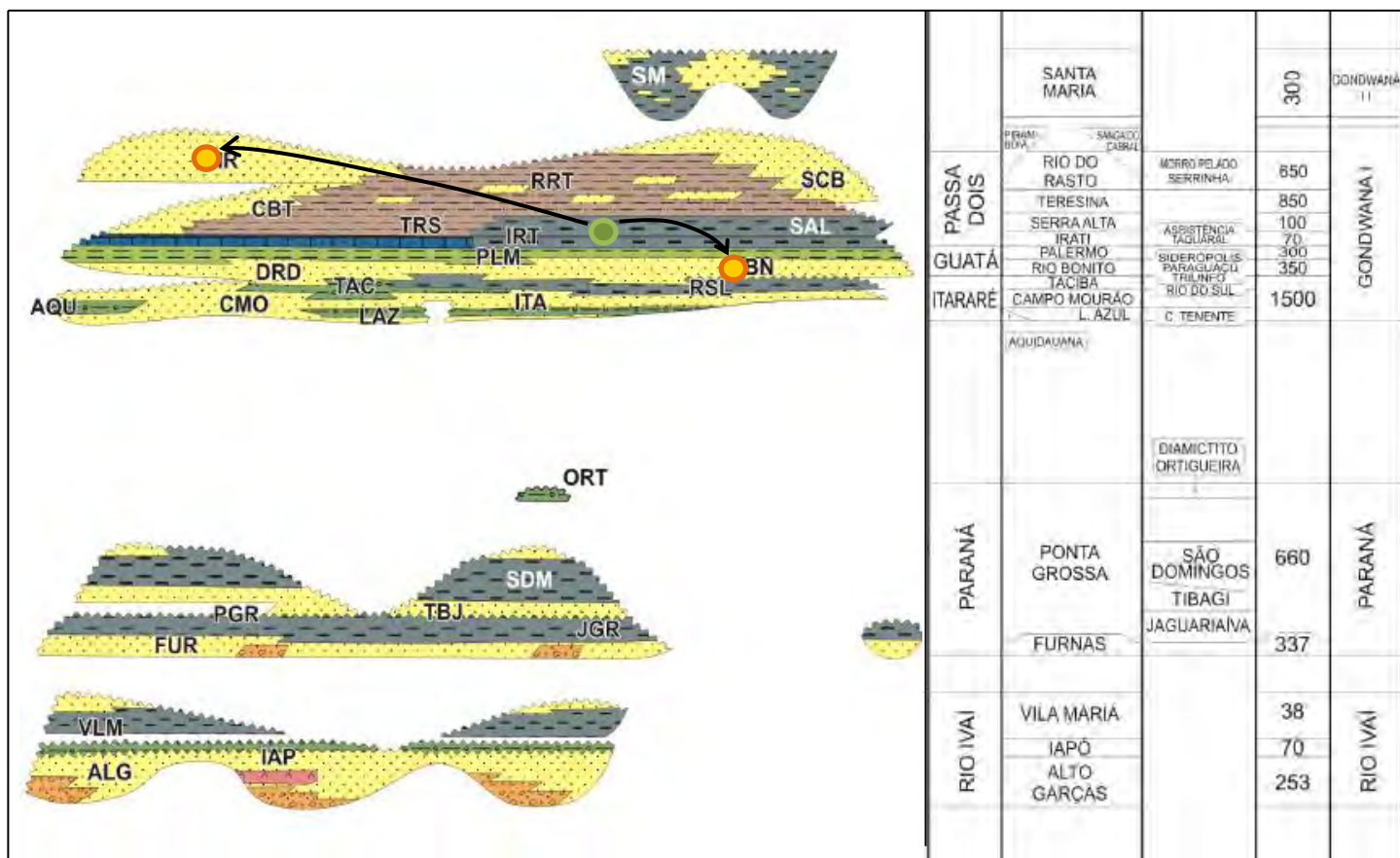
Ponta Grossa – Itararé (!)



Stratigraphic Diagram: Milani *et al.*, 2007

Petroleum Systems

Irati – Rio Bonito/Piramboia (!)



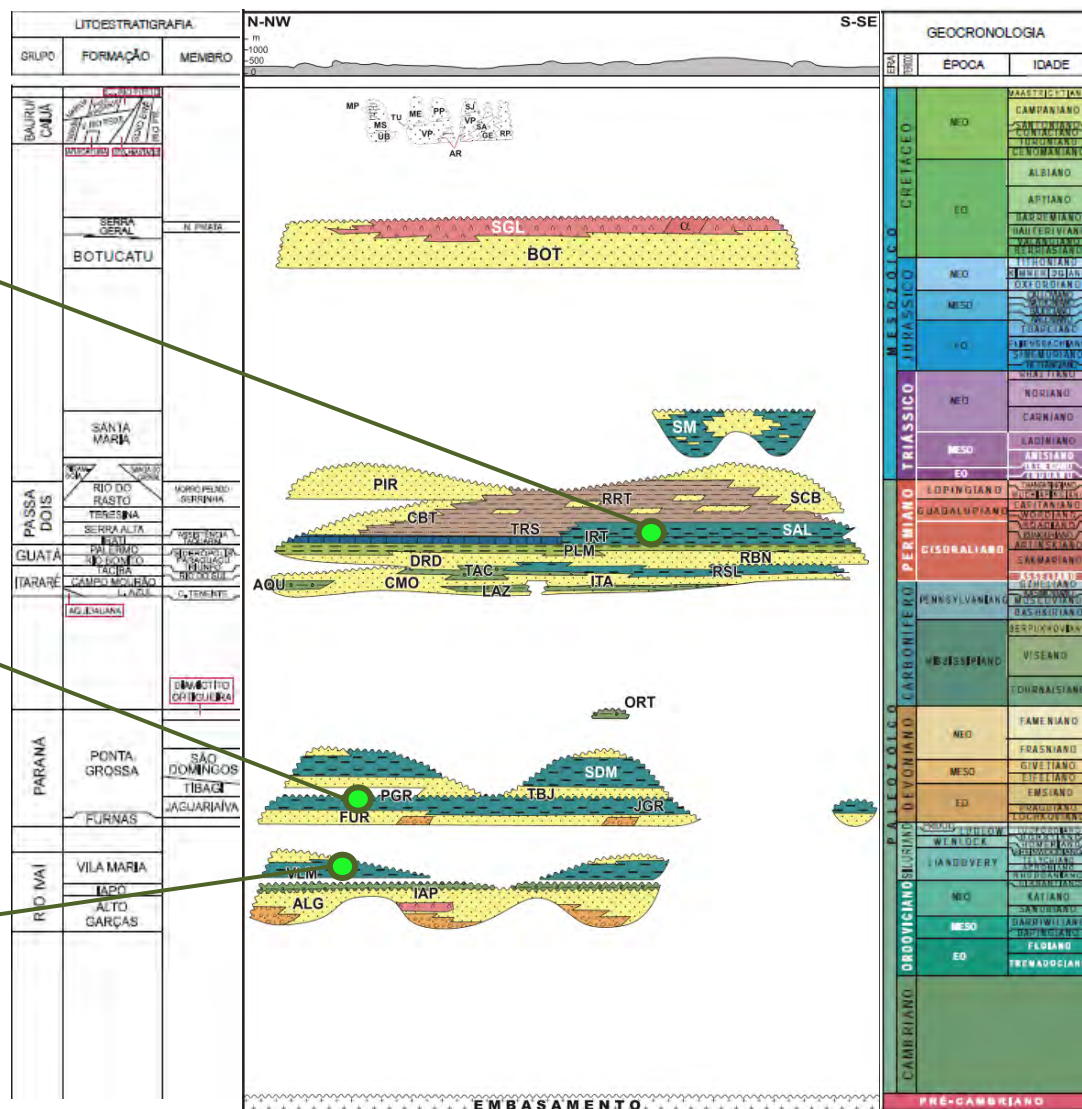
Stratigraphic Diagram: Milani *et al.*, 2007

Source Rocks

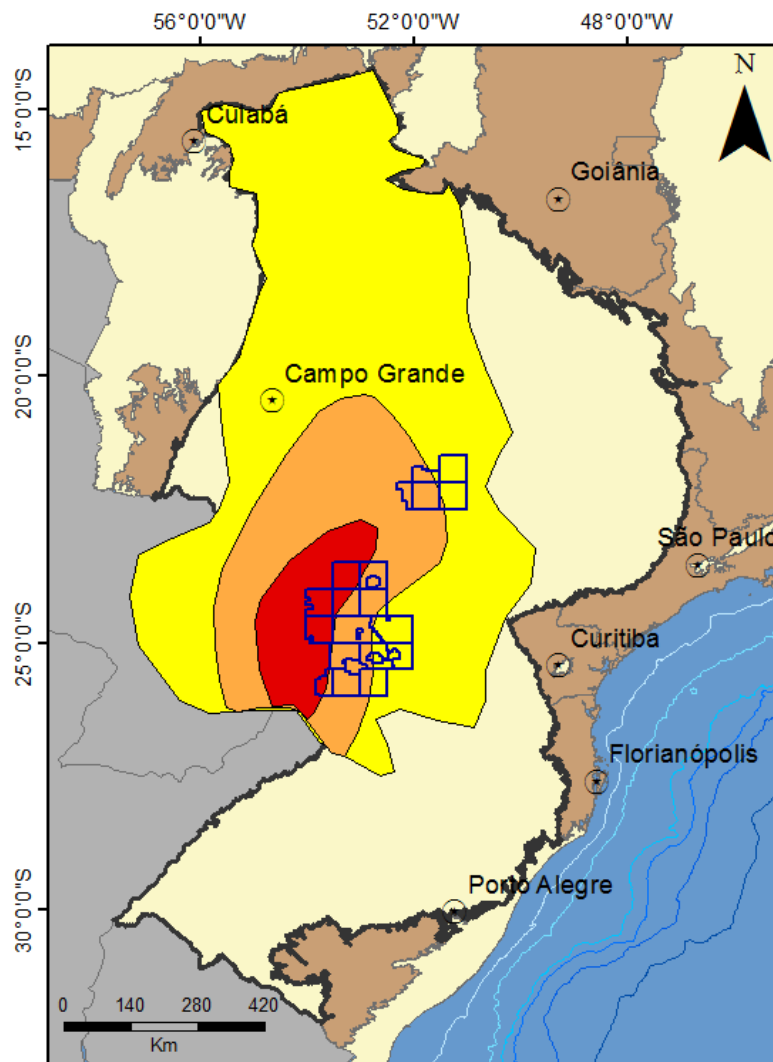
Permian
(Irati Fm.)
TOC = 1 – 13%
Peaks of 23%
Type I

Devonian
(Ponta Grossa Fm.)
TOC ~ 1%
Peaks of 3%
Type II

Silurian
(Vila Maria Fm.)



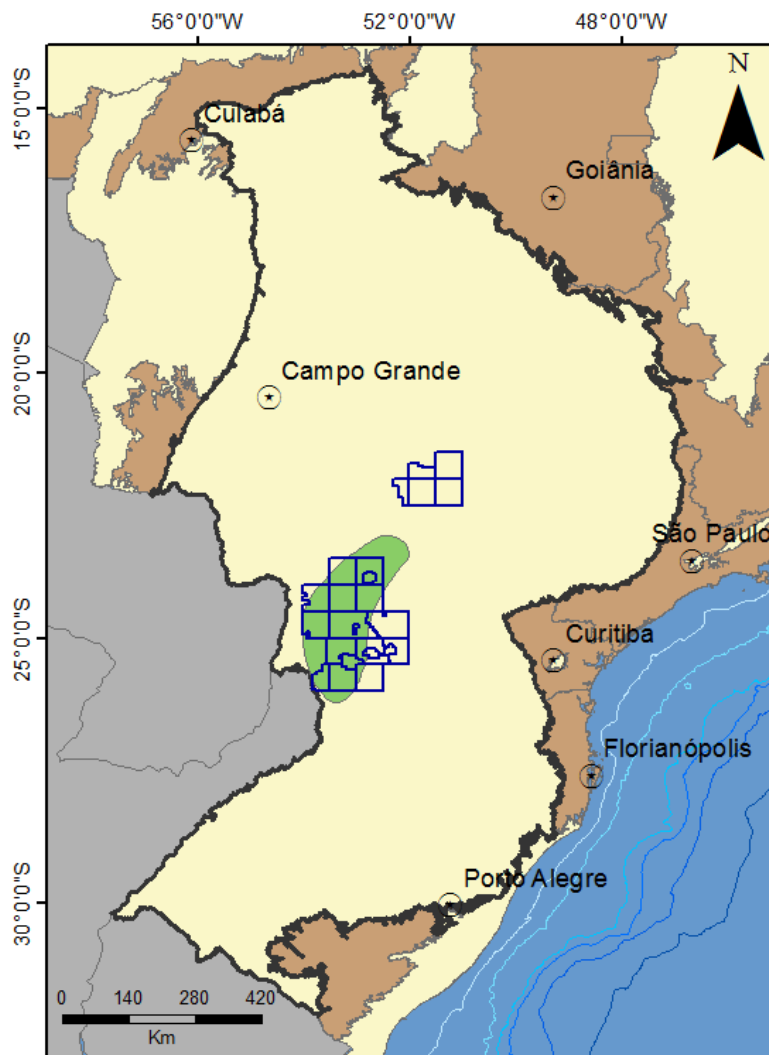
Source Rocks







Burial Maturation Ponta Grossa Fm.



Source Rocks



Burial Maturation Irati Fm.

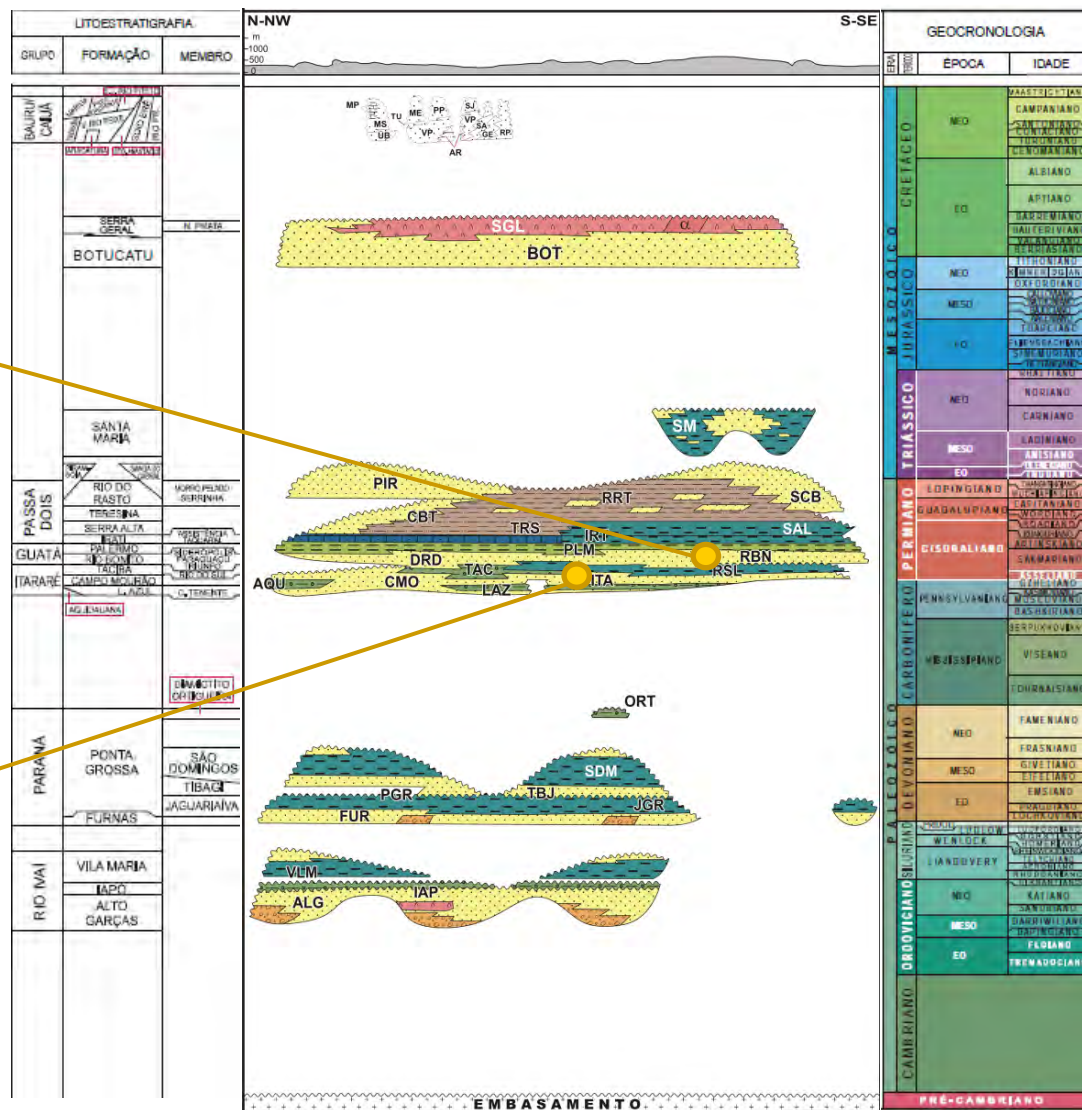
-  Irati Fm.
-  Blocks on offer
-  Basement
-  Parana basin
-  South America

