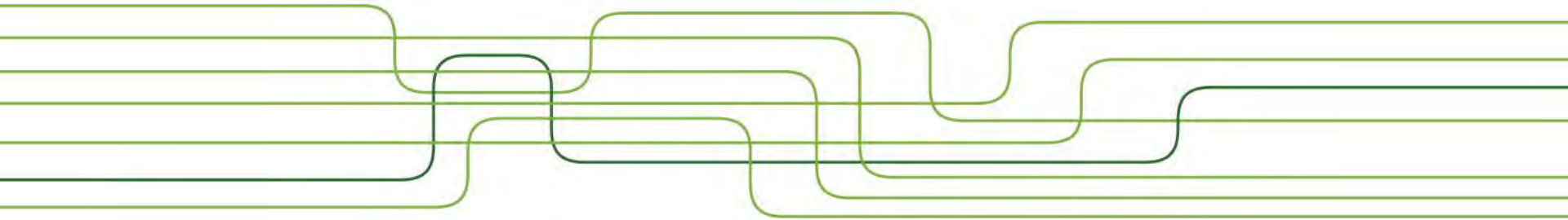


# Brasil12<sup>th</sup>Round

Oil & Gas Bidding Rounds

## Sao Francisco Basin

Andrei Dignart



**Location**

**Infrastructure**

**Exploration Overview**

**Tectonostratigraphic Evolution**

**Petroleum Systems**

**Plays**

**Proterozoic Basins E&P**

**Area on Offer**

**Final Remarks**

**Location**

**Infrastructure**

**Exploration Overview**

**Tectonostratigraphic Evolution**

**Petroleum Systems**

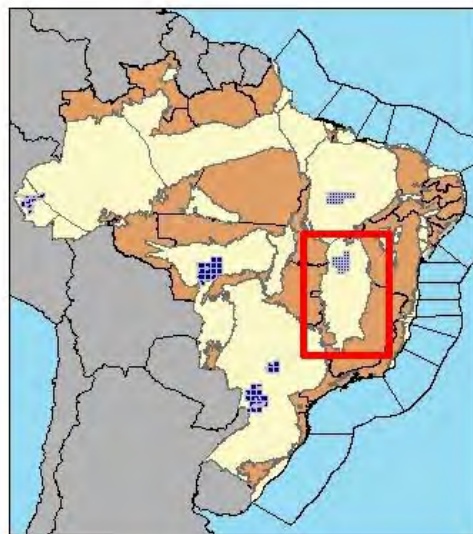
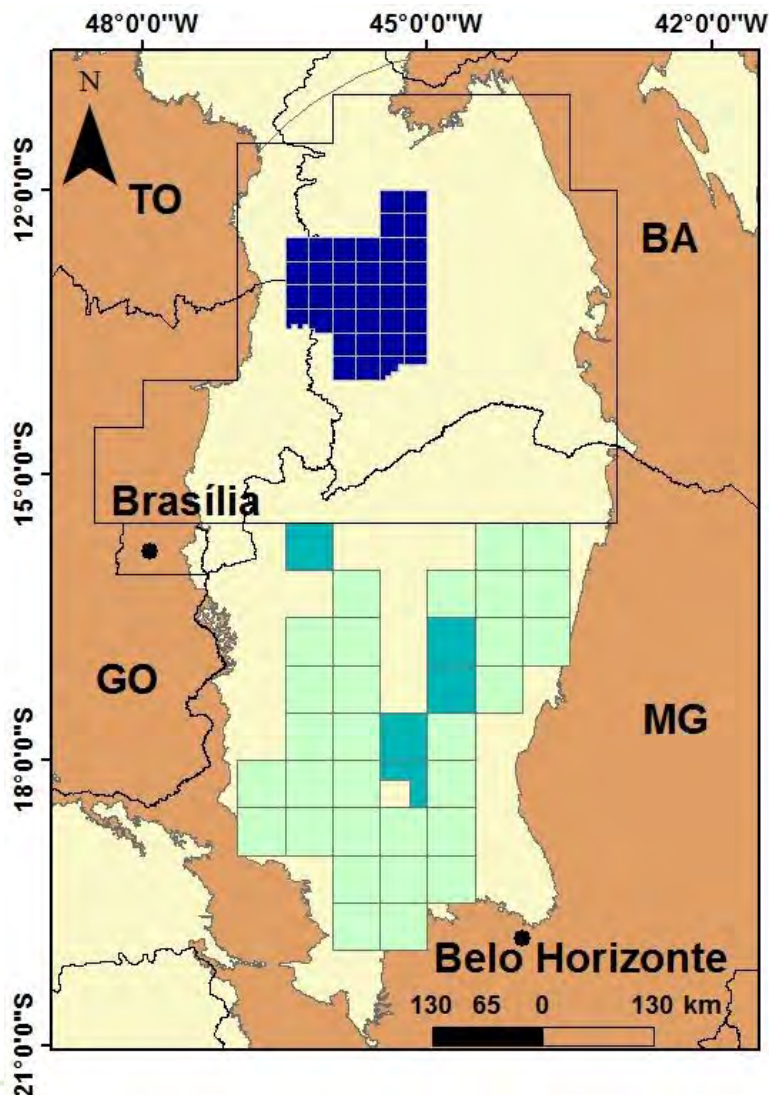
**Plays**