Reservoirs

Main

Early Permian
(Rio Bonito Fm.)
Sandstones
Ø ~ 20%

**Late Carboniferous/
Early Permian
(Itarare Gr.)
Sandstones
Ø = 6-16%**



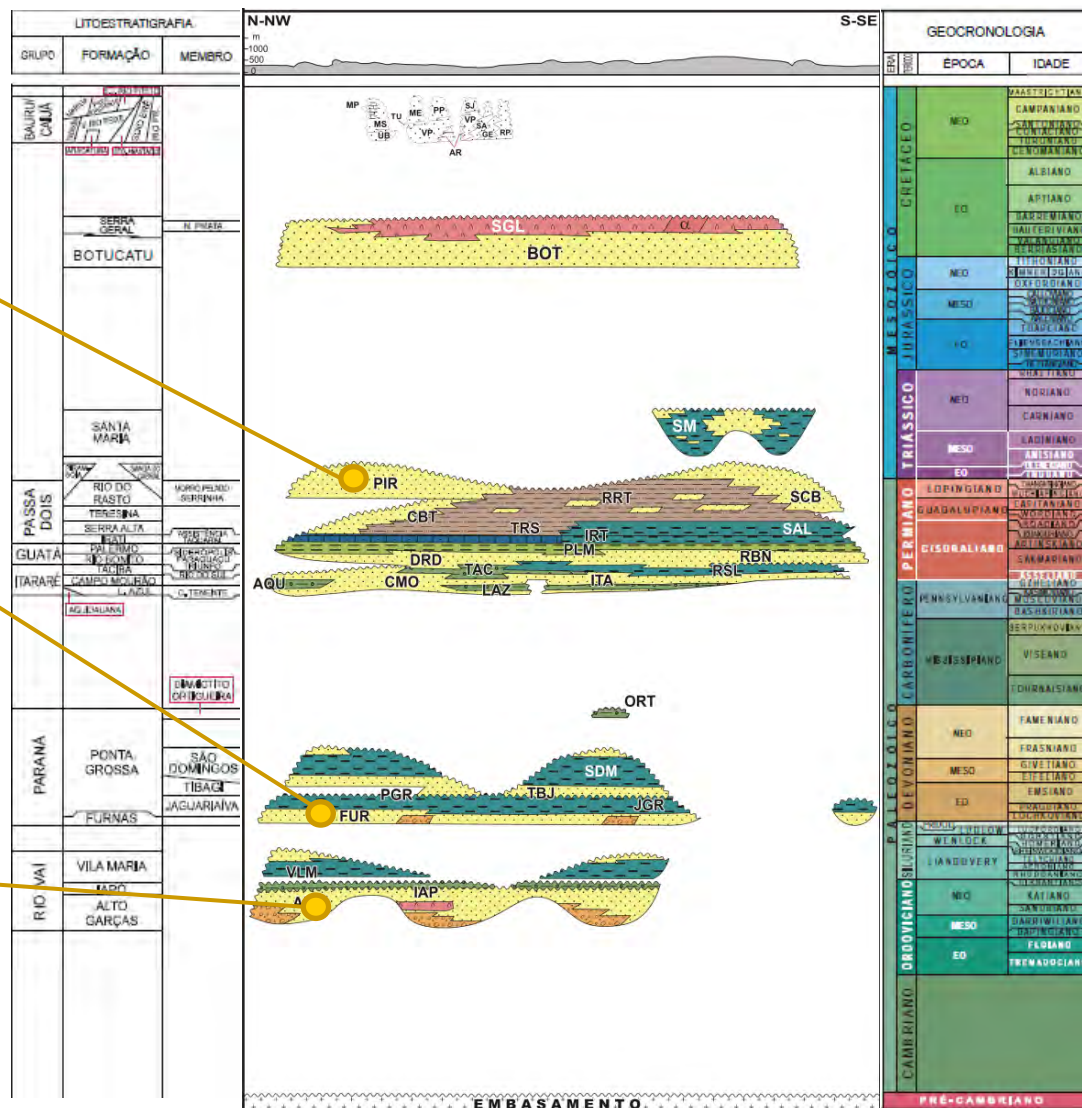
Reservoirs

Secondary

**Late Permian/
Early Triassic**
(Piramboia Fm.)
Sandstones

Devonian
(Furnas Fm.)
Sandstones

Ordovician
(Alto Garcas Fm.)
Sandstones



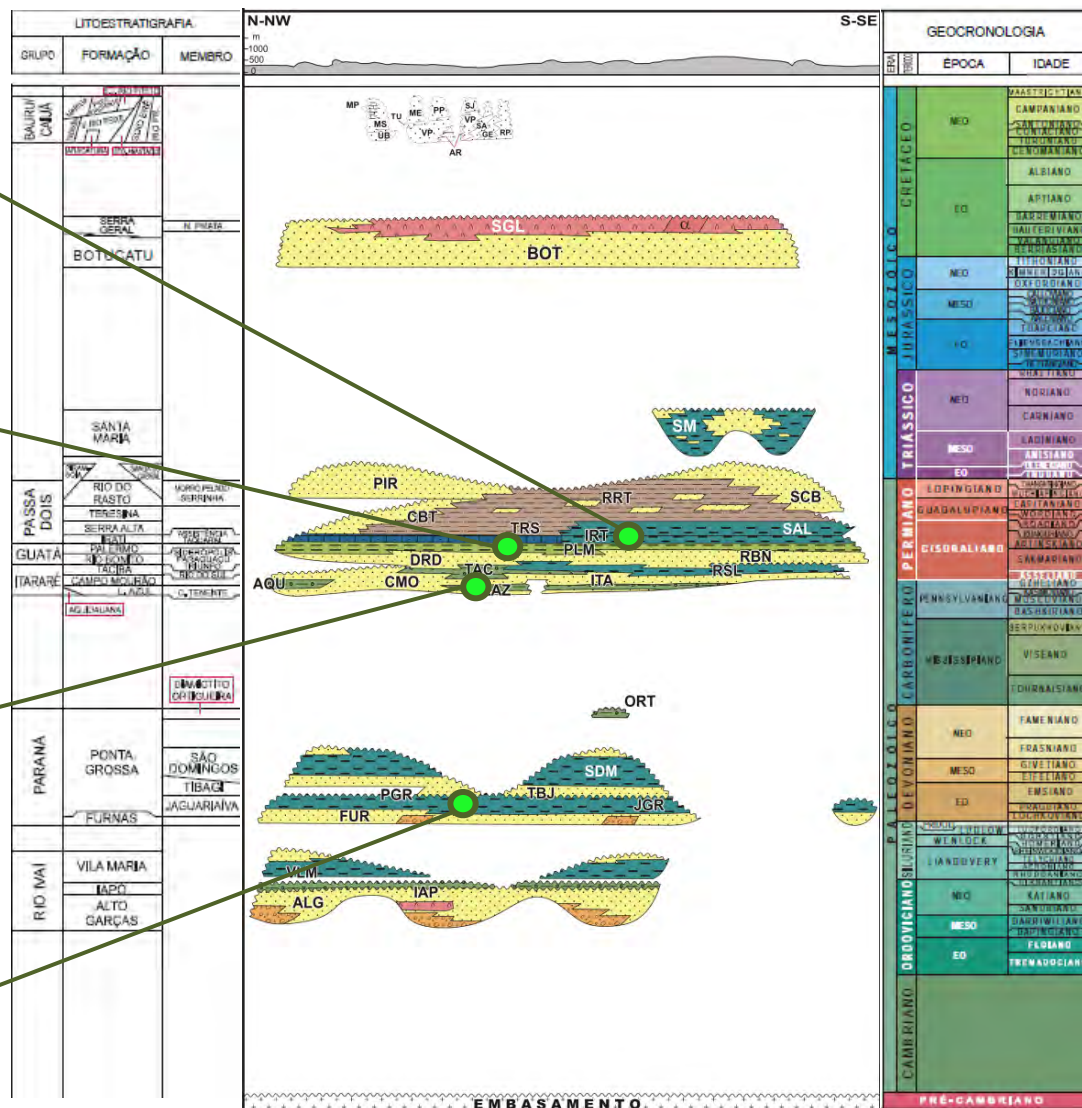
Seals

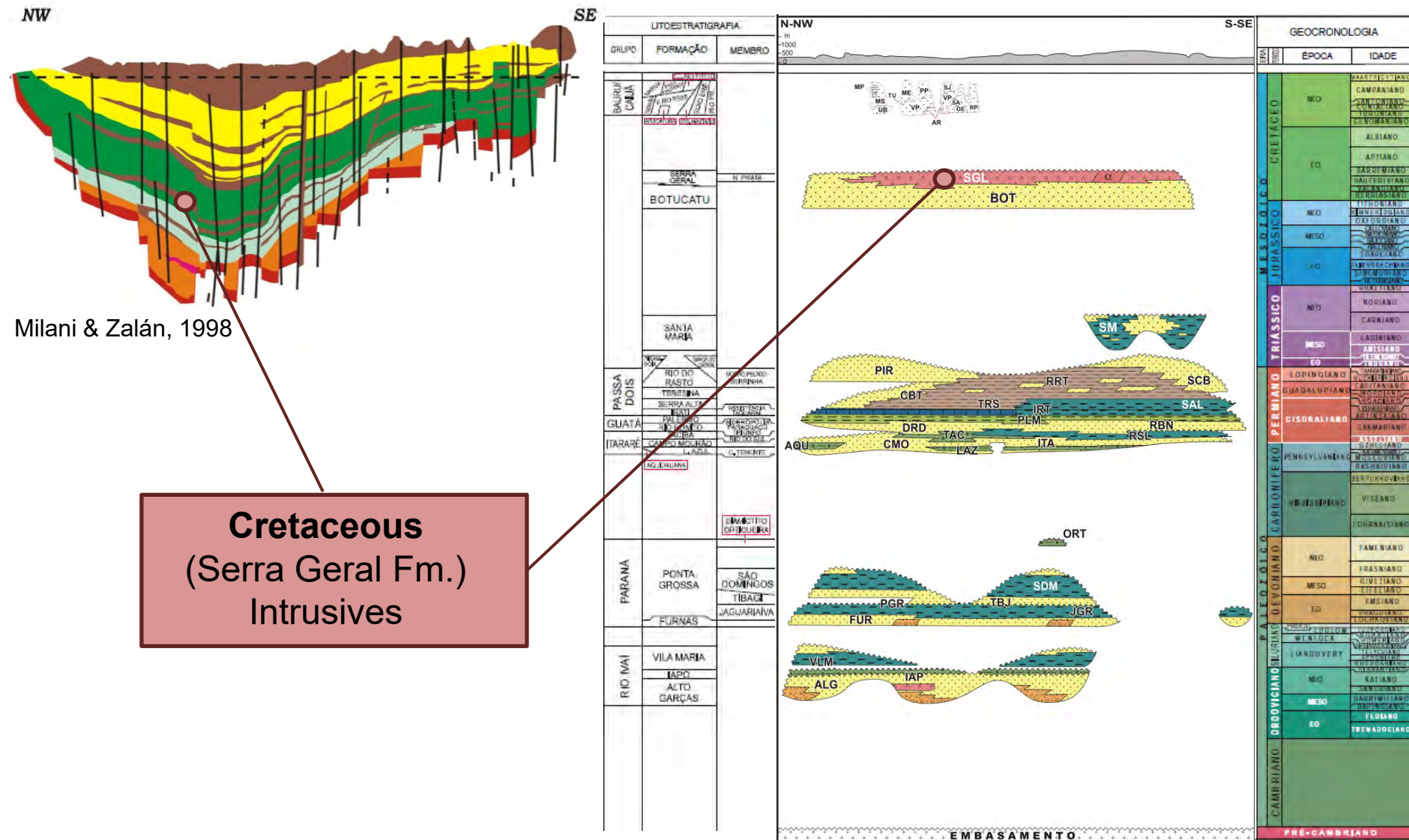
Permian
(Irati Fm.)
Shales

Permian
(Palermo Fm.)
Shales

**Late Carboniferous/
Early Permian**
(Itarare Gr.)
Intraformational Shales

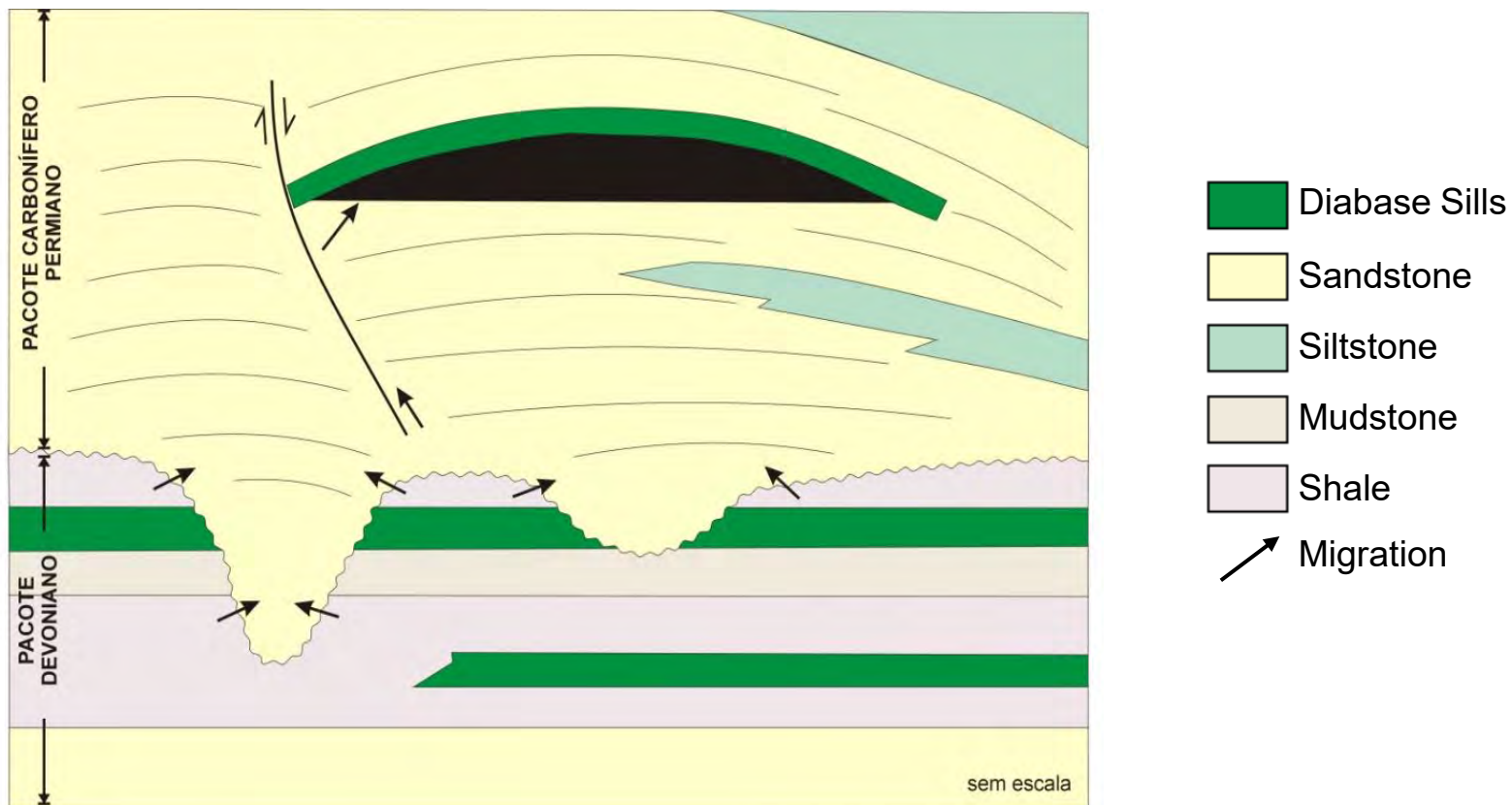
Devonian
(Fm. Ponta Grossa)
Shales





Traps and Migration

Schematic Model of the Barra Bonita Accumulation



Milani & Catto, 1998

Plays

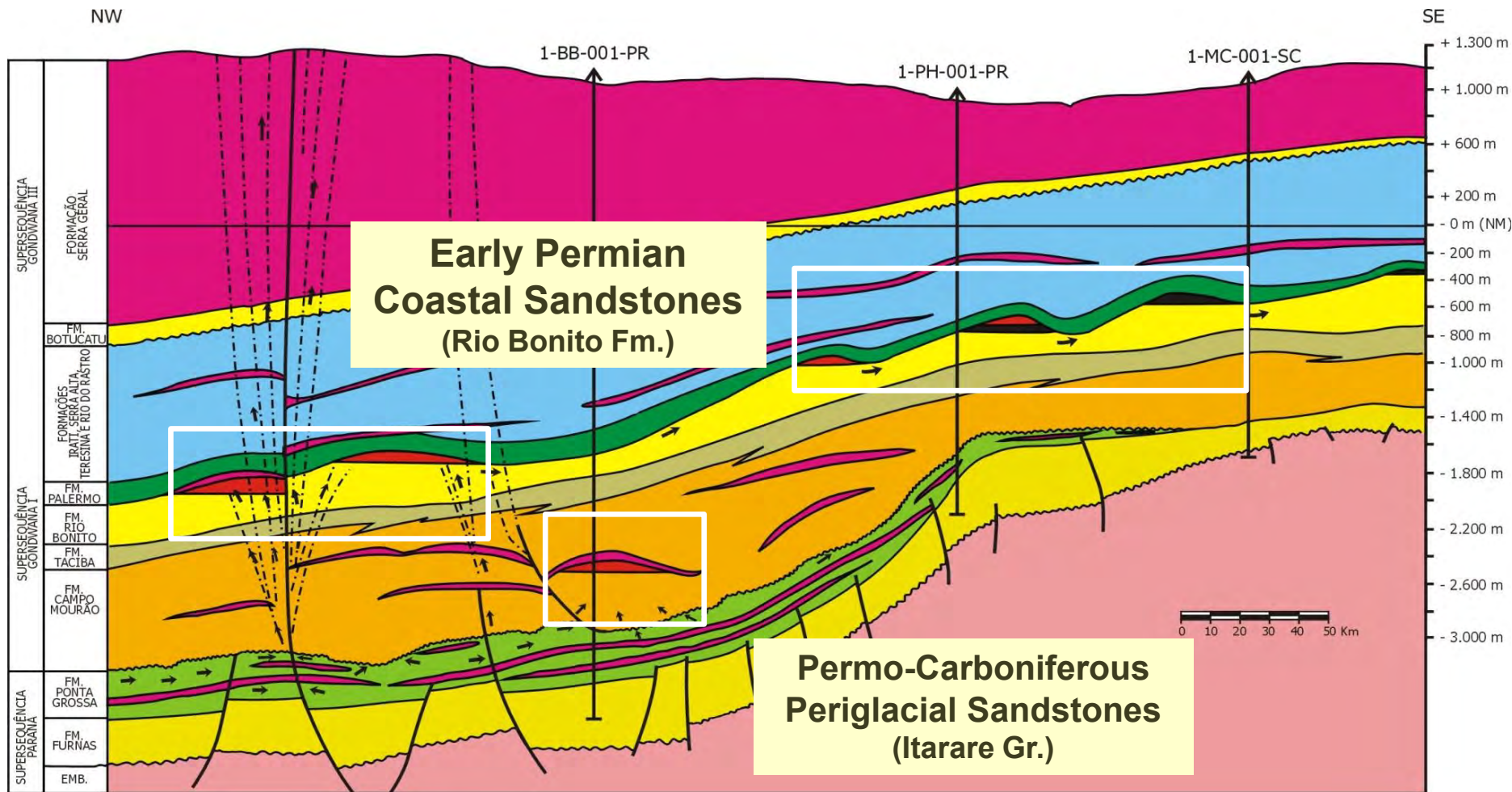
Plays	Sectors
Permo-Carboniferous Periglacial Sandstones	SPAR-CS and SPAR-CN
Early Permian Coastal Sandstones	



anp
National Agency
of Petroleum,
Natural Gas and Biofuels

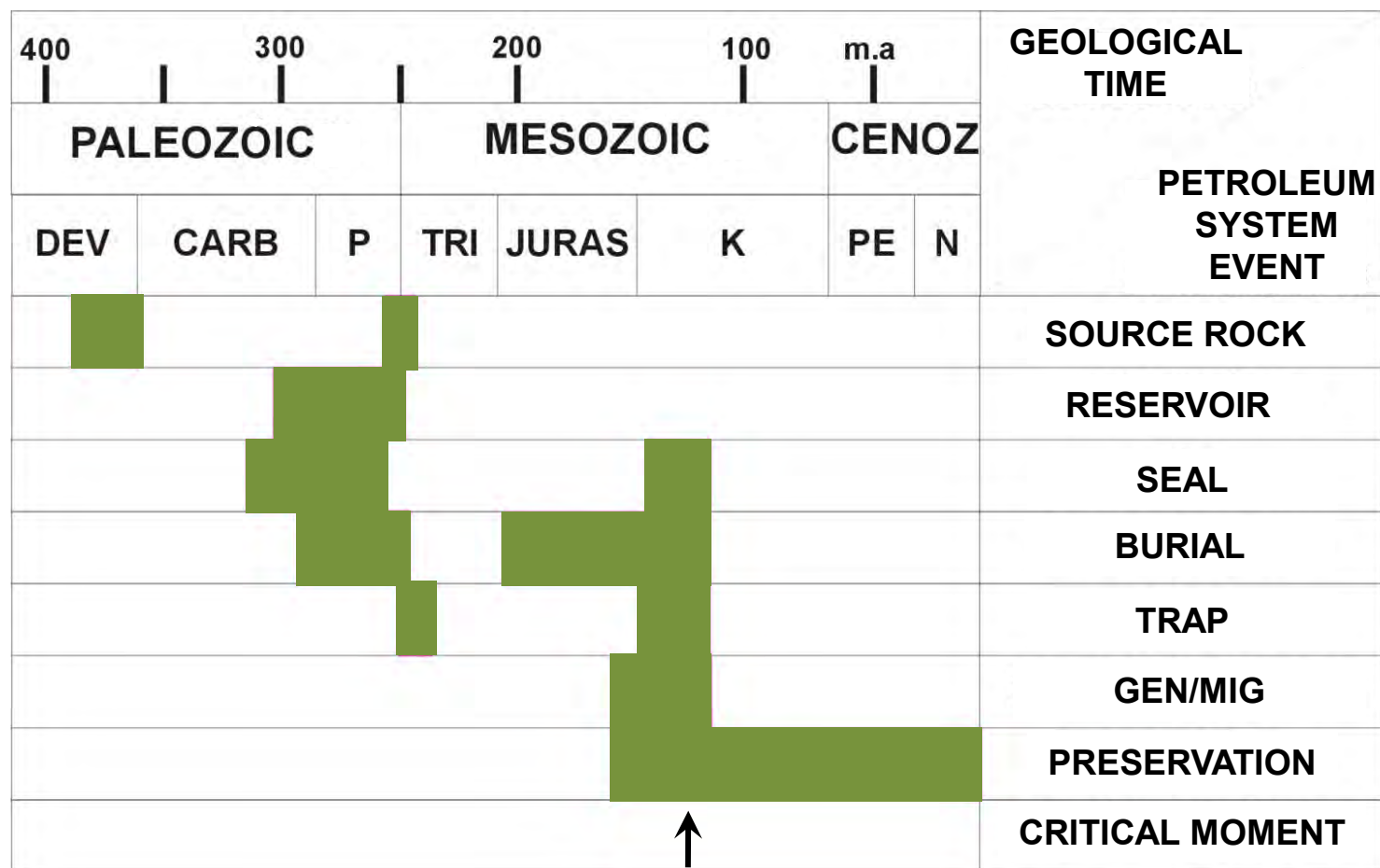
Brasil
12th Round
Oil & Gas Bidding Rounds

Plays



Catto & Zanoto, 1998

Event Chart



Source: Milani & Zalán, 1998

Agenda

Location

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Tectonostratigraphic Evolution

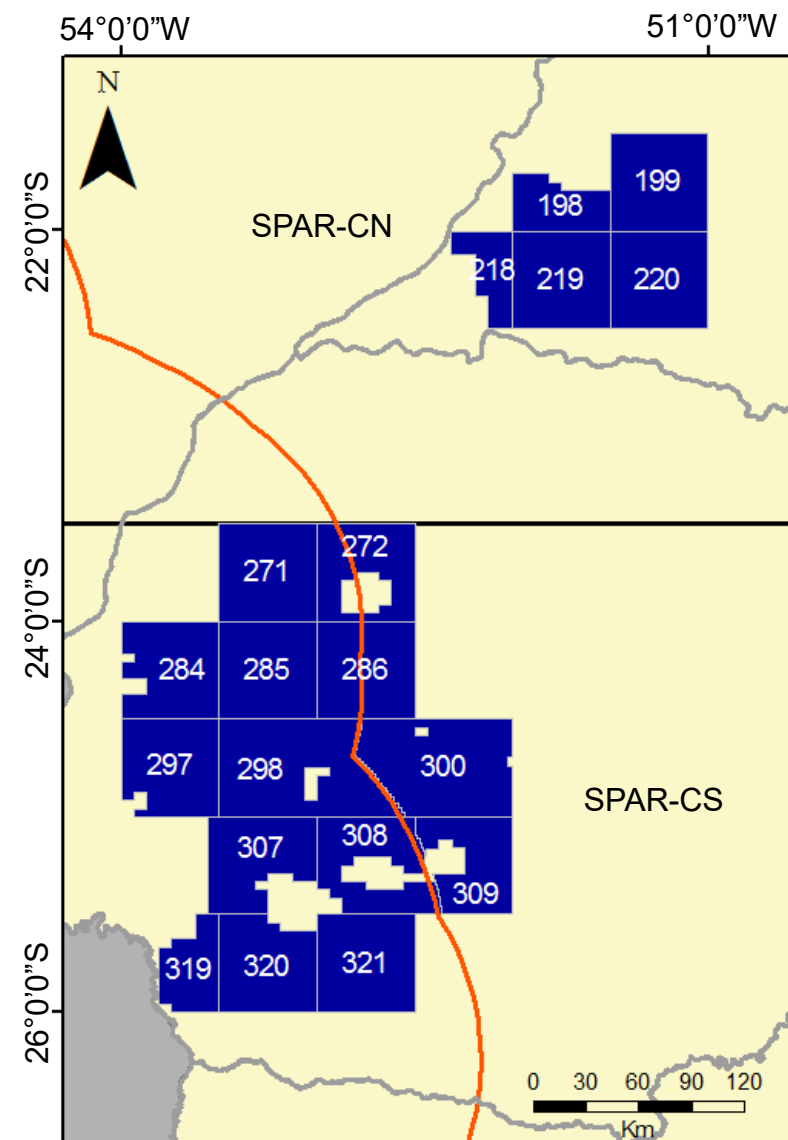
Petroleum Systems

Plays

Area on Offer

Final Remarks

Area on Offer



Legenda

-  Capitals
-  Border strip
-  State boundaries
-  Sectors
-  Blocks on offer
-  Basement
-  Parana basin
-  South America

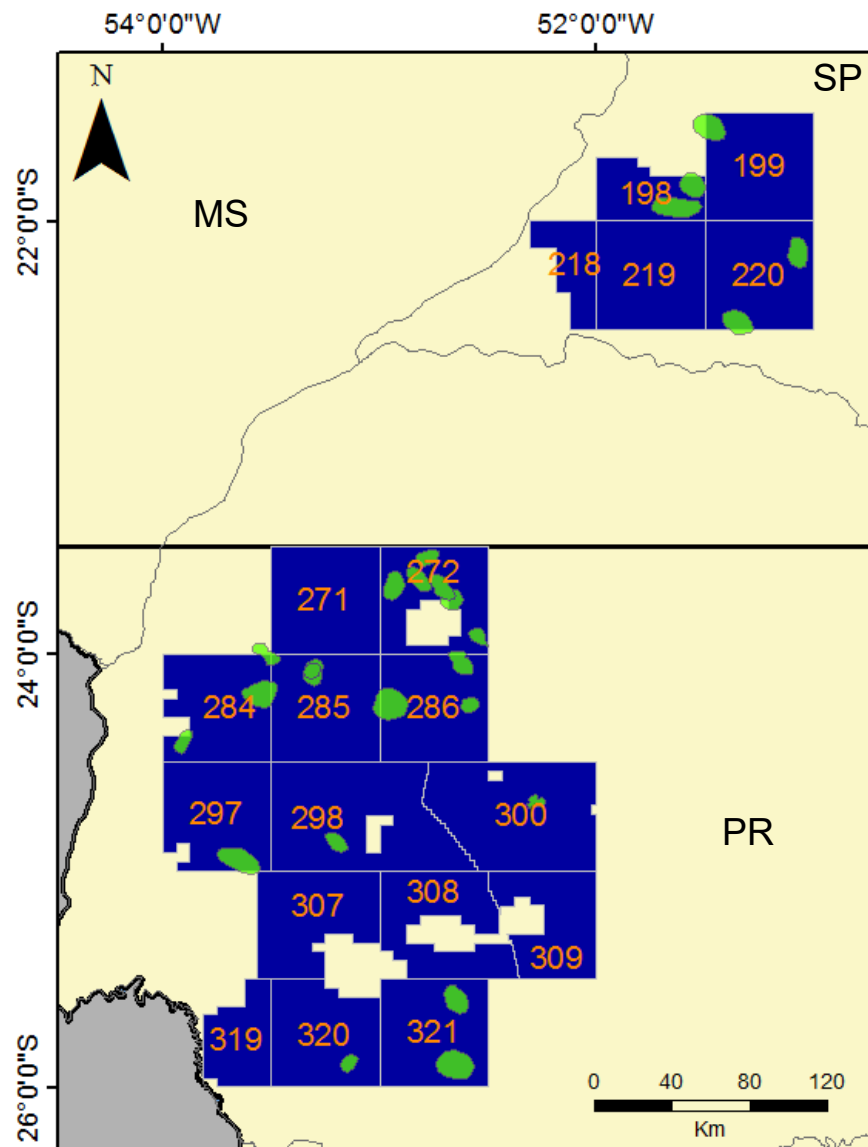
19 Exploration Blocks:
~ 49,370 km²

Sector SPAR-CS:
14 blocks (~ 38,270 km²)

Sector SPAR-CN:
5 blocks (~ 11,100 km²)

Border strip:
12 Blocks

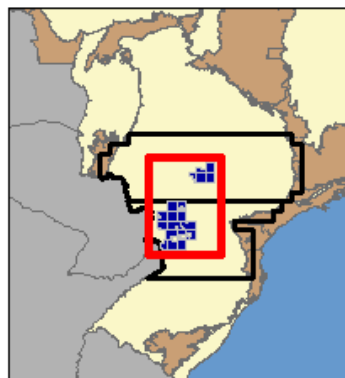
Leads



Leads
Rio Bonito Fm.
Itarare Gr.
Tibagi Mb.
Furnas Fm.

Legend

-  States
-  R12 Blocks
-  Sectors
-  Leads

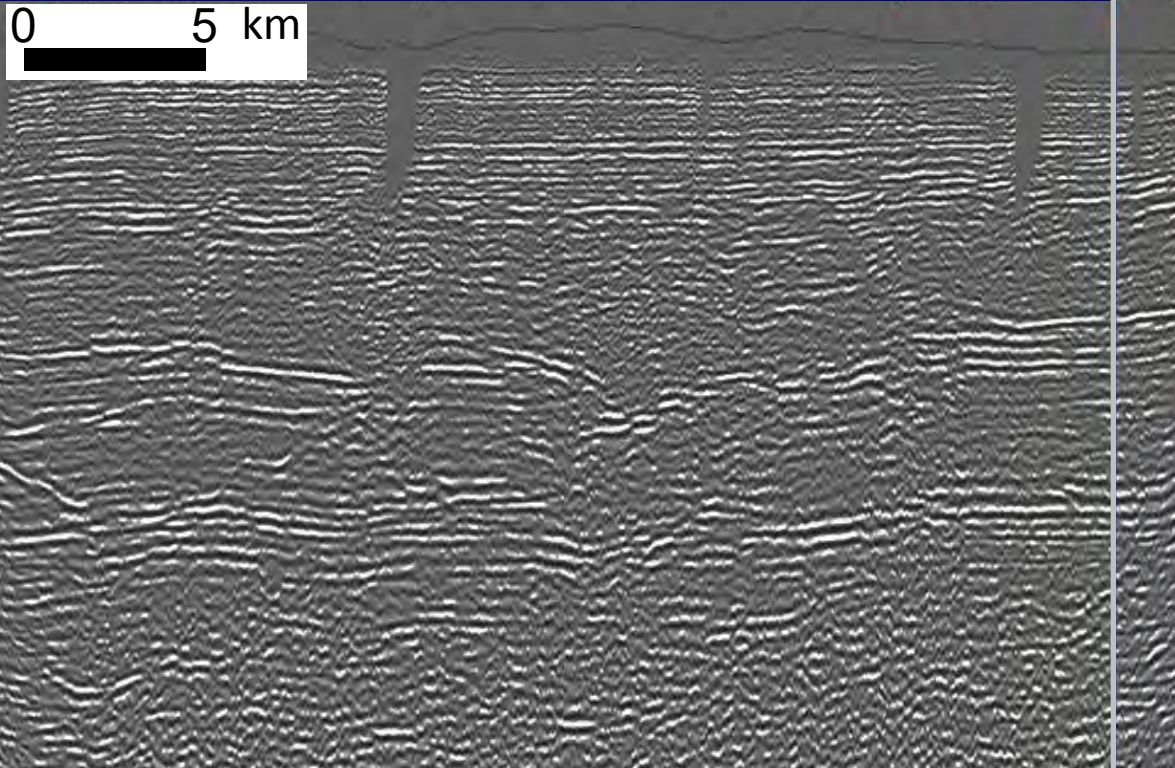


Leads

Line 0225-0011

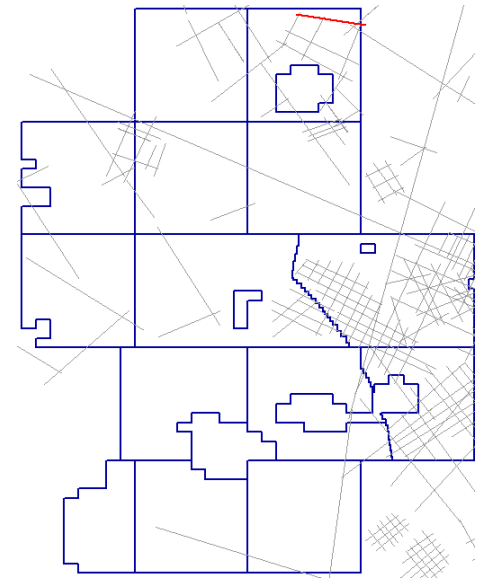
272

0 5 km



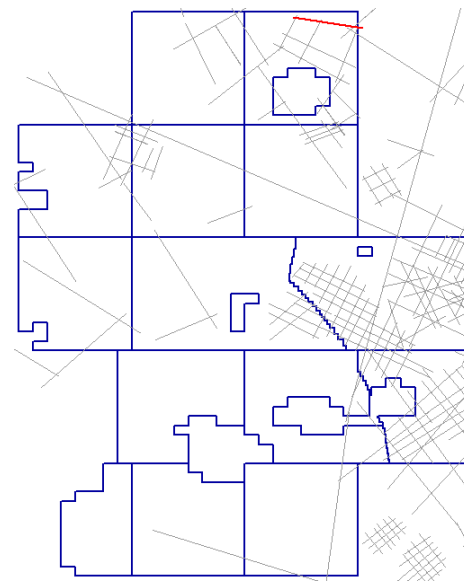
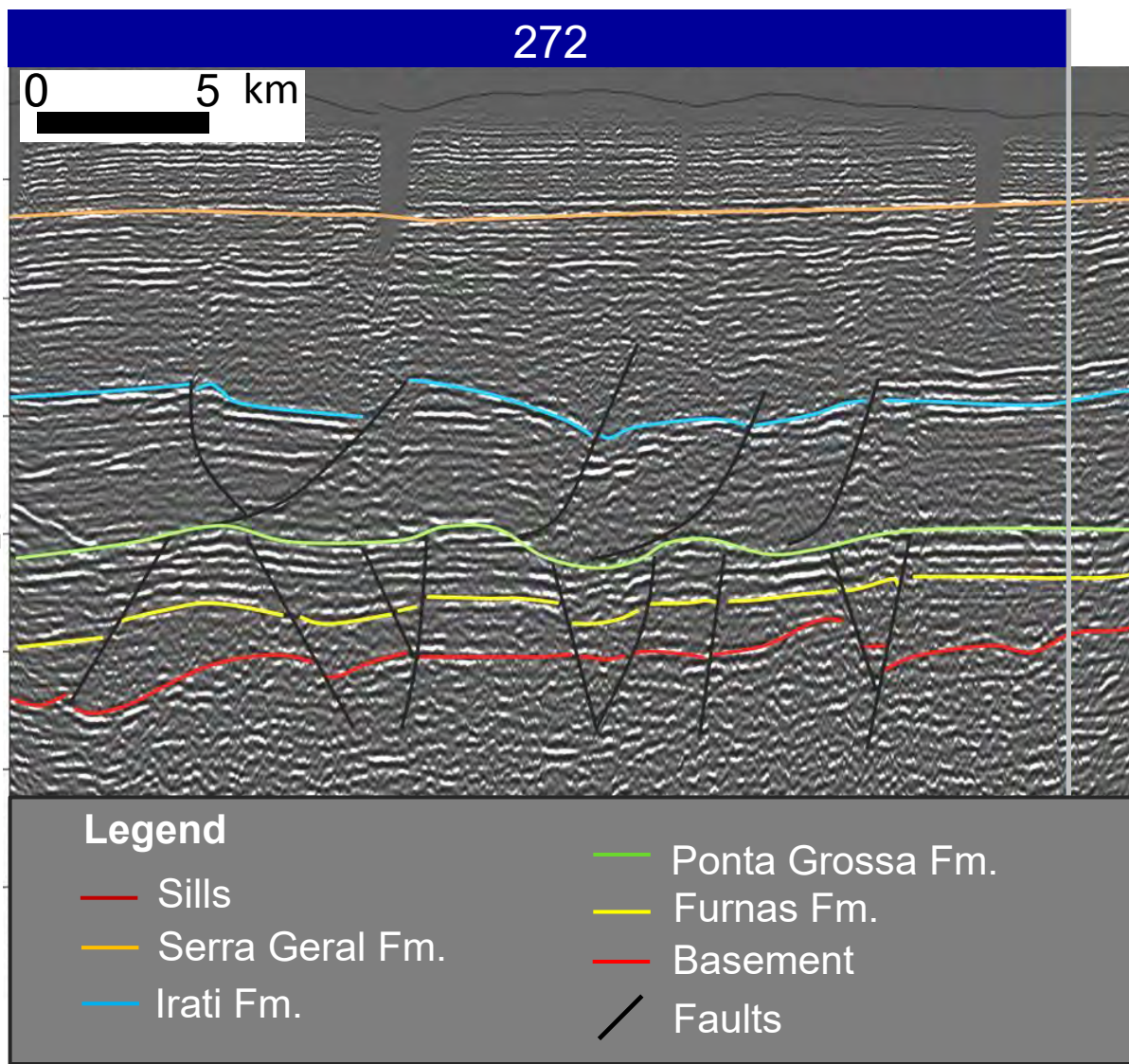
Legend

- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basement
- / Faults



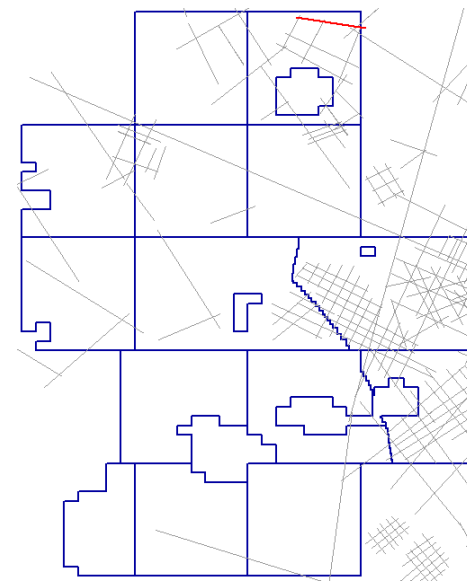
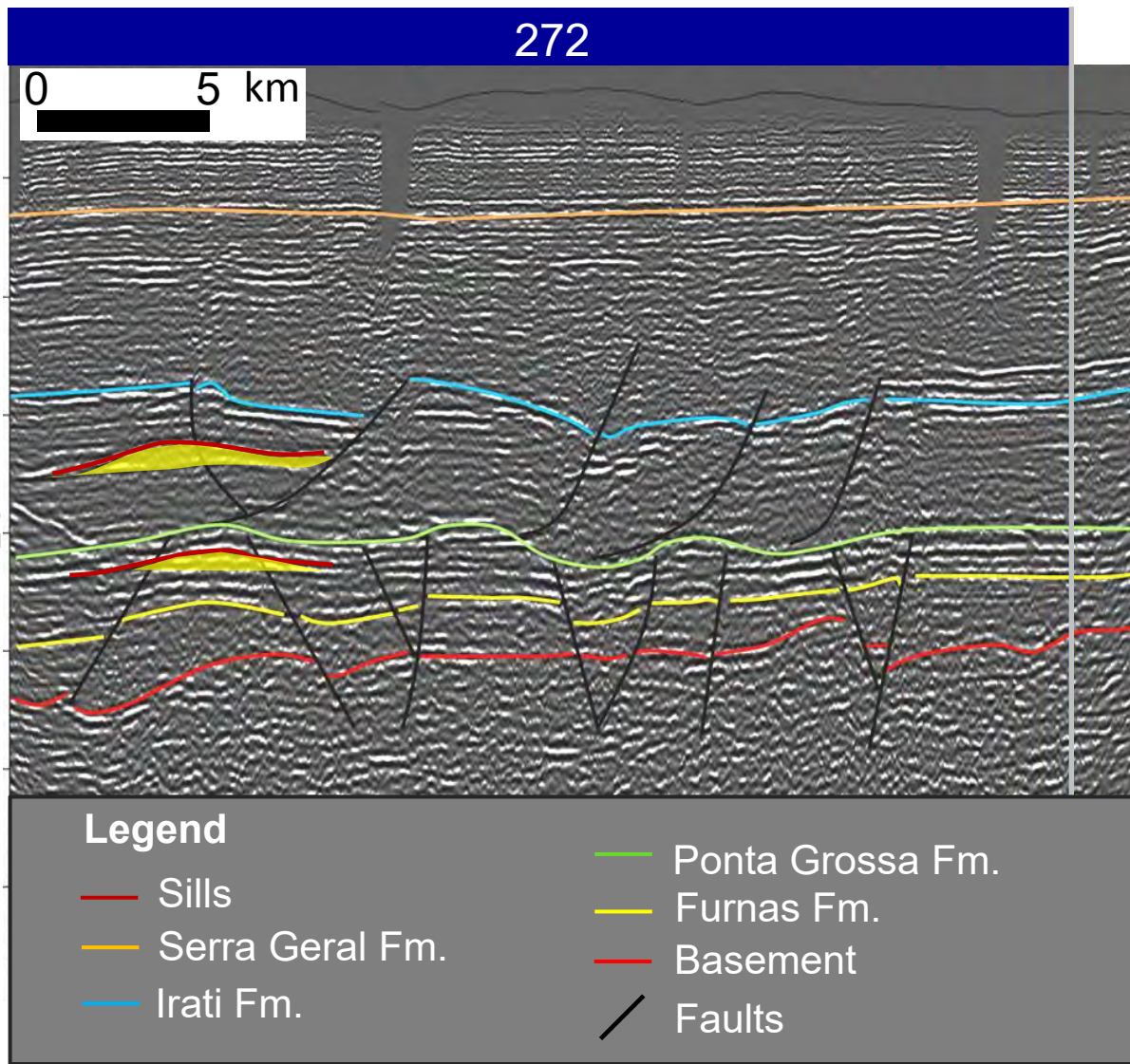
Leads

Line 0225-0011

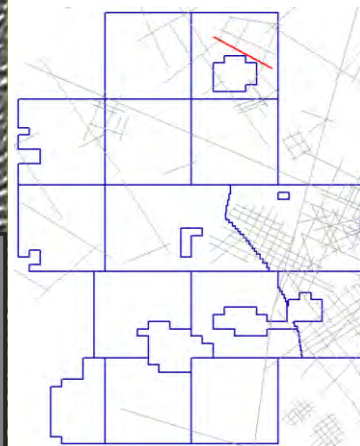
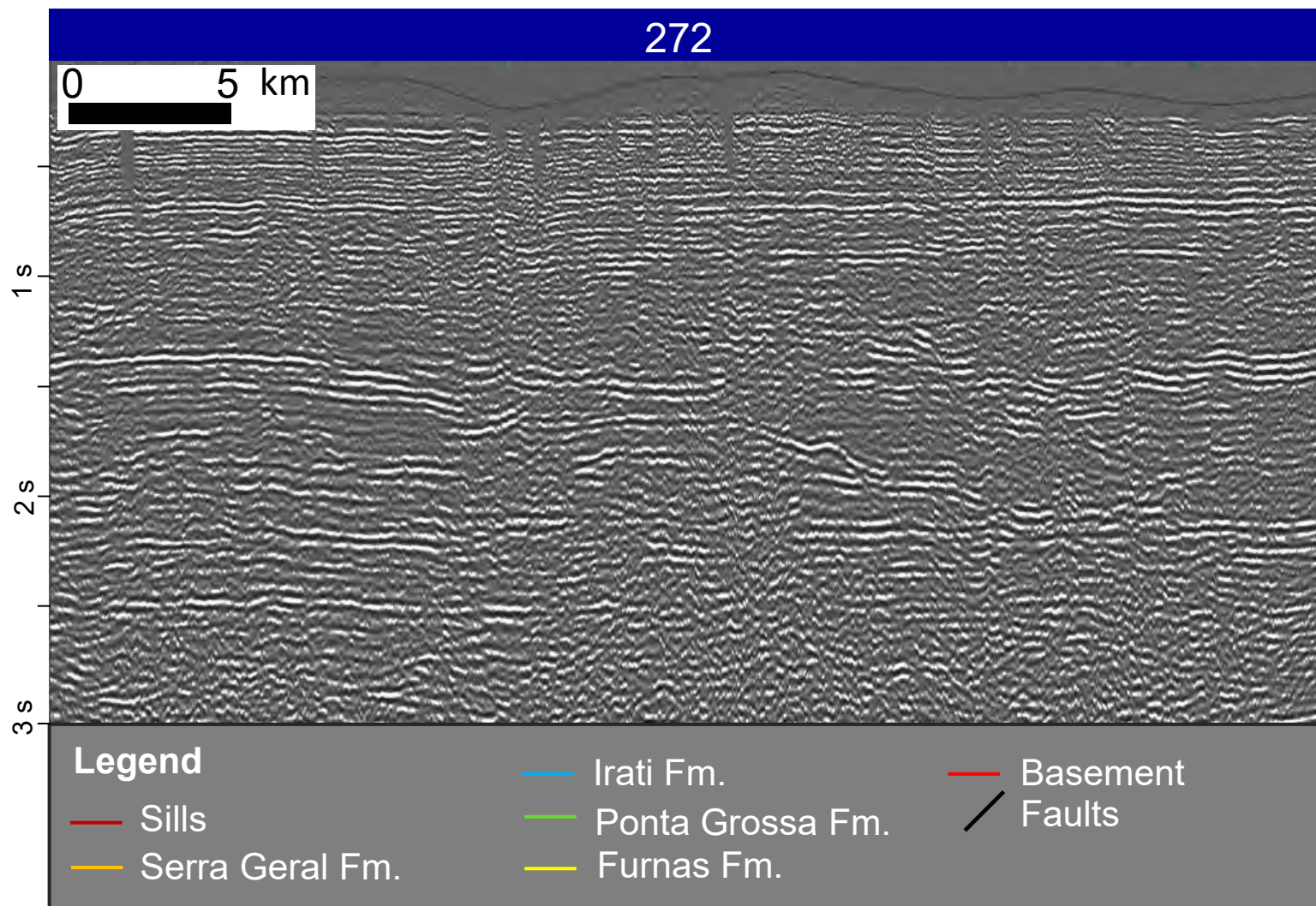