**Proterozoic Basins E&P**

**Area on Offer**

**Final Remarks**

# Location



**Sao Francisco  
Basin**

**Proterozoic**

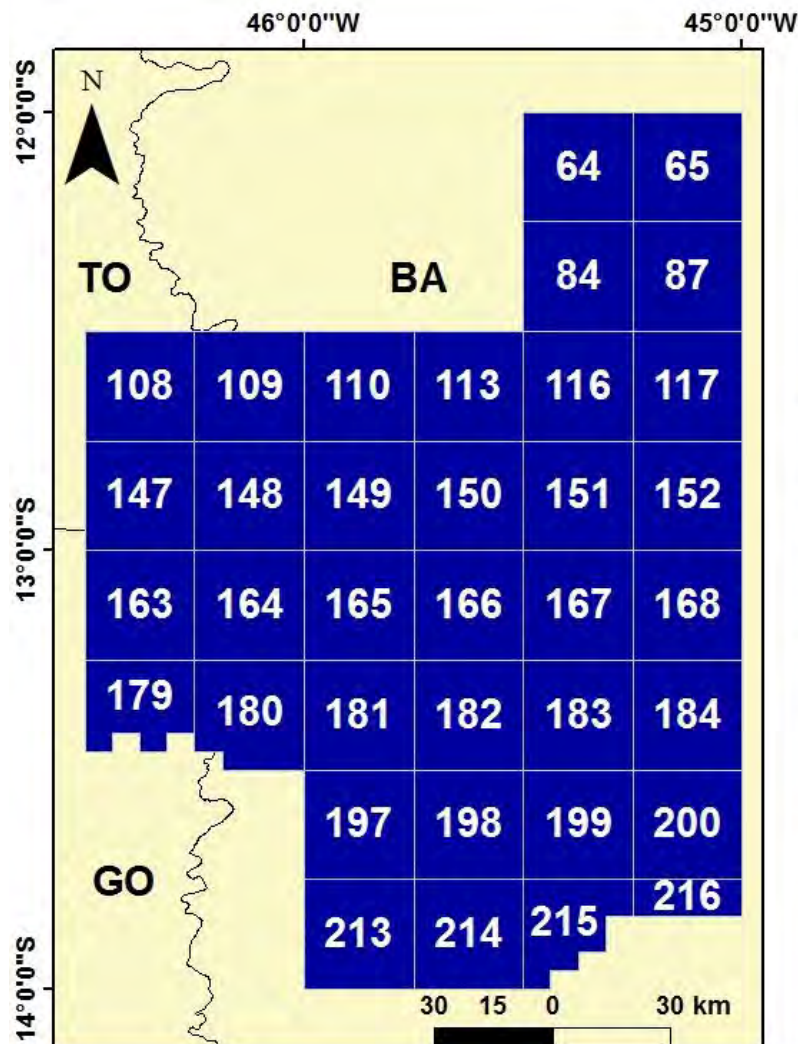
**Area: ~370,000 km<sup>2</sup>**

**Sector on offer:  
SF-N**

**Blocks on offer: 36**

**Area on offer:  
~26,000 km<sup>2</sup>**

# Location



Location