Leads

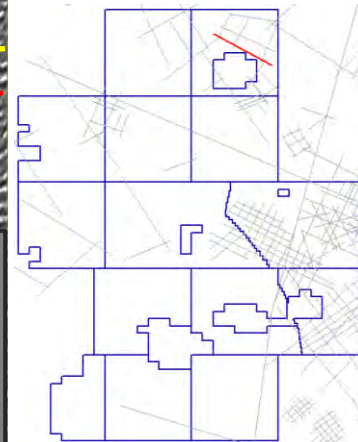
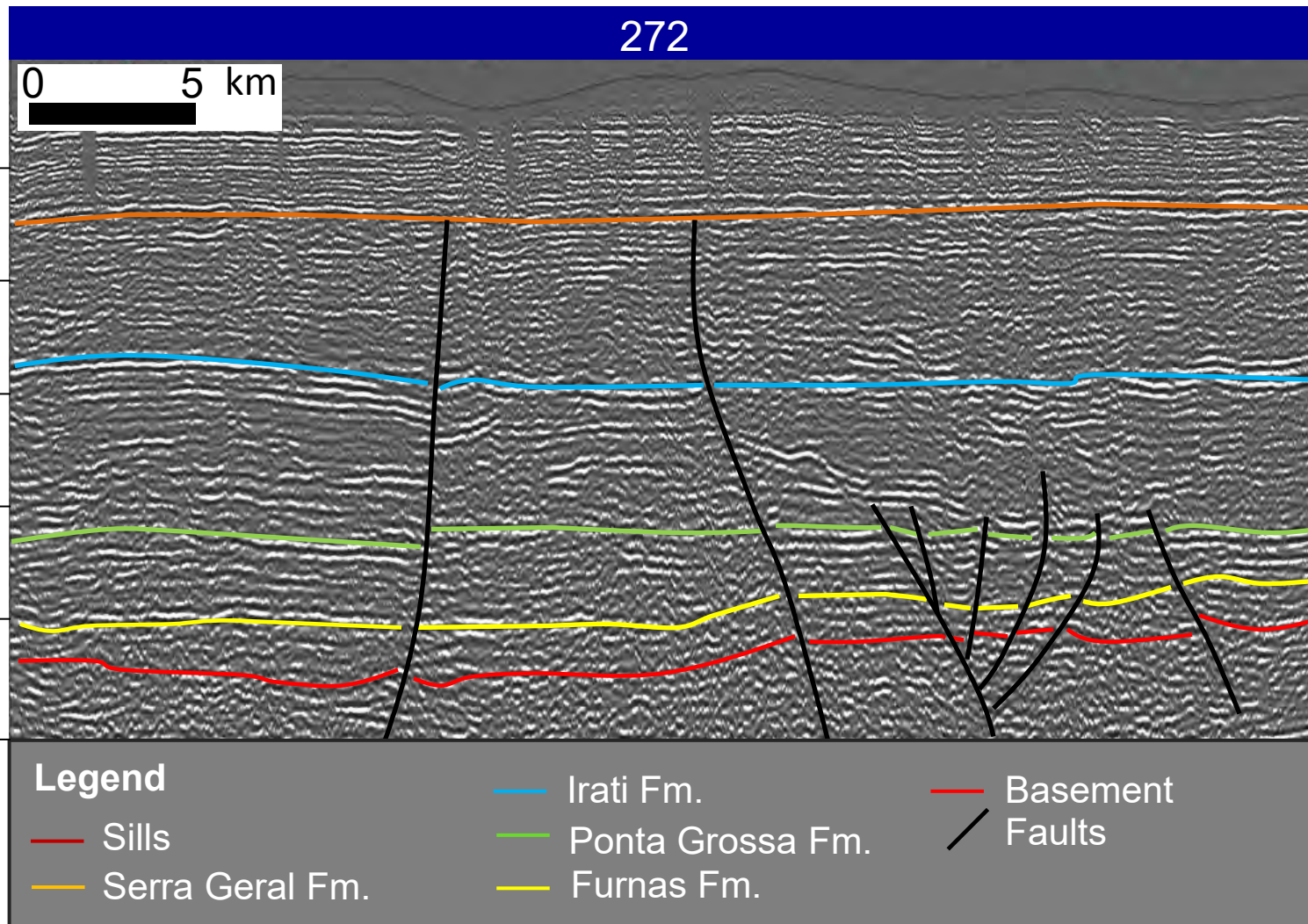
Line 0225-0011



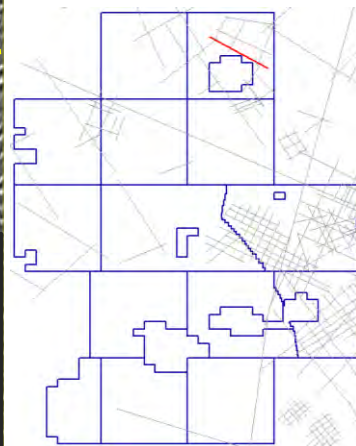
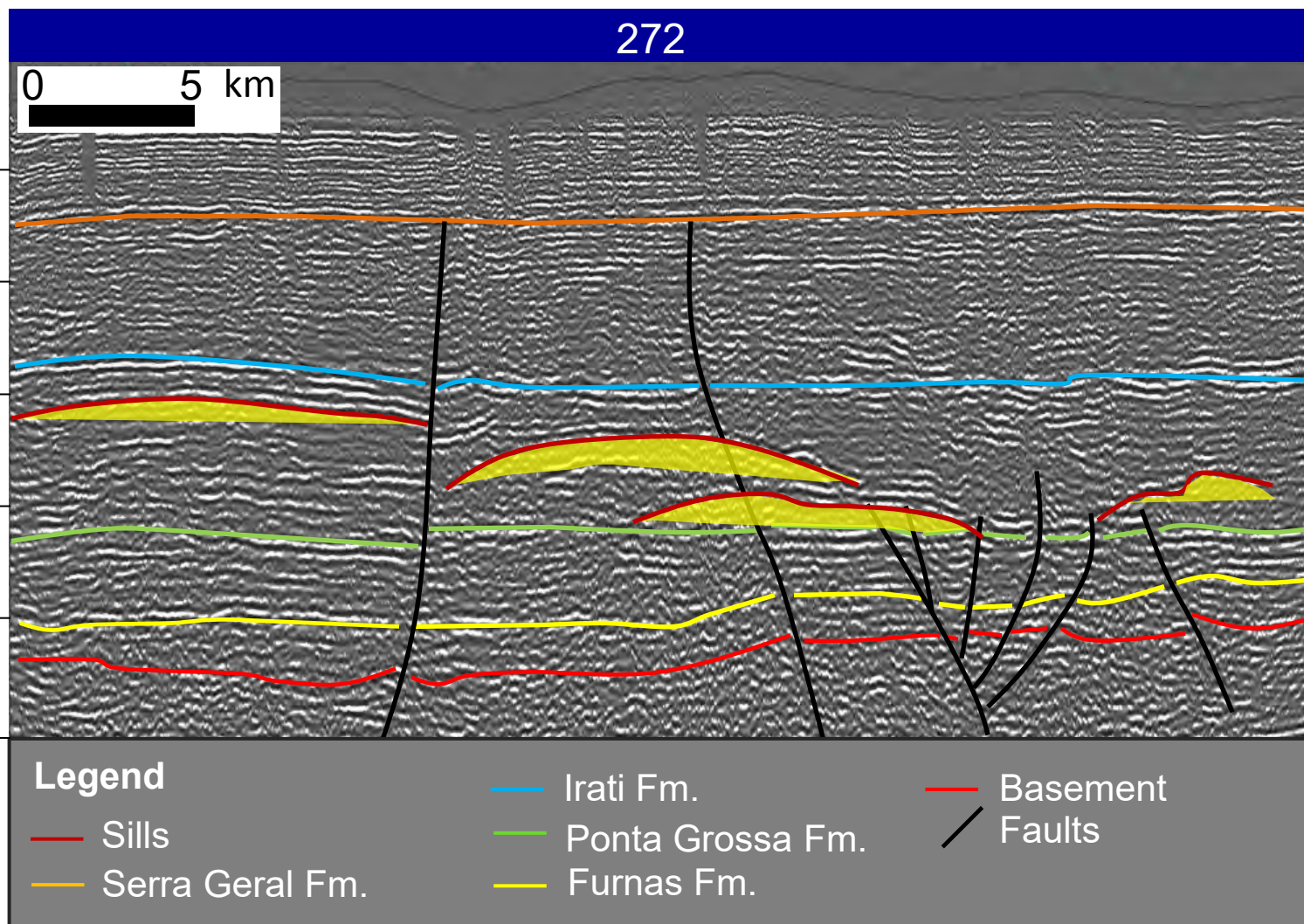
Line 0225-0007



Line 0225-0007

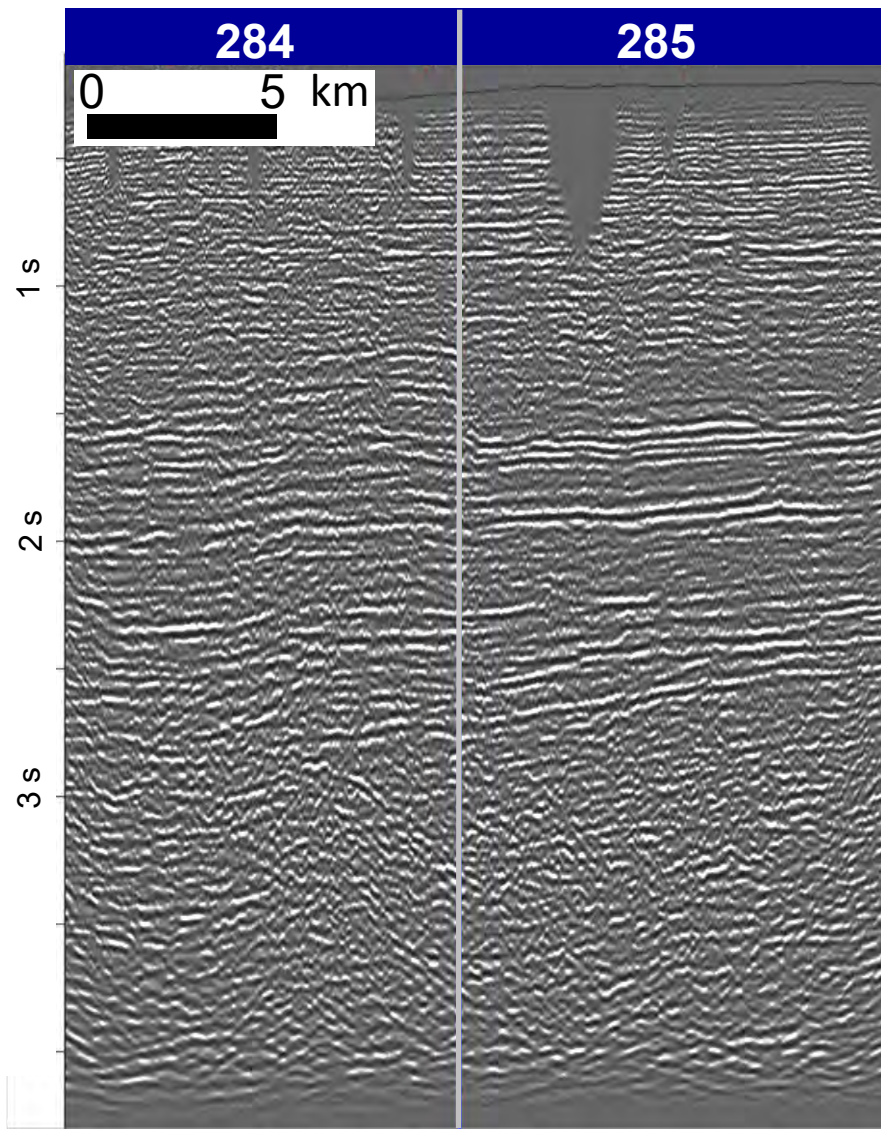


Line 0225-0007



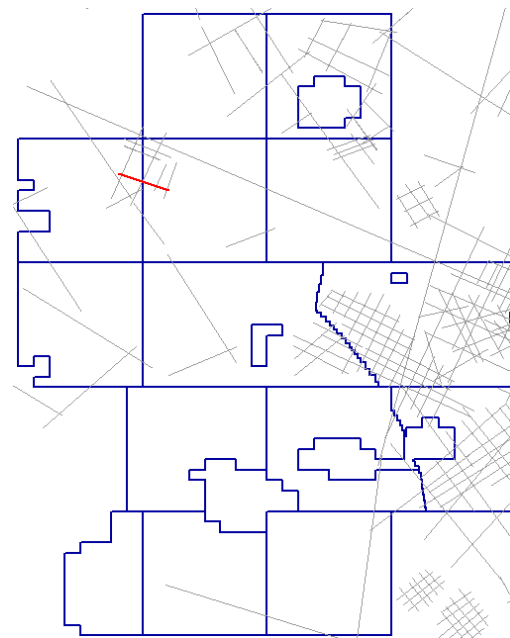
Leads

Line 0225-0150



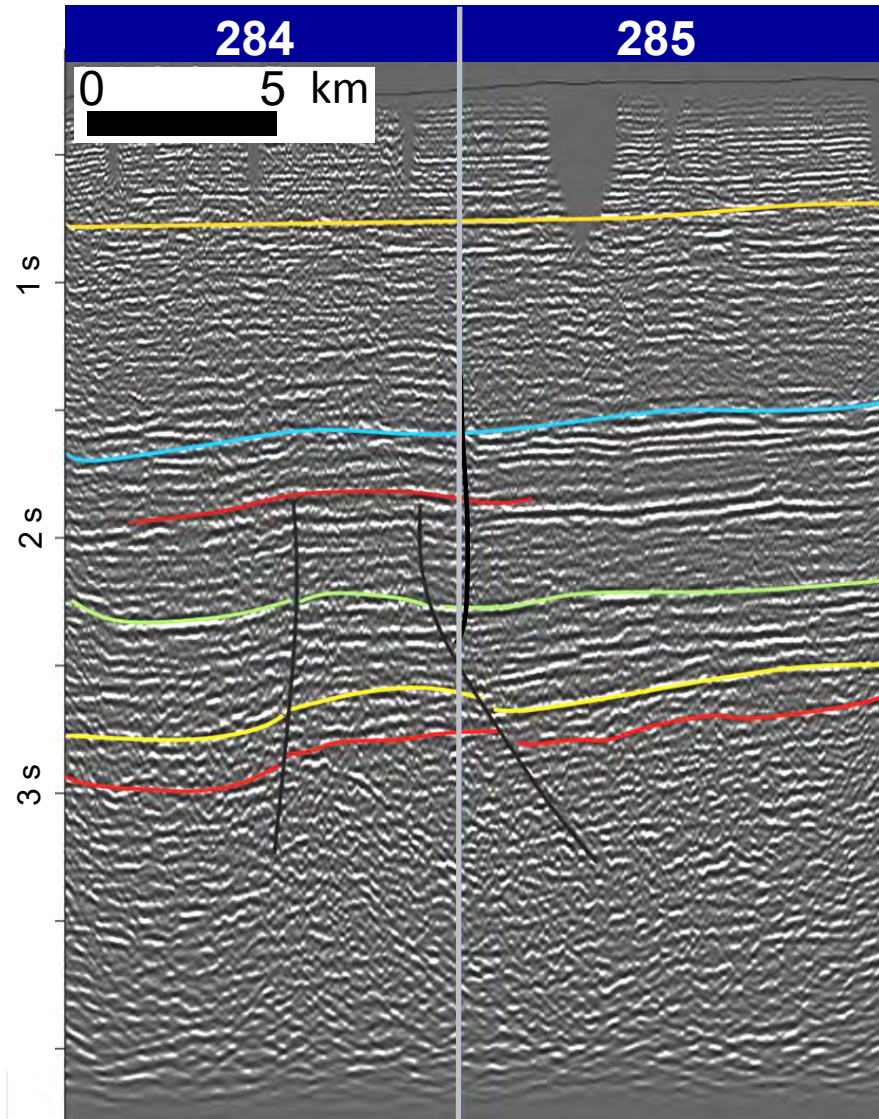
Legend

- | | |
|--------------------|--------------|
| — Sills | — Furnas Fm. |
| — Serra Geral Fm. | — Basement |
| — Irati Fm. | — Faults |
| — Ponta Grossa Fm. | |



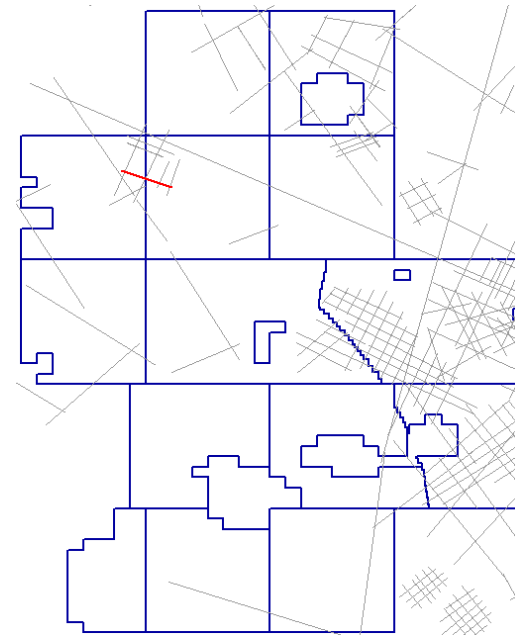
Leads

Line 0225-0150



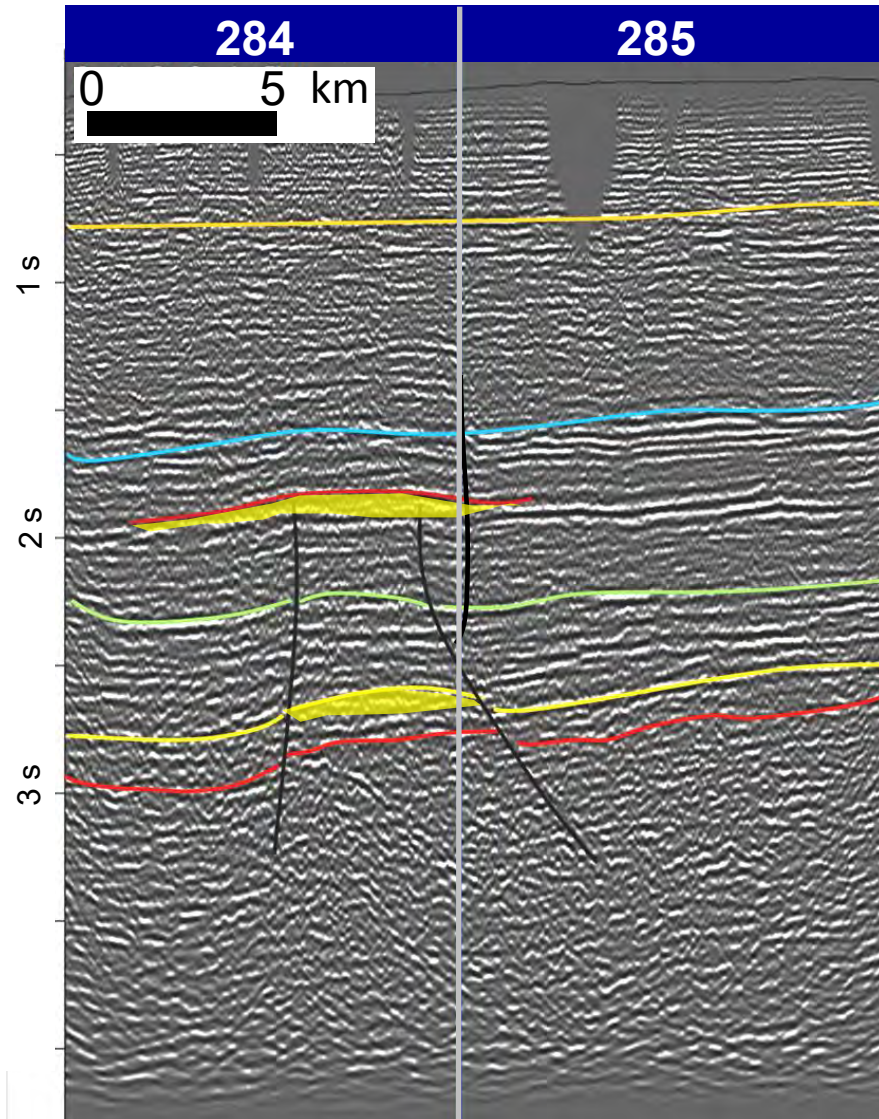
Legend

- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basement
- / Faults



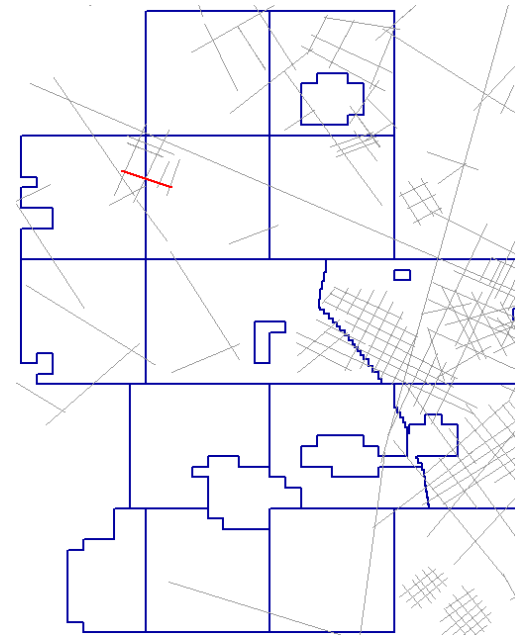
Leads

Line 0225-0150



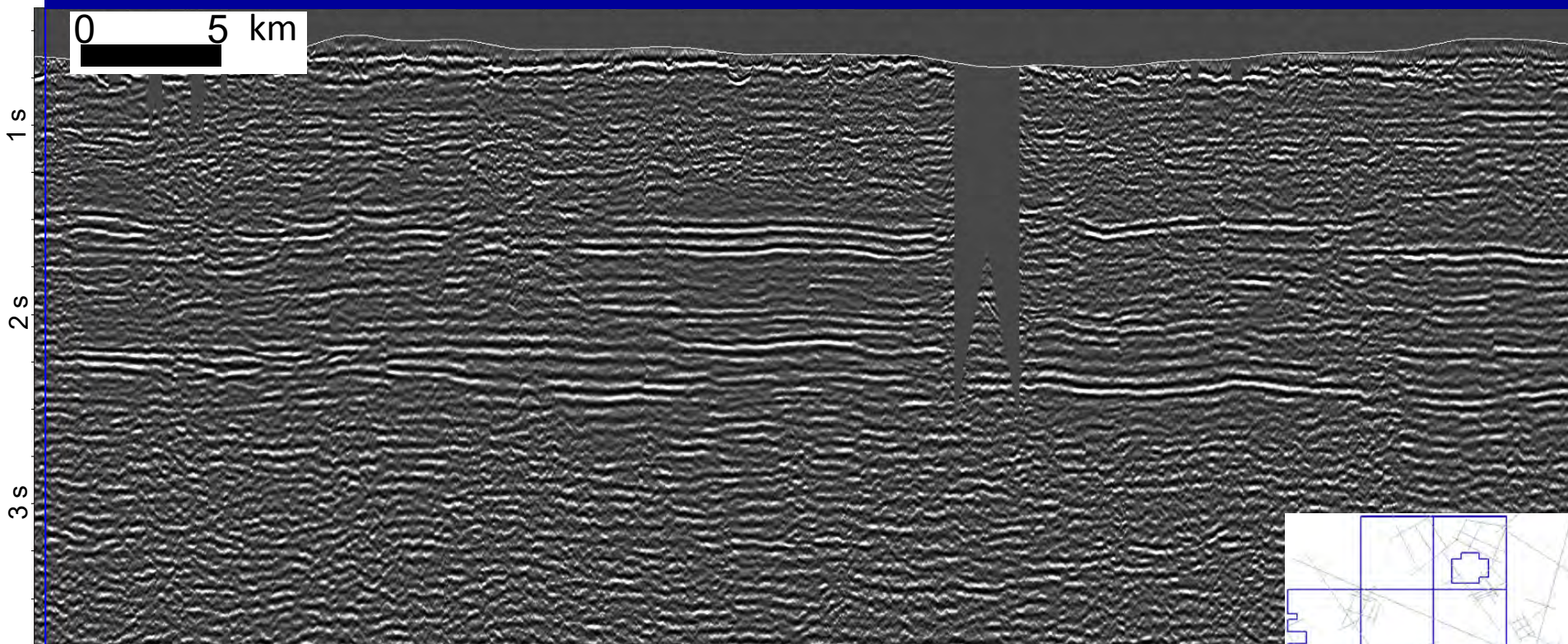
Legend

- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basement
- Faults



Line 0301-0006a / 0301_2D_BACIA_DO_PARANA Survey

321



Legend

— Sills

— Serra Geral Fm.

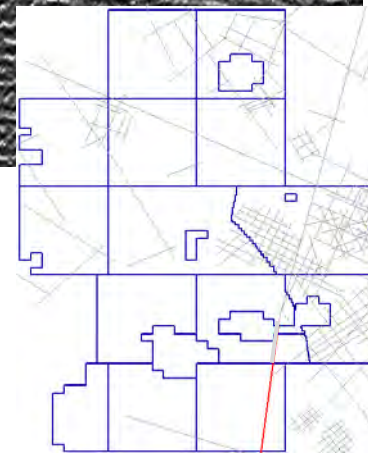
— Irati Fm.

— Ponta Grossa Fm.

— Furnas Fm.

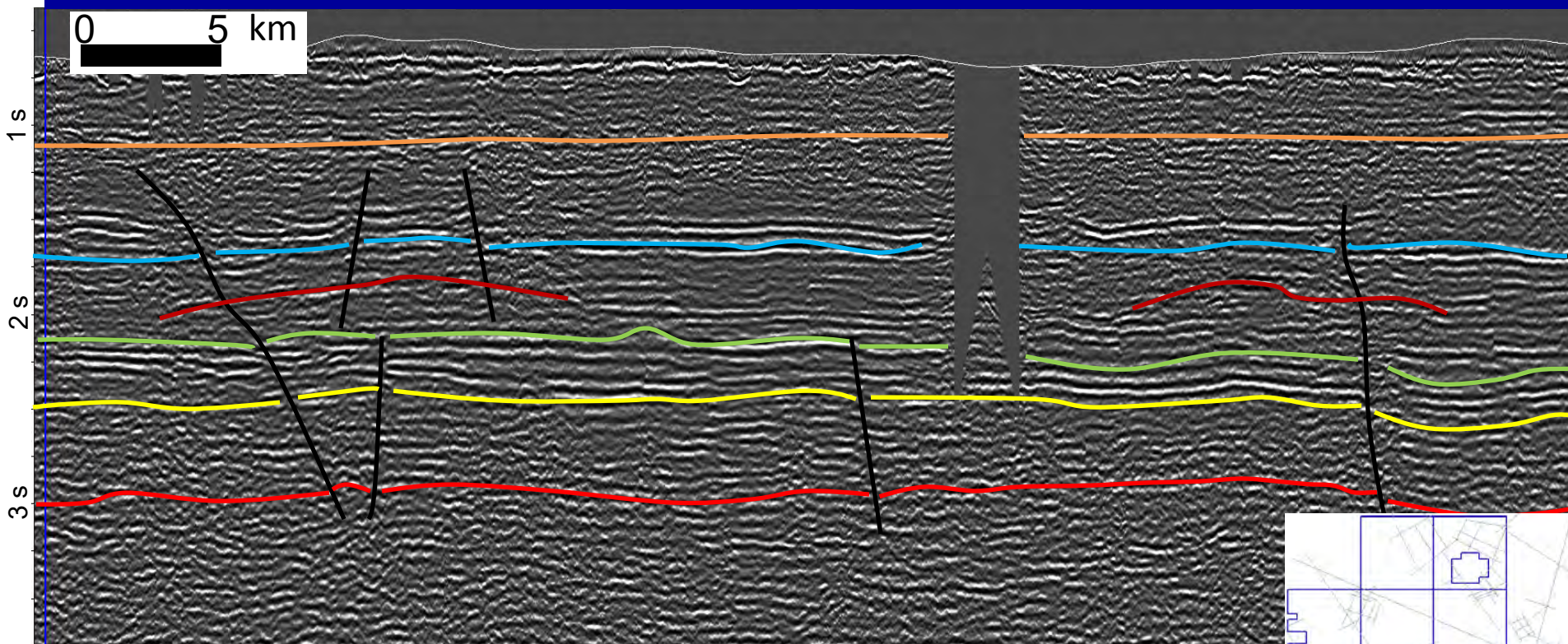
— Basement

— Faults



Line 0301-0006a / 0301_2D_BACIA_DO_PARANA Survey

321



Legend

— Sills

— Serra Geral Fm.

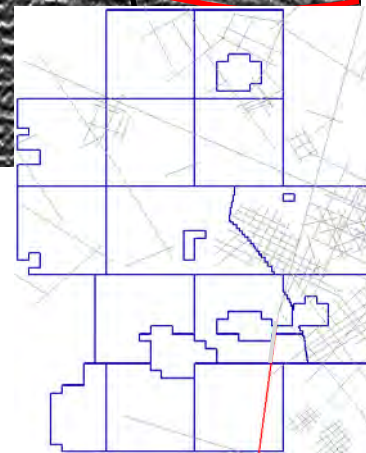
— Irati Fm.

— Ponta Grossa Fm.

— Furnas Fm.

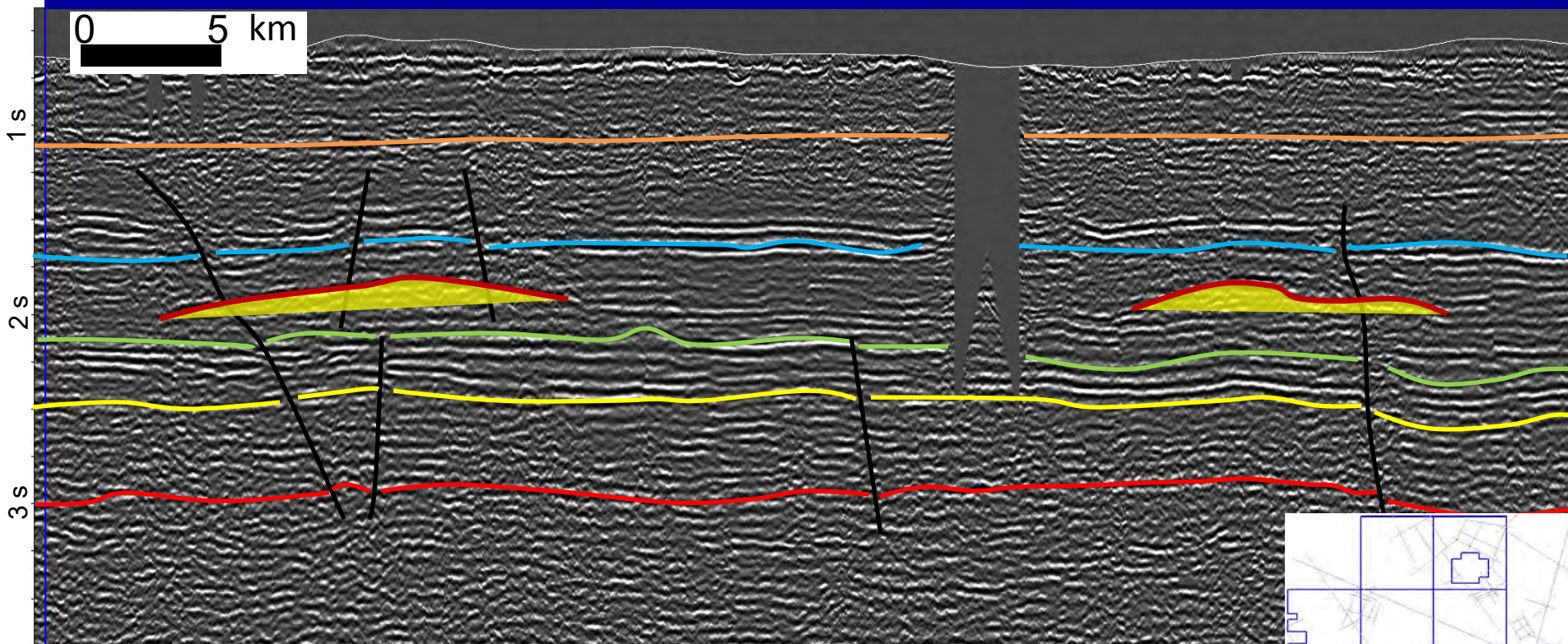
— Basement

— Faults



Line 0301-0006a / 0301_2D_BACIA_DO_PARANA Survey

321



Legend

— Sills

— Serra Geral Fm.

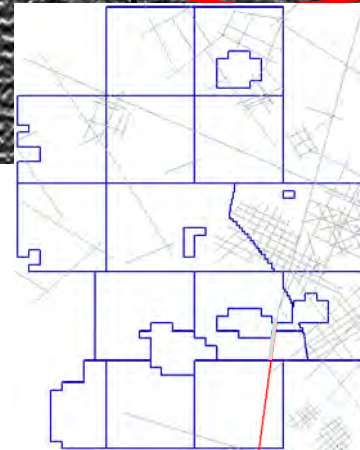
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— Ponta Grossa Fm.

— Furnas Fm.

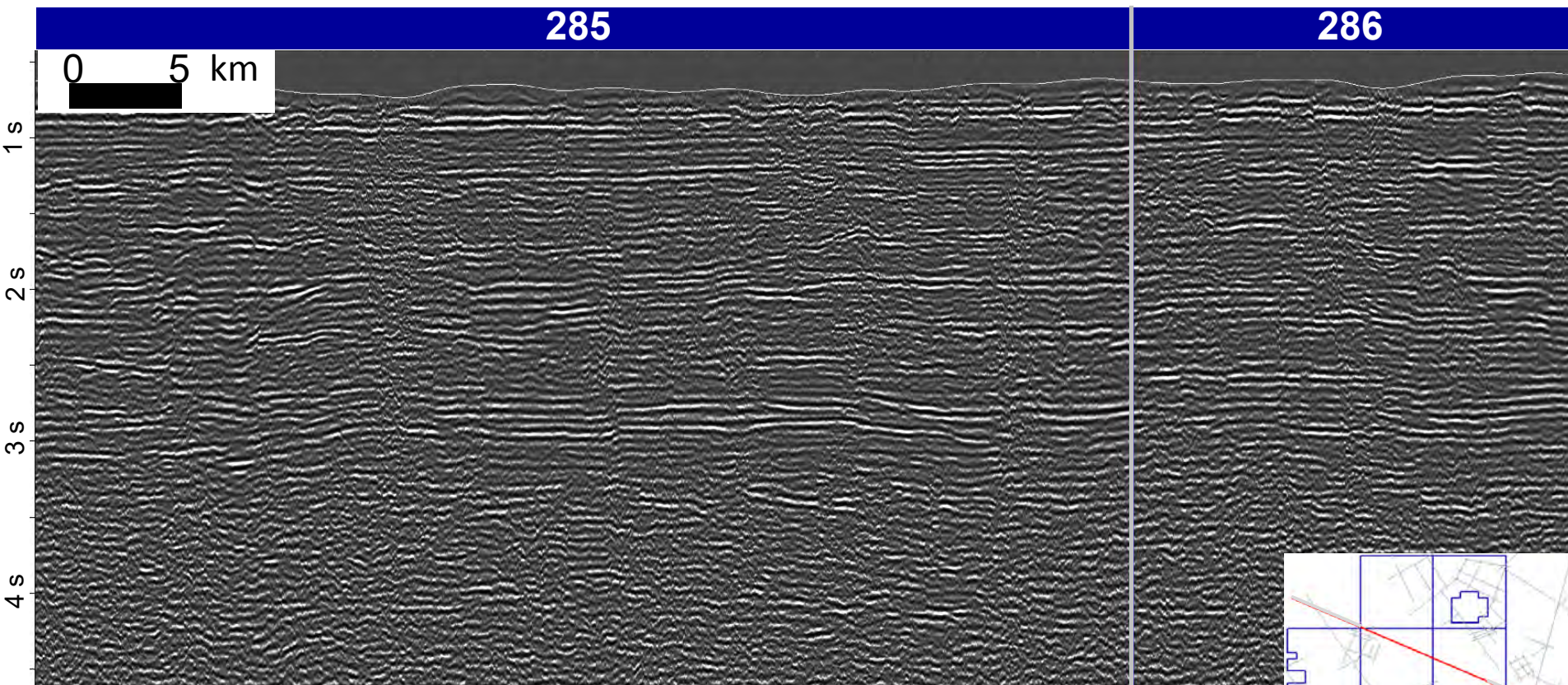
— Basement

— Faults



Leads

Line 0301-0003 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

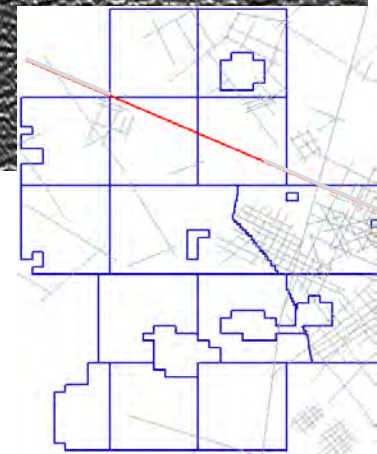
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— Ponta Grossa Fm.

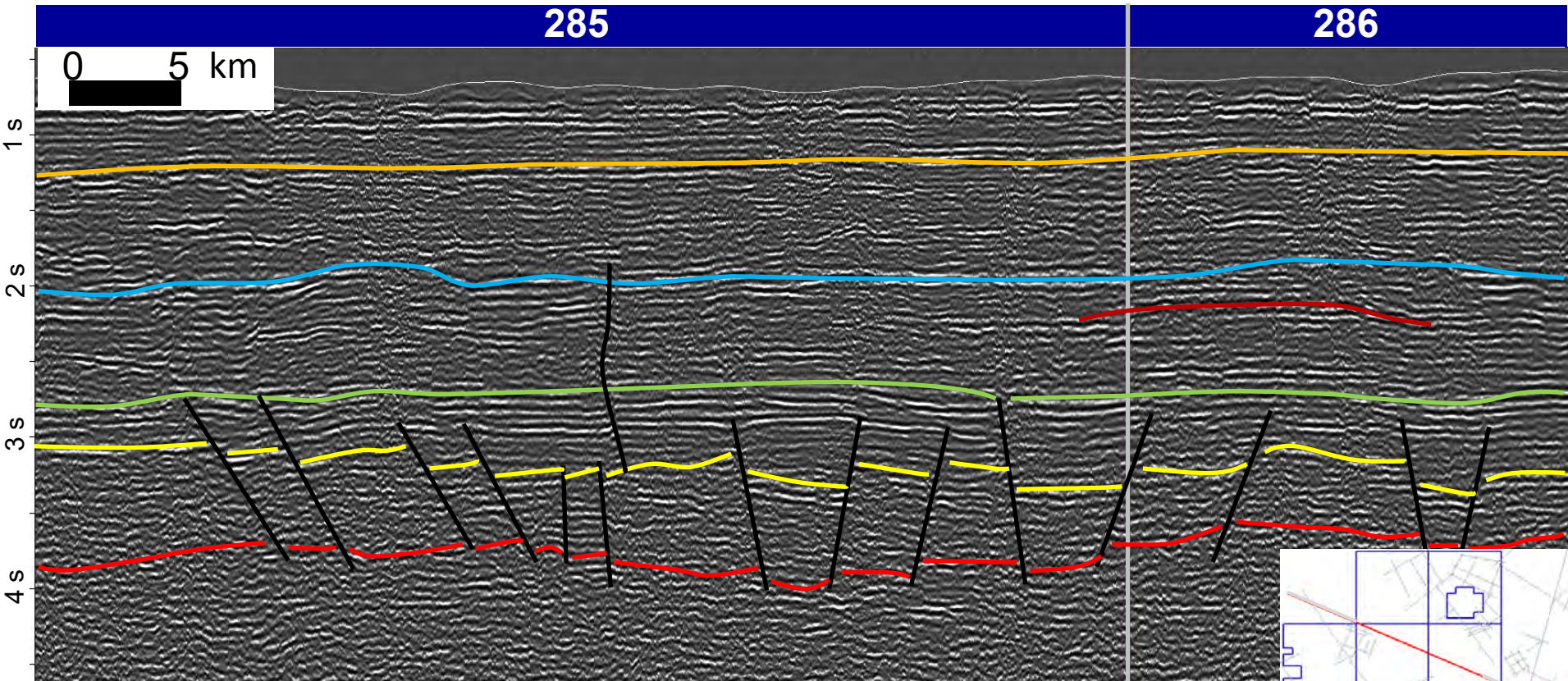
— Furnas Fm.

— Basement

— Faults



Line 0301-0003 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

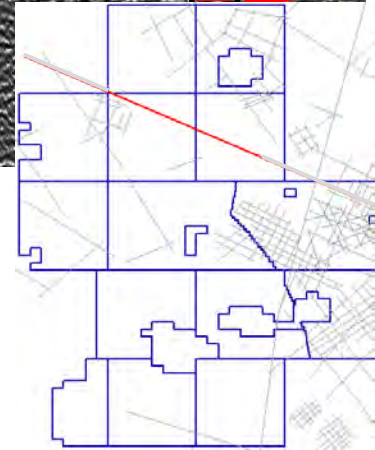
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— Ponta Grossa Fm.

— Furnas Fm.

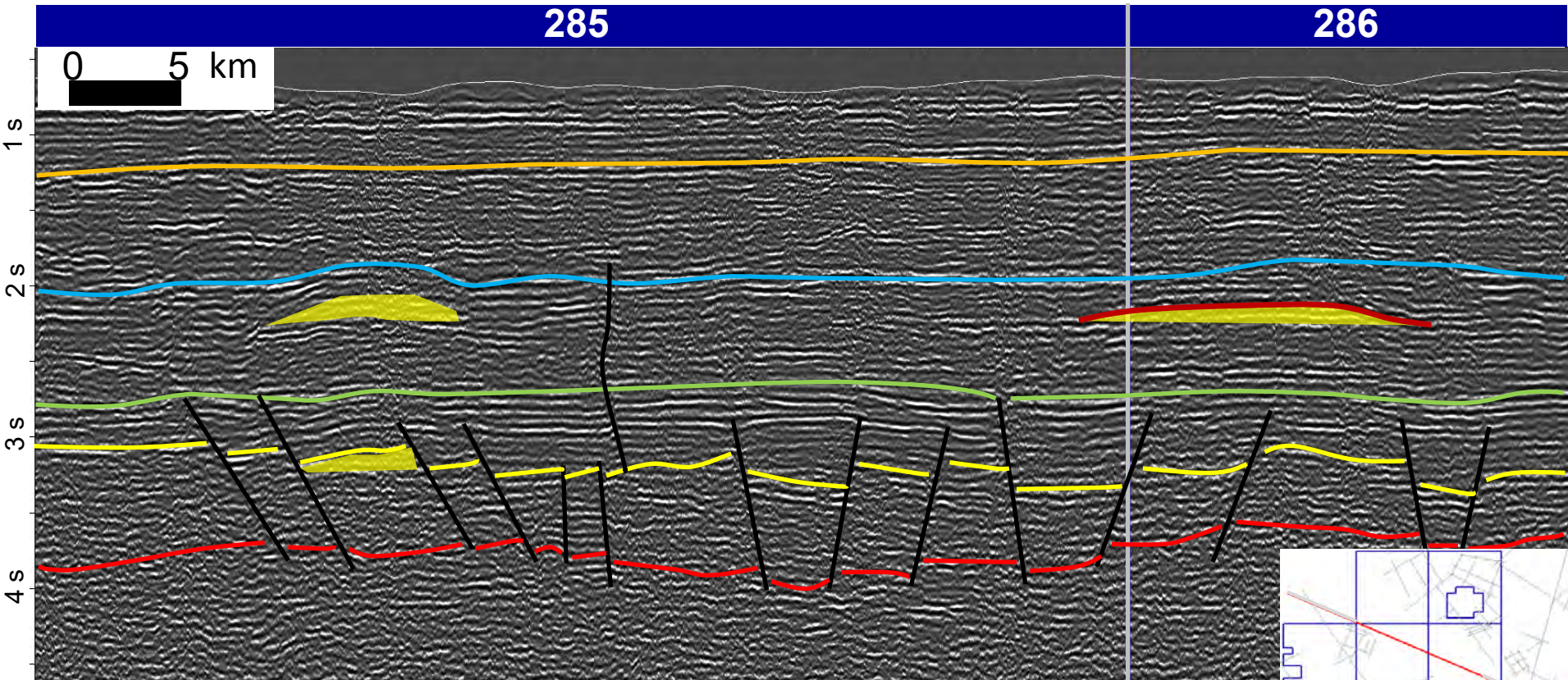
— Basement

— Faults



Leads

Line 0301-0003 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

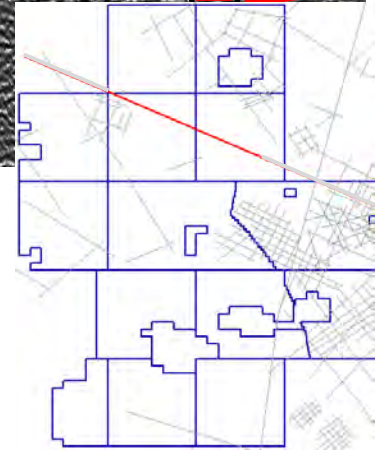
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— Ponta Grossa Fm.

— Furnas Fm.

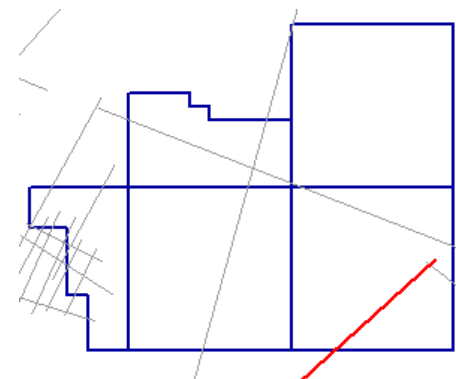
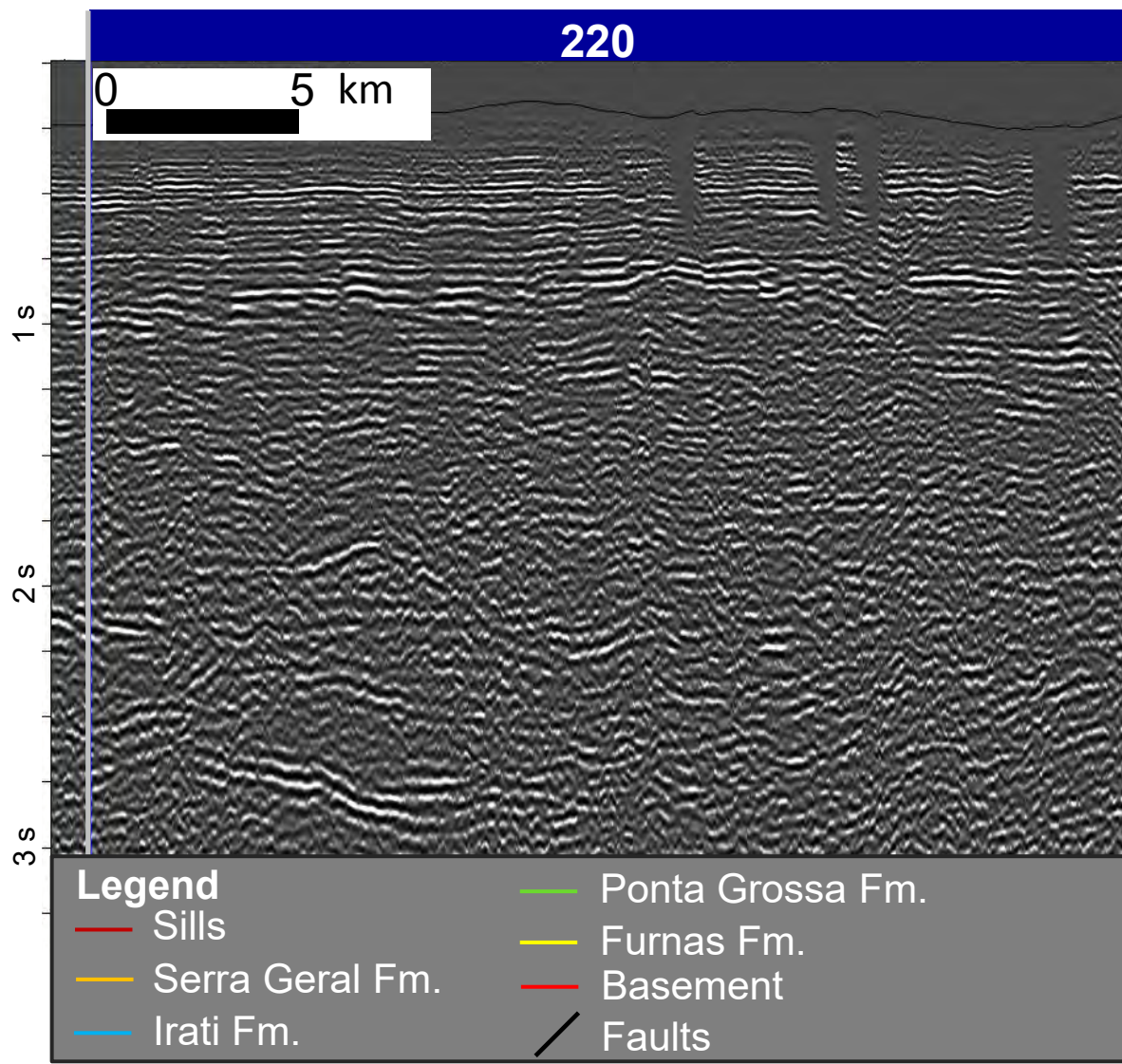
— Basement

— Faults



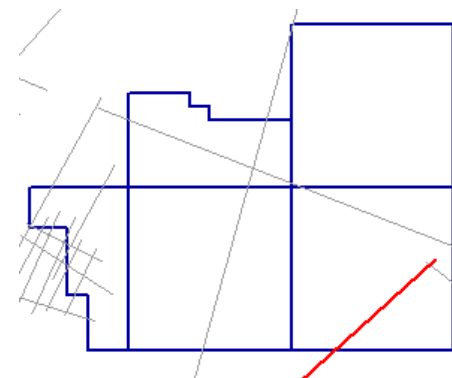
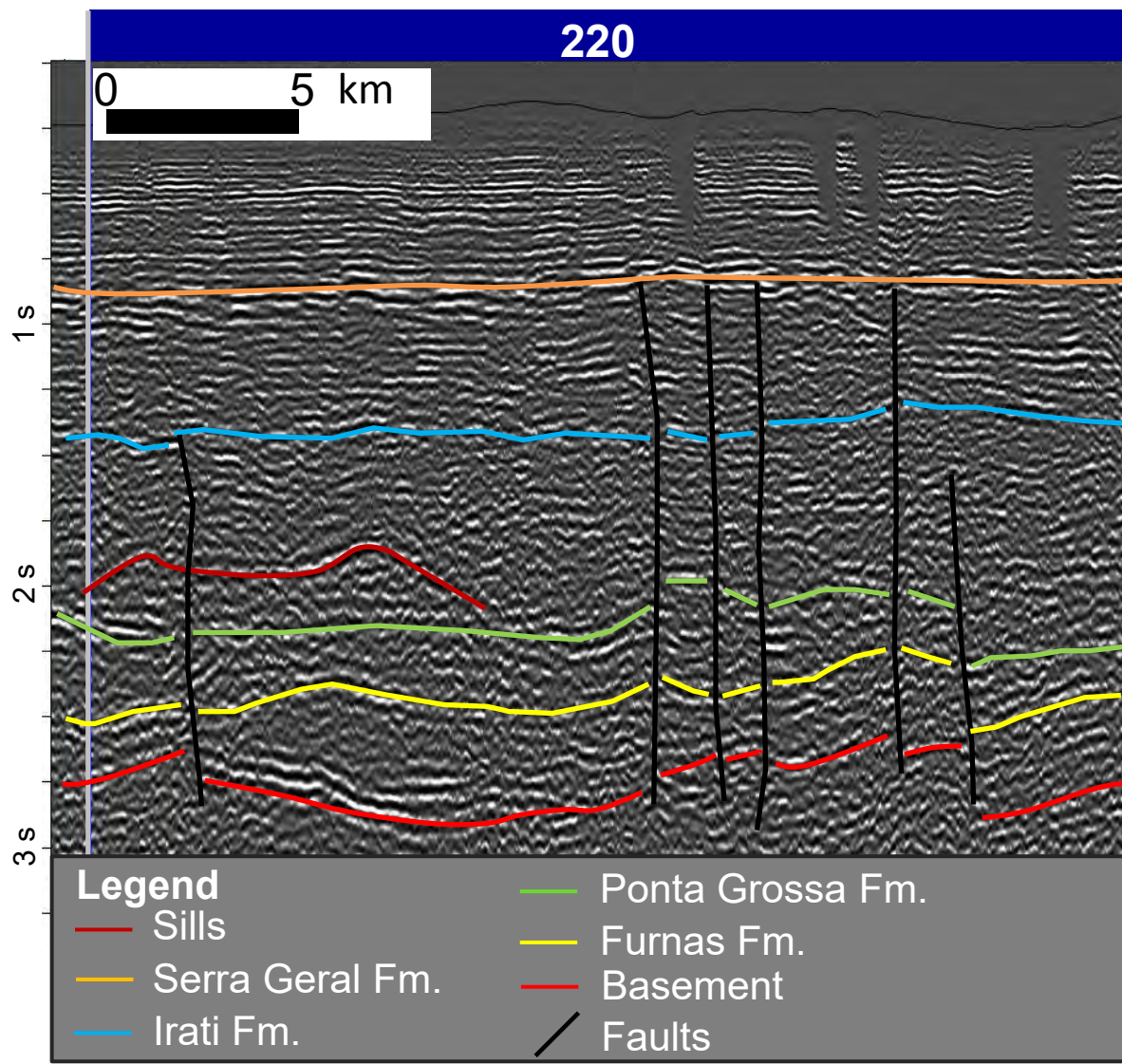
Leads

Line 0225-0030



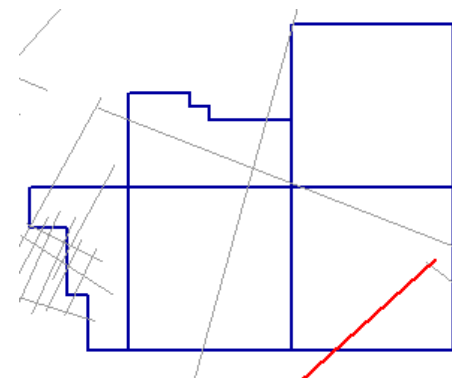
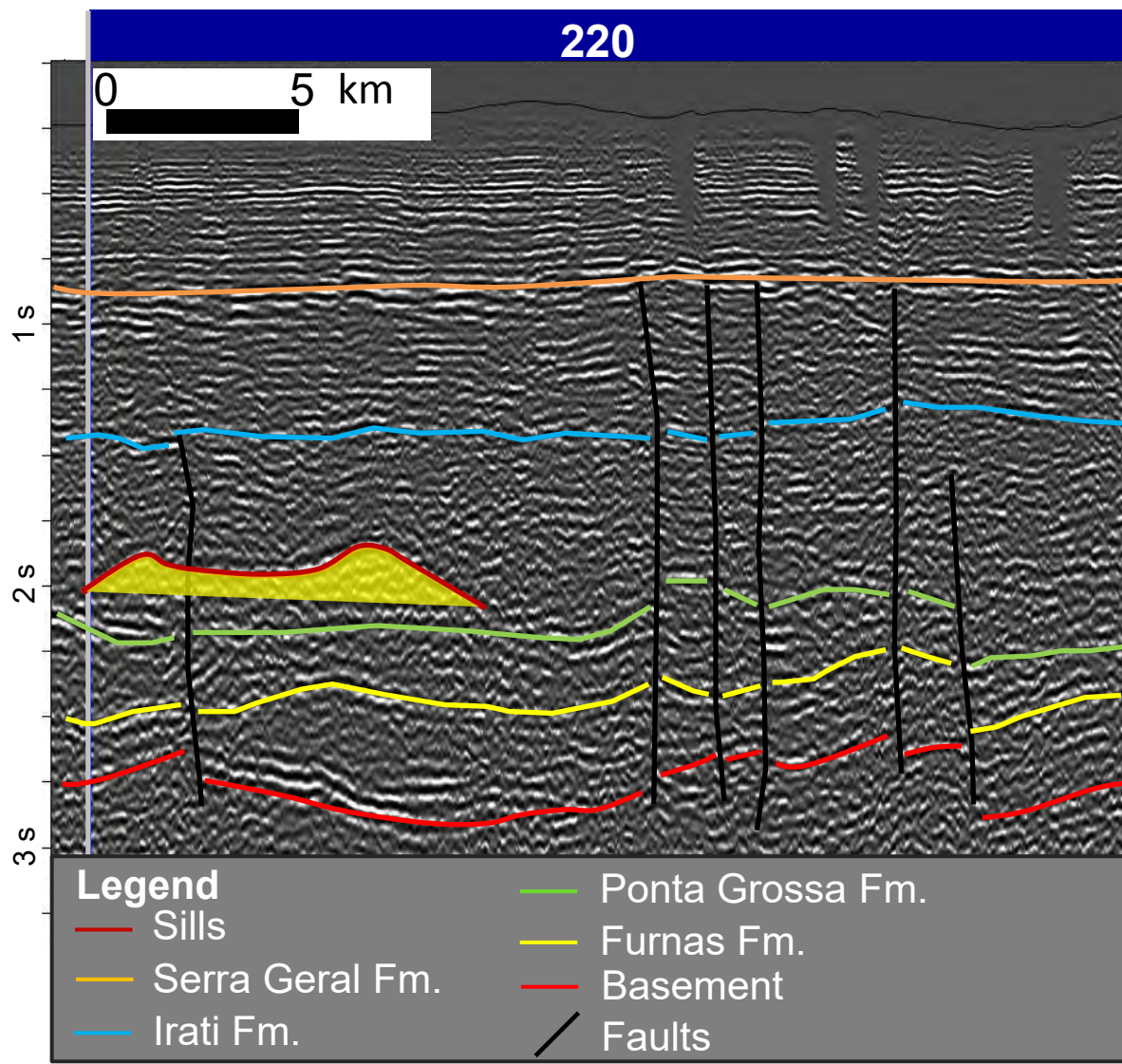
Leads

Line 0225-0030

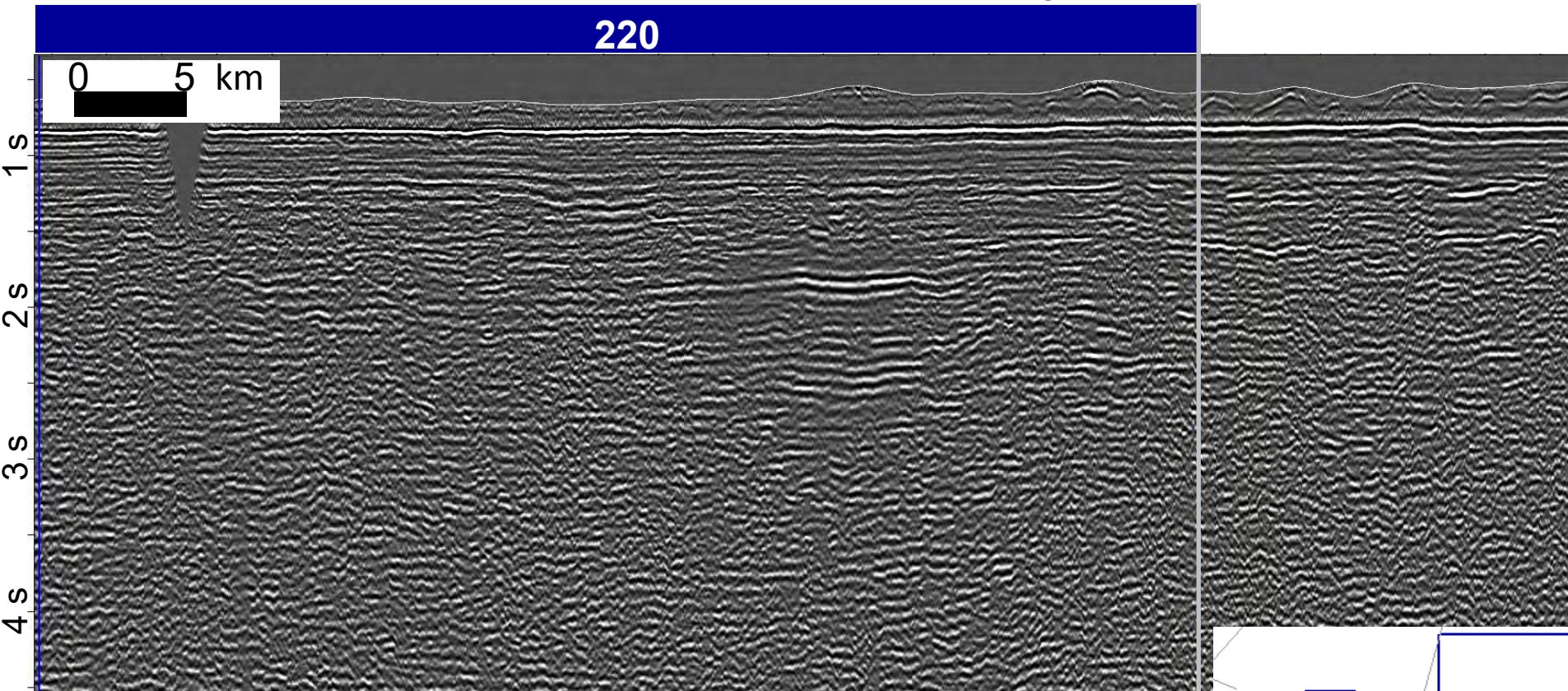


Leads

Line 0225-0030

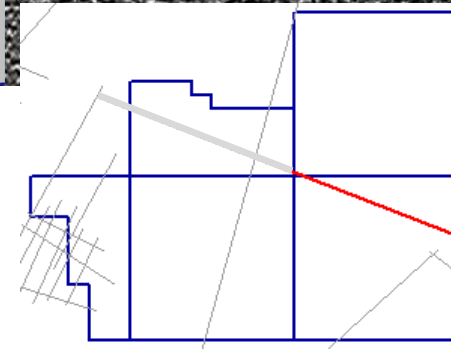


Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey

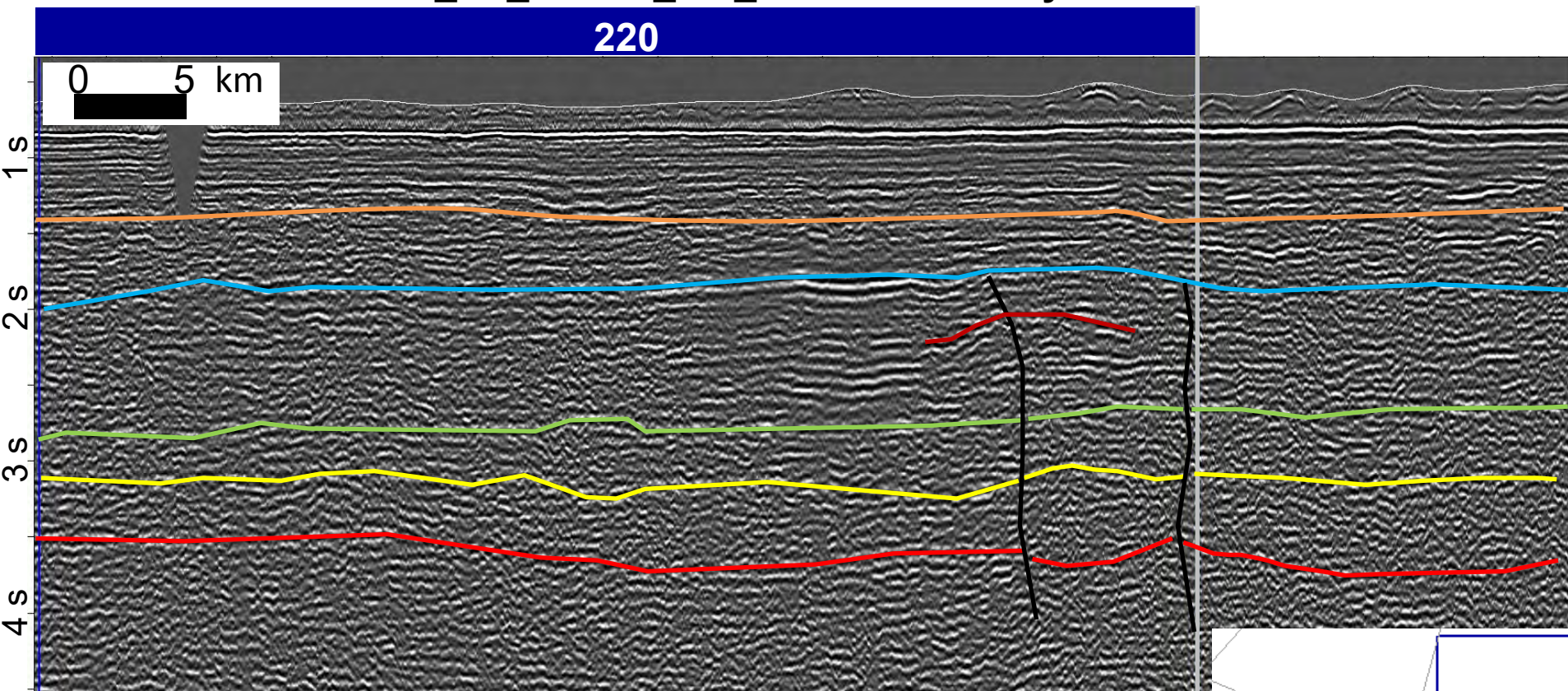


Legend

- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basement
- Faults

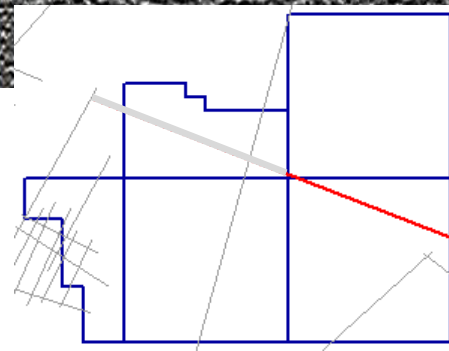


Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey

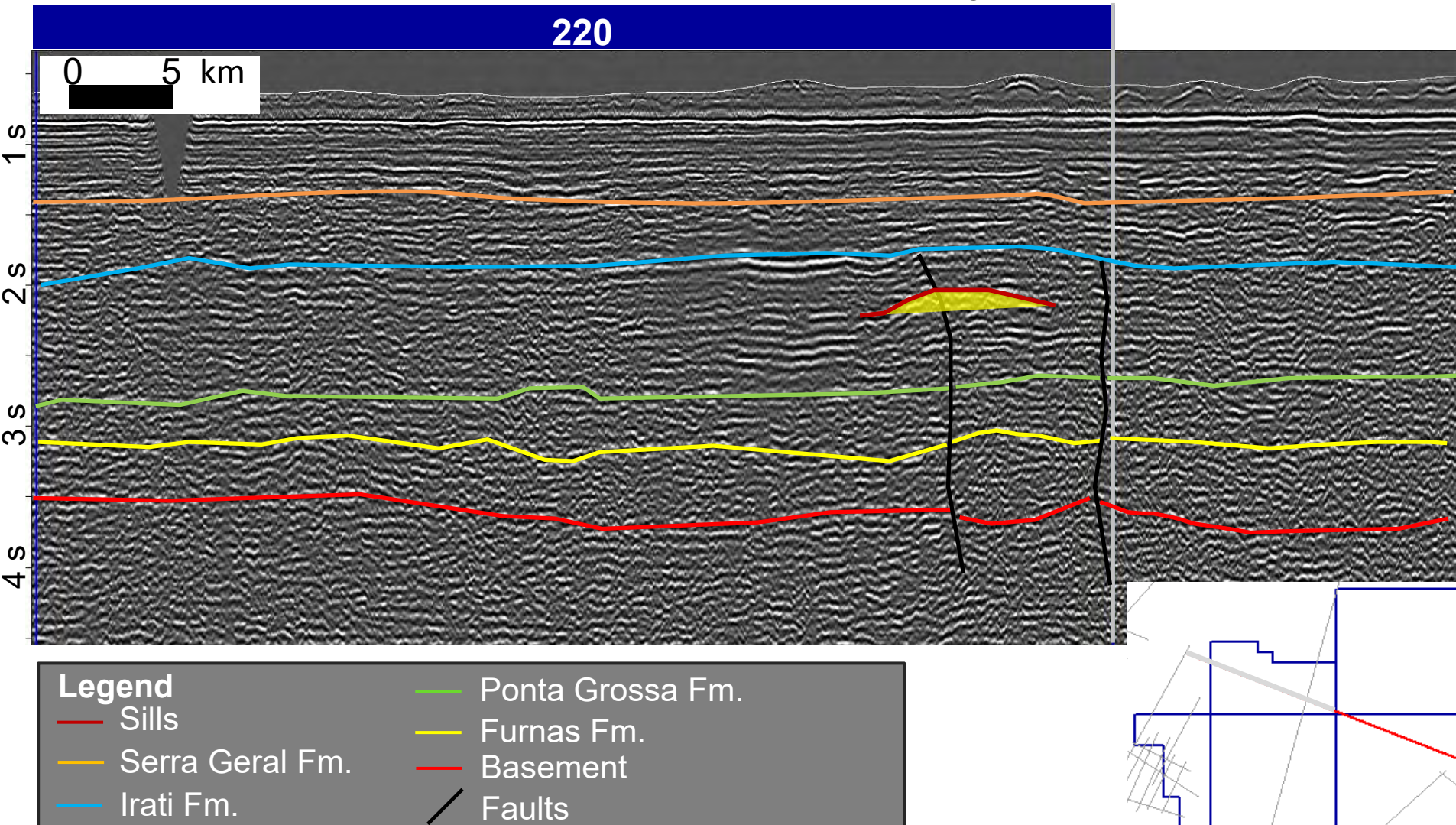


Legend

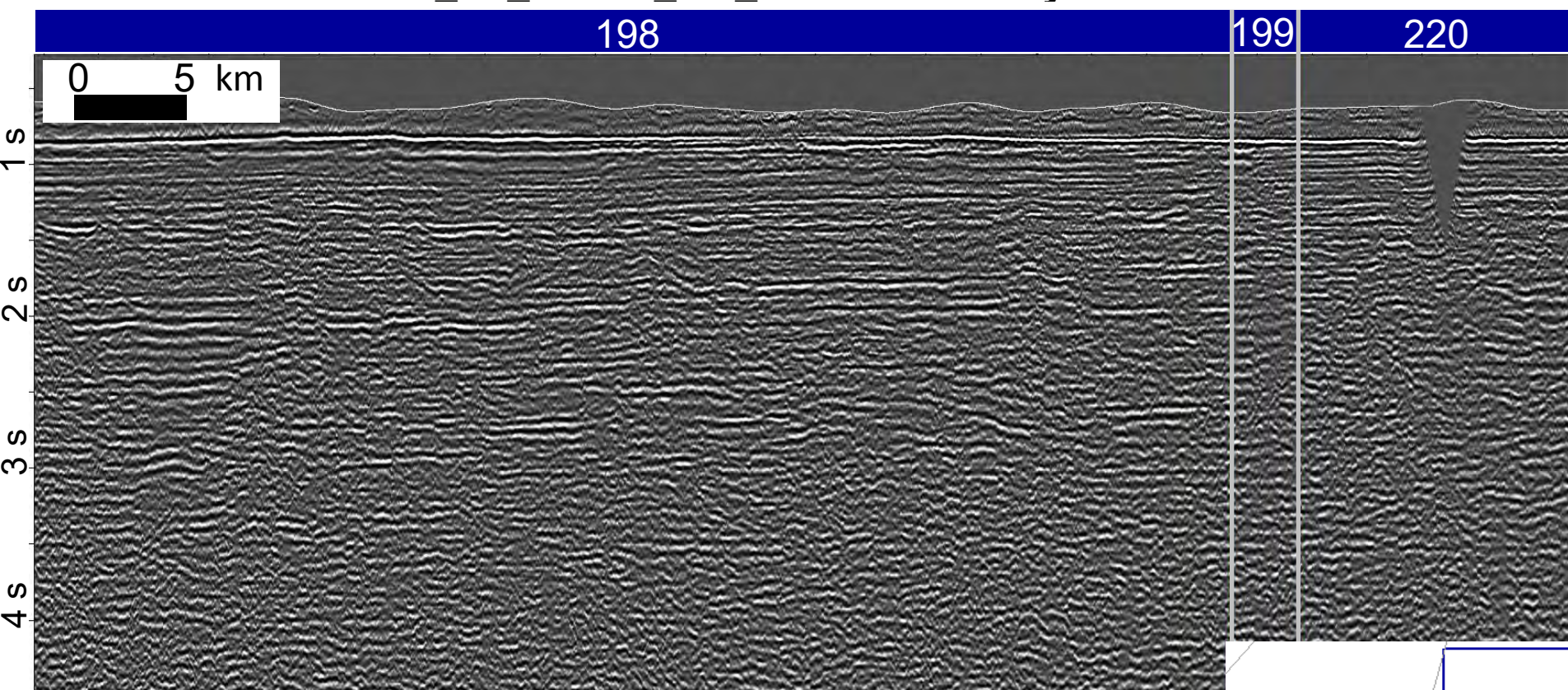
- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basalment
- Faults



Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey



Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

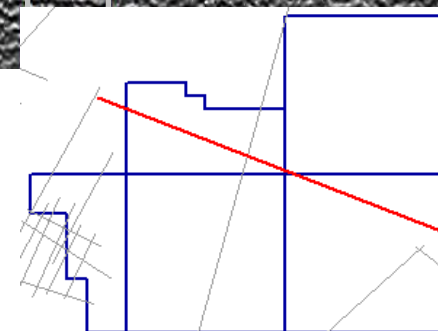
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— Ponta Grossa Fm.

— Furnas Fm.

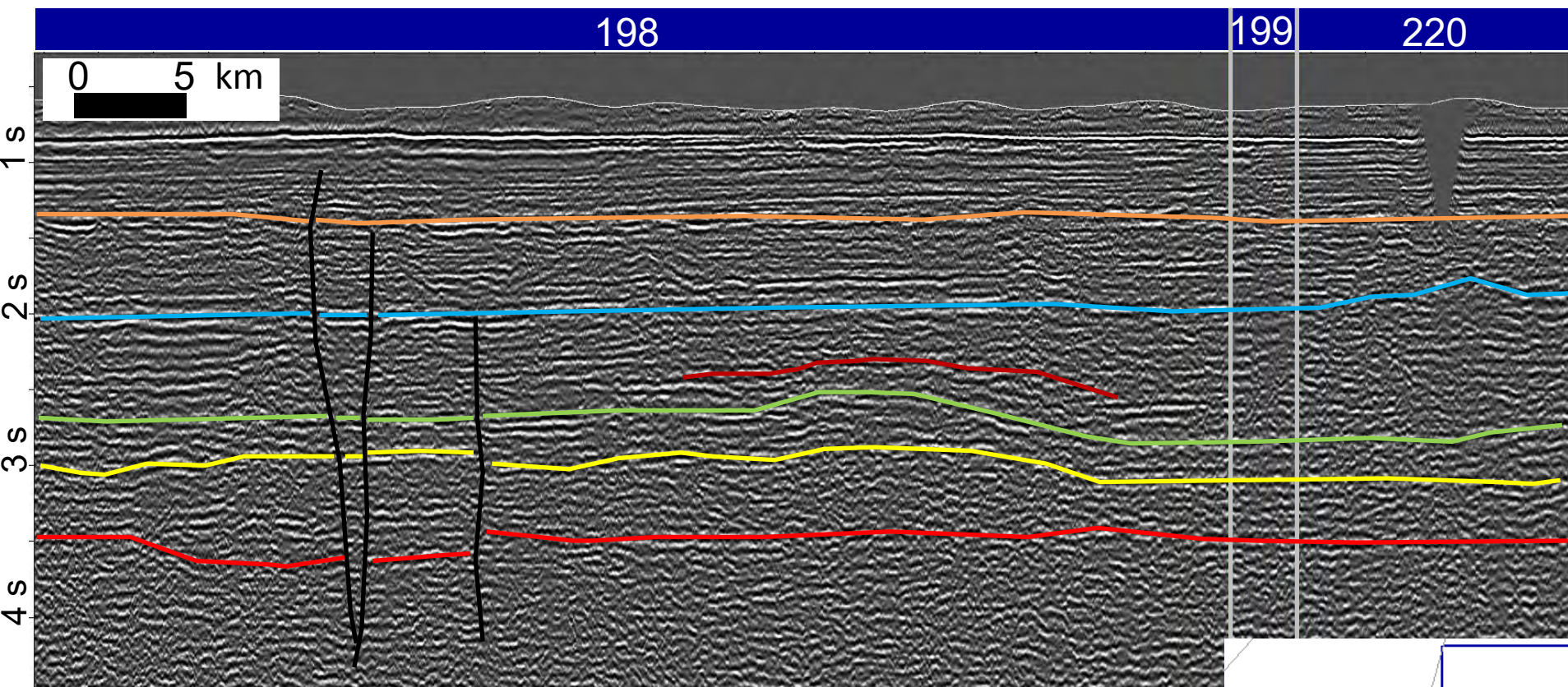
— Basement

— Faults



Leads

Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

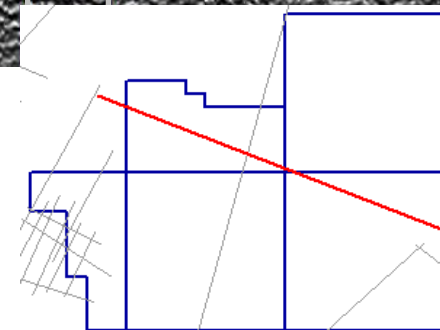
— Irati Fm.

— Ponta Grossa Fm.

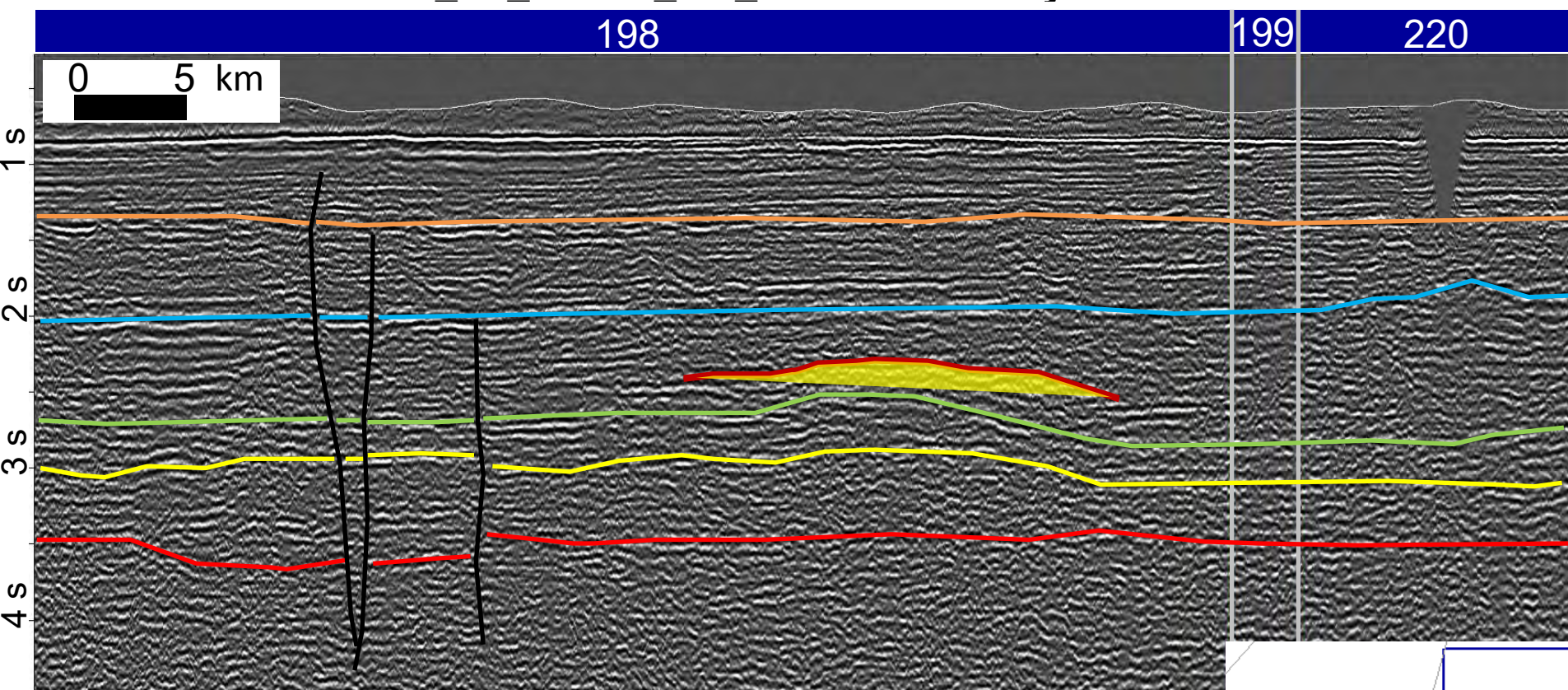
— Furnas Fm.

— Basement

— Faults



Line 0301-0002 / 0301_2D_BACIA_DO_PARANA Survey



Legend

— Sills

— Serra Geral Fm.

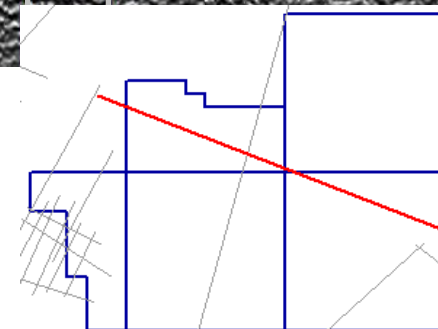
— Irati Fm.

— Ponta Grossa Fm.

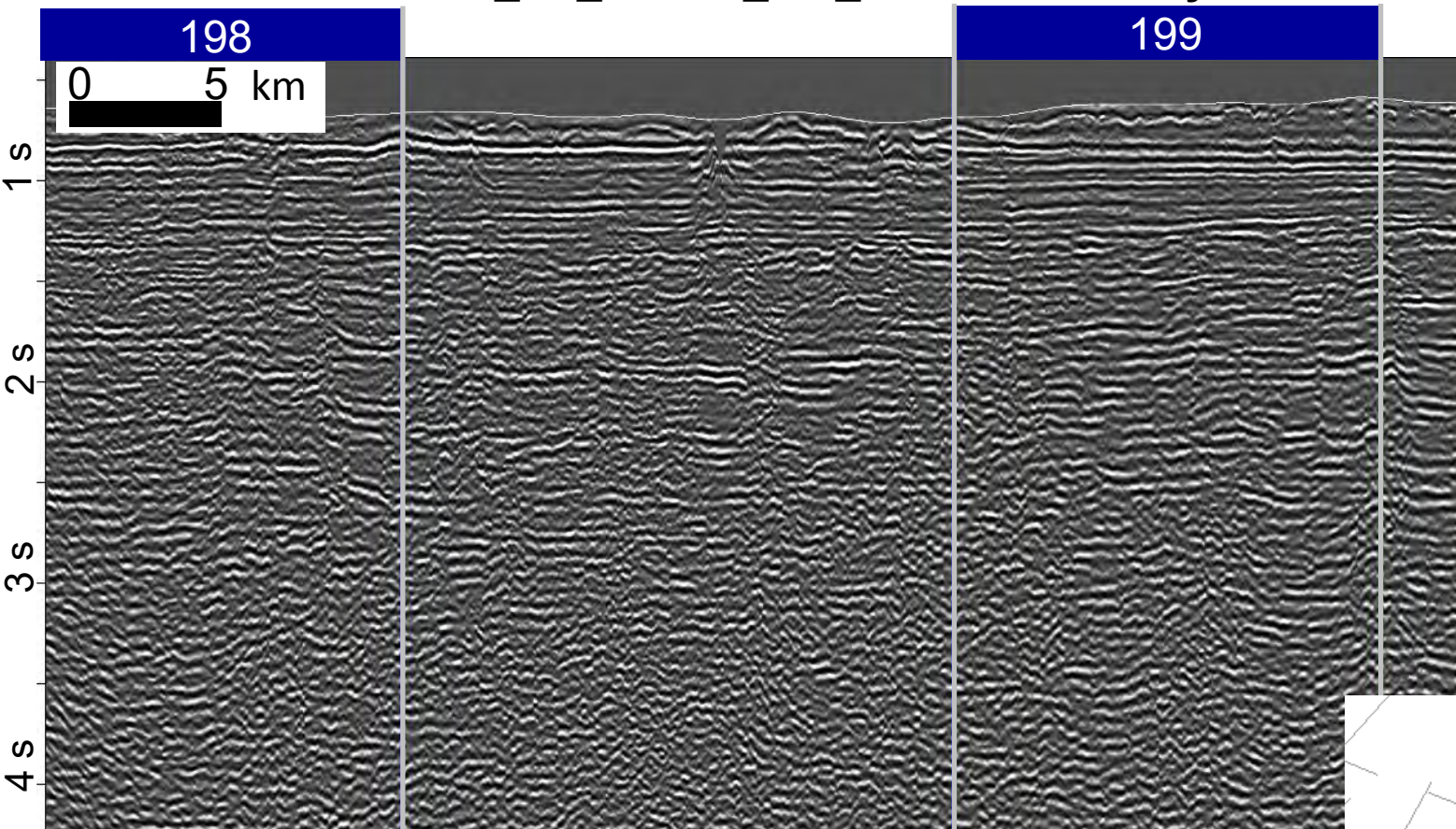
— Furnas Fm.

— Basement

— Faults

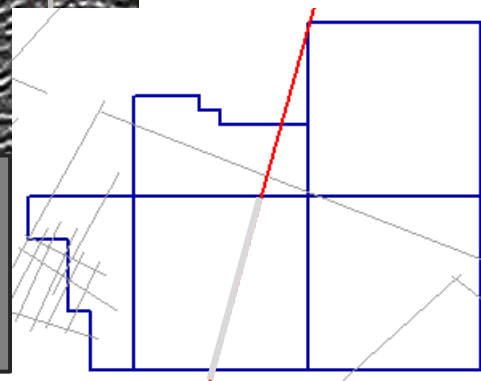


Line 0301-0007 / 0301_2D_BACIA_DO_PARANA Survey

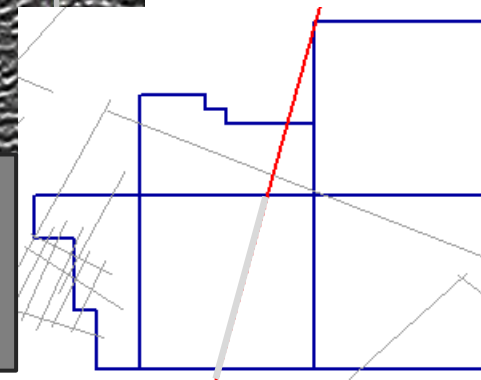
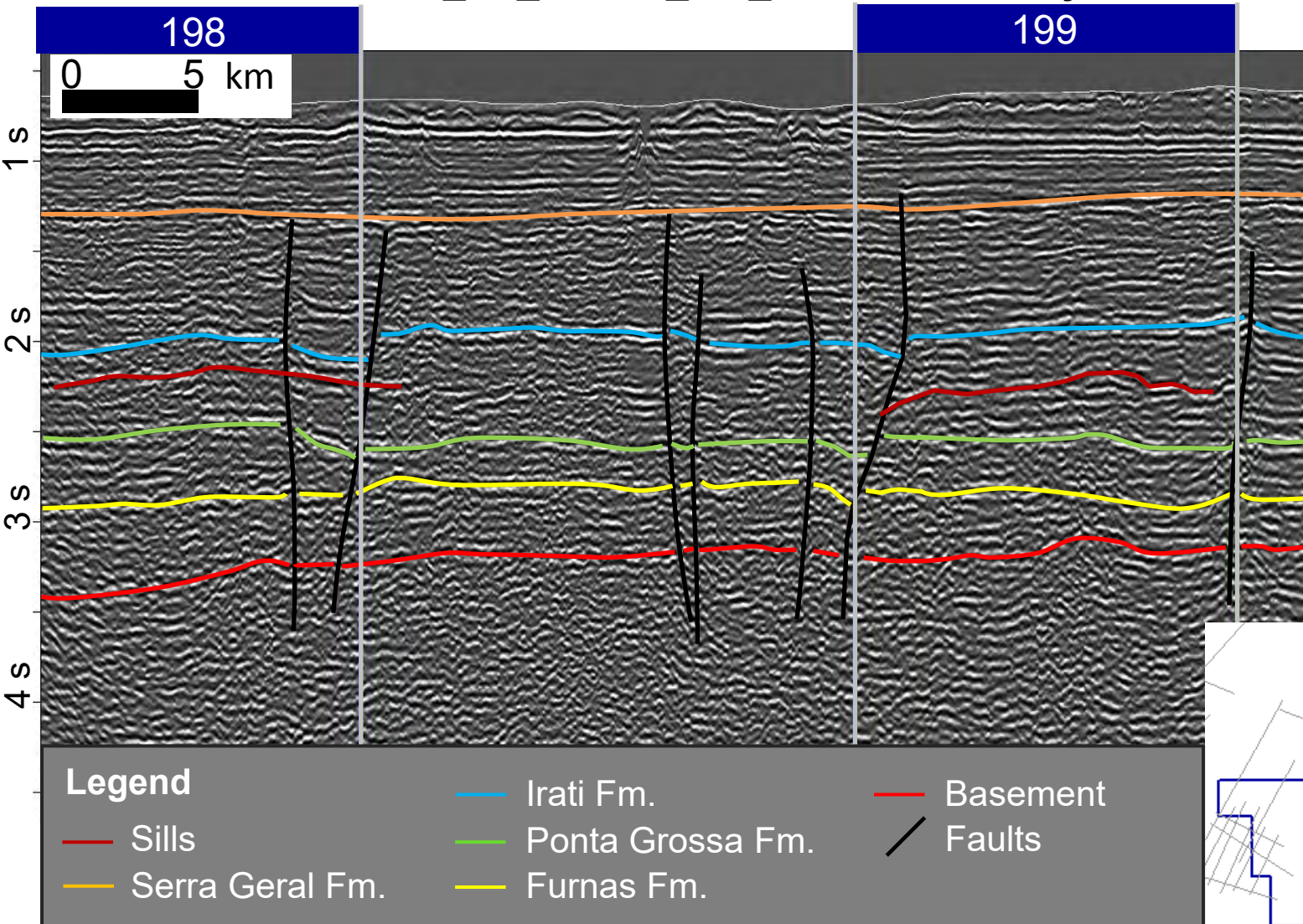


Legend

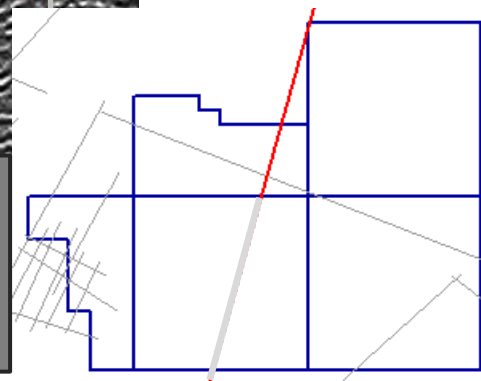
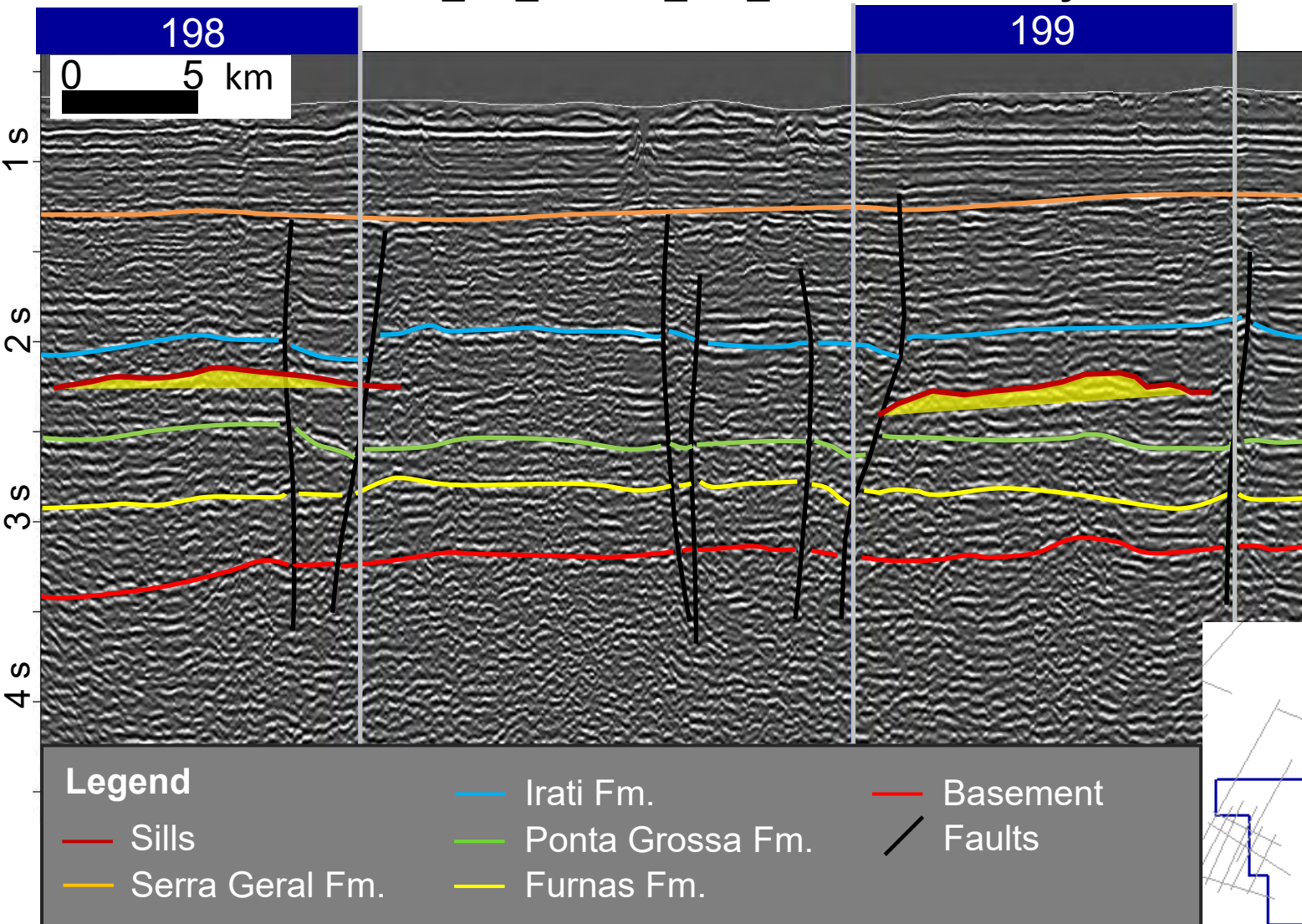
- Sills
- Serra Geral Fm.
- Irati Fm.
- Ponta Grossa Fm.
- Furnas Fm.
- Basement Faults



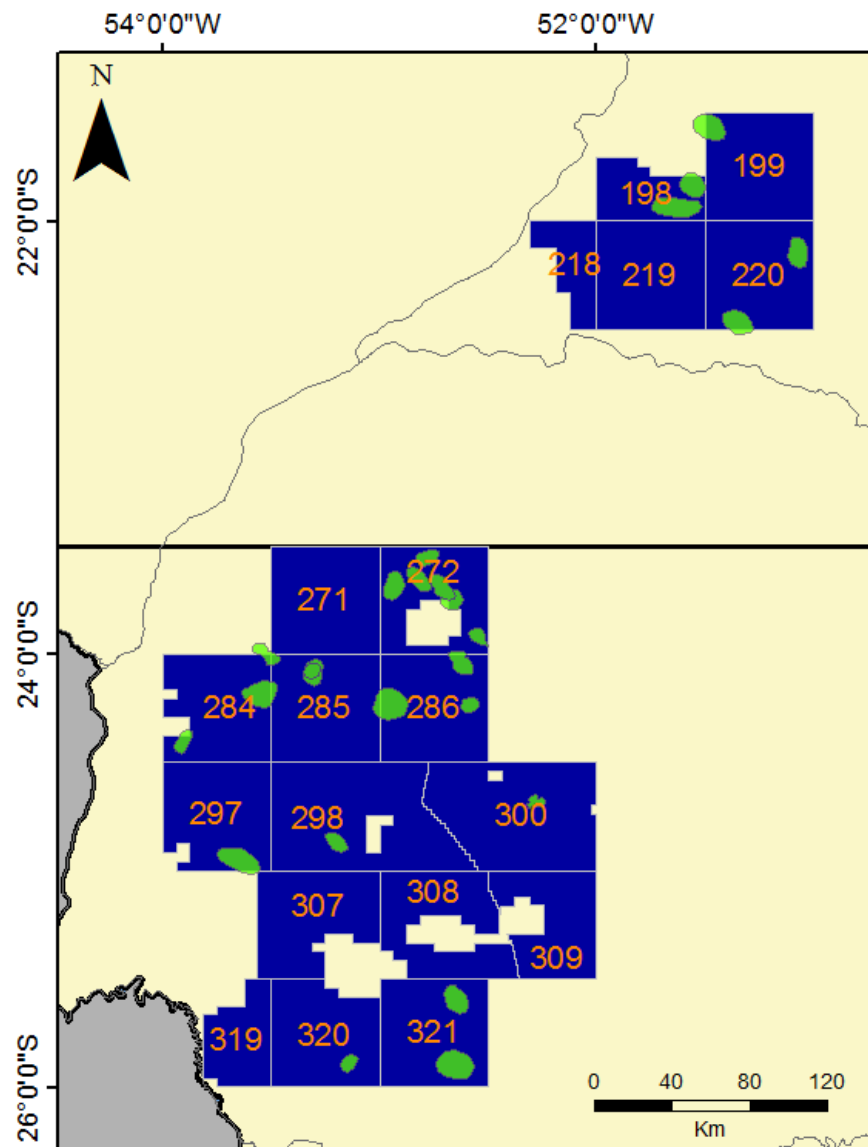
Line 0301-0007 / 0301_2D_BACIA_DO_PARANA Survey



Line 0301-0007 / 0301_2D_BACIA_DO_PARANA Survey



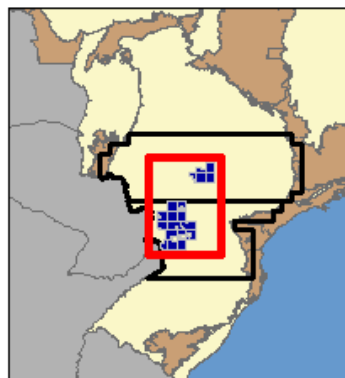
Leads



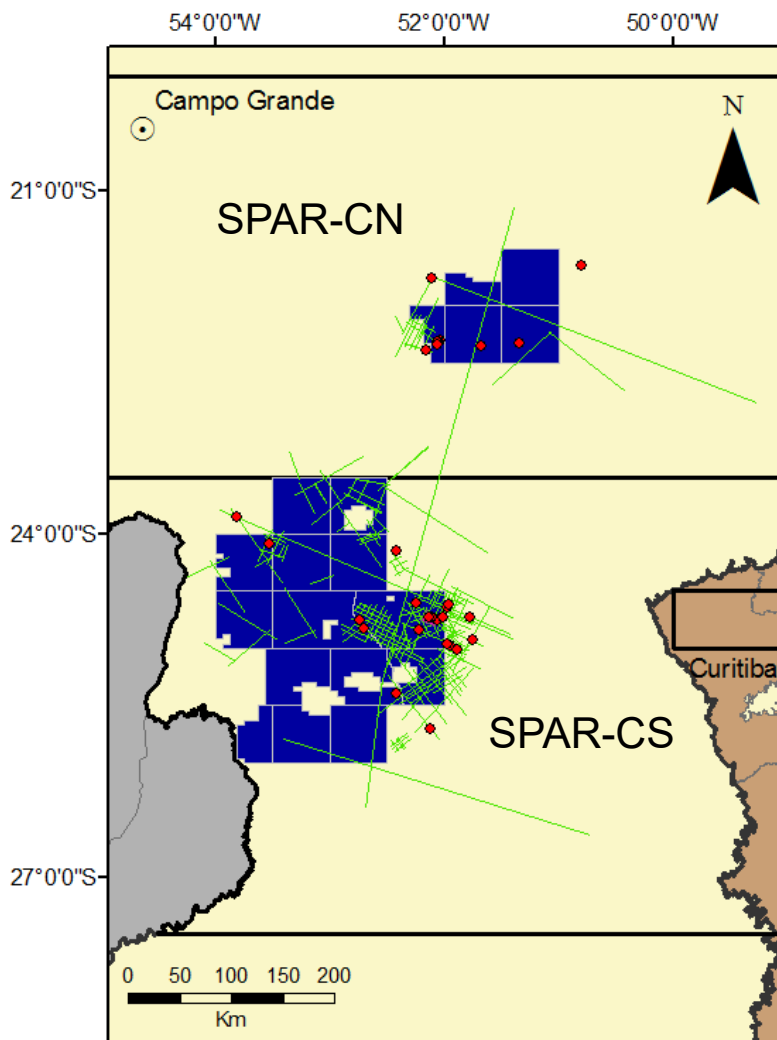
**In place gas volume estimated
~ 3.4 TCF**

Legenda





-  States
-  R12 Blocks
-  Sectors
-  Leads



Data Package



Legend

-  Capital
-  Exploration Wells
-  2D Seismic
-  3D Seismic
-  Blocks on Offer
-  Basement
-  Parana Basin
-  South America

34 Exploration Wells

9,474 km of 2D Public
Seismic
(Post-Stack)

151 km² of 3D Public
Seismic

Potential Methods

Geochemical Data

Contractual Aspects

Name of the Sector	SPAR-CN	SPAR-CS
Exploration Model	Frontier Basin	Frontier Basin
Number of Blocks	5	14
Area on Offer	11,101 km ²	38,272 km ²
Exploration Phase	6 years	6 years
Exploration Period	4 + 2 years	4 + 2 years
Technical Qualification of the Operator	C	C
Minimum Bonus	R\$ 168,297.52 – R\$ 612,498.16	R\$ 92,055.97 – R\$ 463,613.58
Exploration Objective	Permo-Carboniferous (Itarare Gr.)	Permo-Carboniferous (Itarare Gr.)
Stratigraphic Objective	Devonian (Ponta Grossa Fm.)	Devonian (Ponta Grossa Fm.)

Agenda

Location

Infrastructure and Operational Conditions

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

Plays

Area on Offer

Final Remarks

- Frontier Basin – underexplored in relation to large basin area
- Gas accumulations – confirm the potential of Parana Basin
- Privileged location – the most industrialized region of South America and the largest Brazilian consumer market
- New technologies in acquisition and seismic processing can be used to improve the quality of regional data

- Technical studies promoted by ANP– leads identified in dome-shaped structures associated to sills and anticlines associated to faults
- For the area on offer, in place volumes estimated are 3.4 TCF of gas
- Various other exploration opportunities may occur in different stratigraphic horizons: increase of the expected volume for the area on offer

National Agency of Petroleum, Natural Gas and Biofuels

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www.anp.gov.br