**Infrastructure**

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

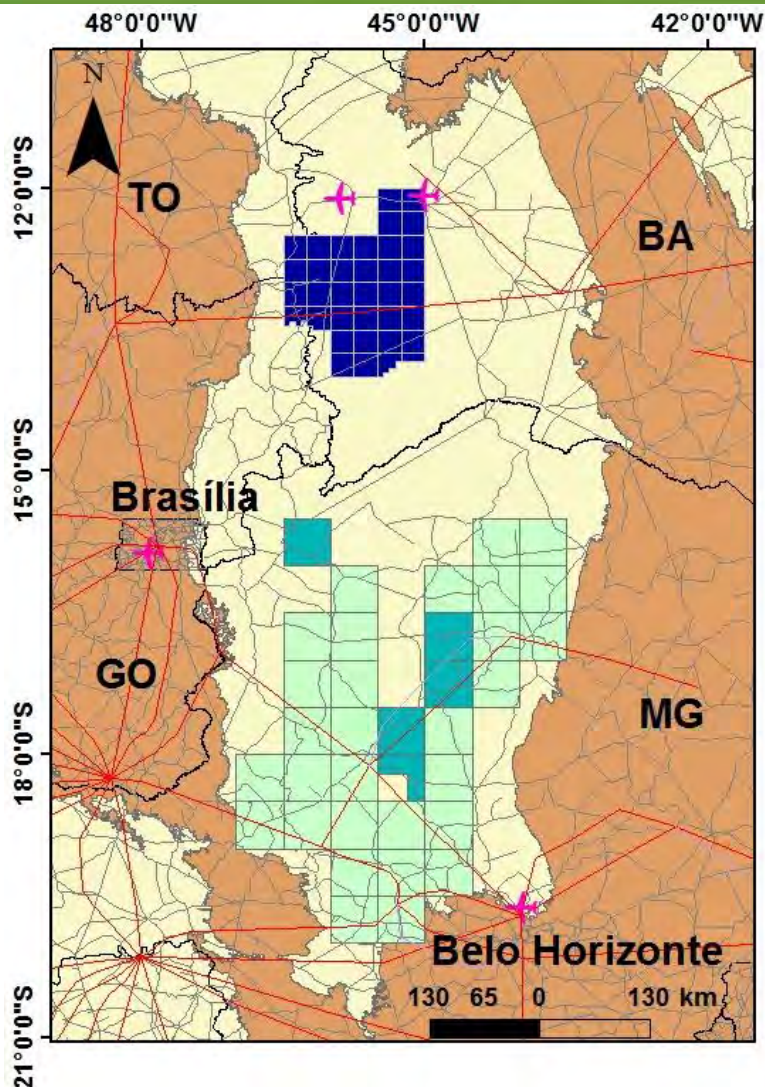
Plays

Proterozoic Basins E&P

Area on Offer

Final Remarks

# Infrastructure



Location

Infrastructure

**Exploration Overview**

Tectonostratigraphic Evolution

Petroleum Systems

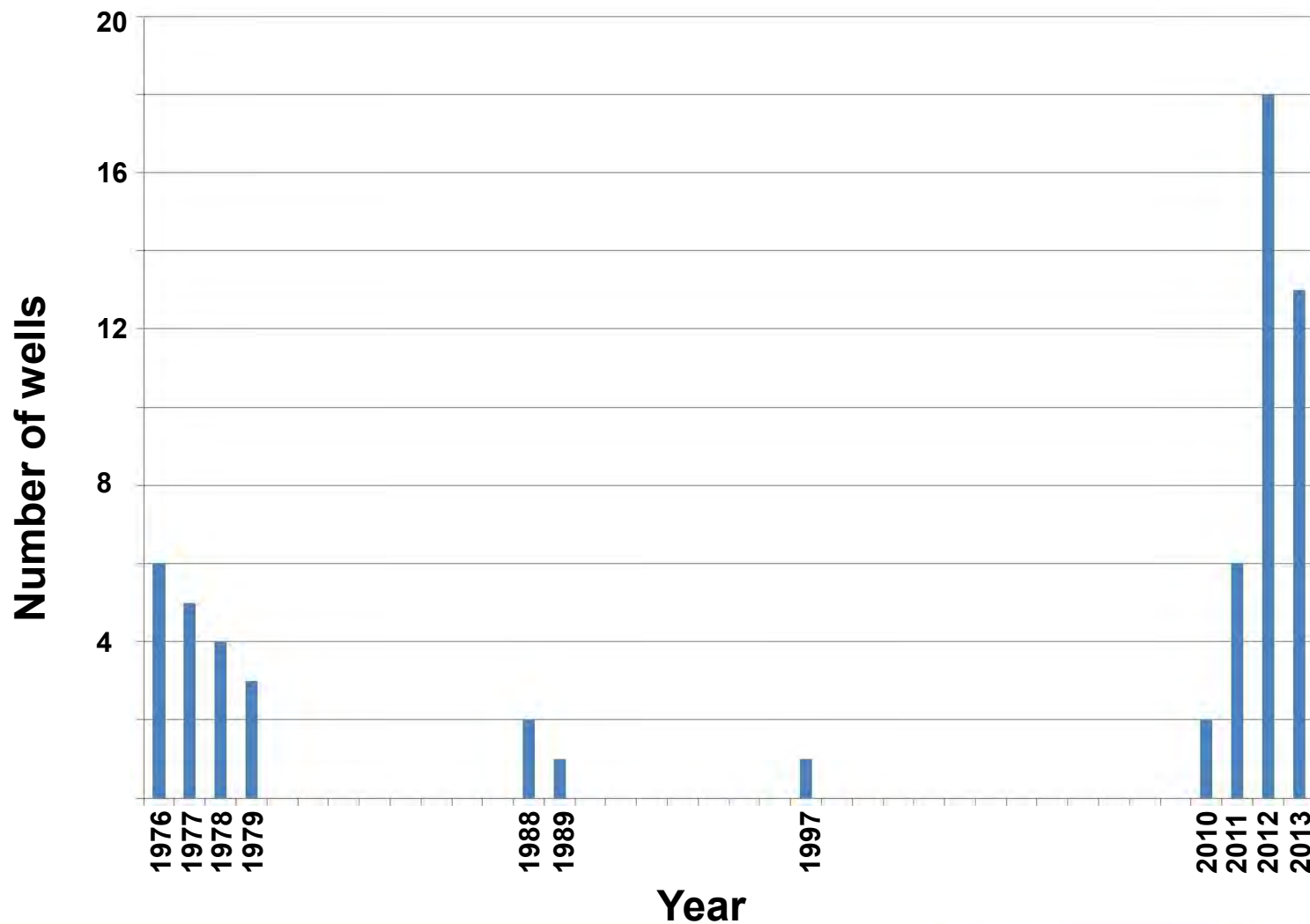
Plays

Proterozoic Basins E&P

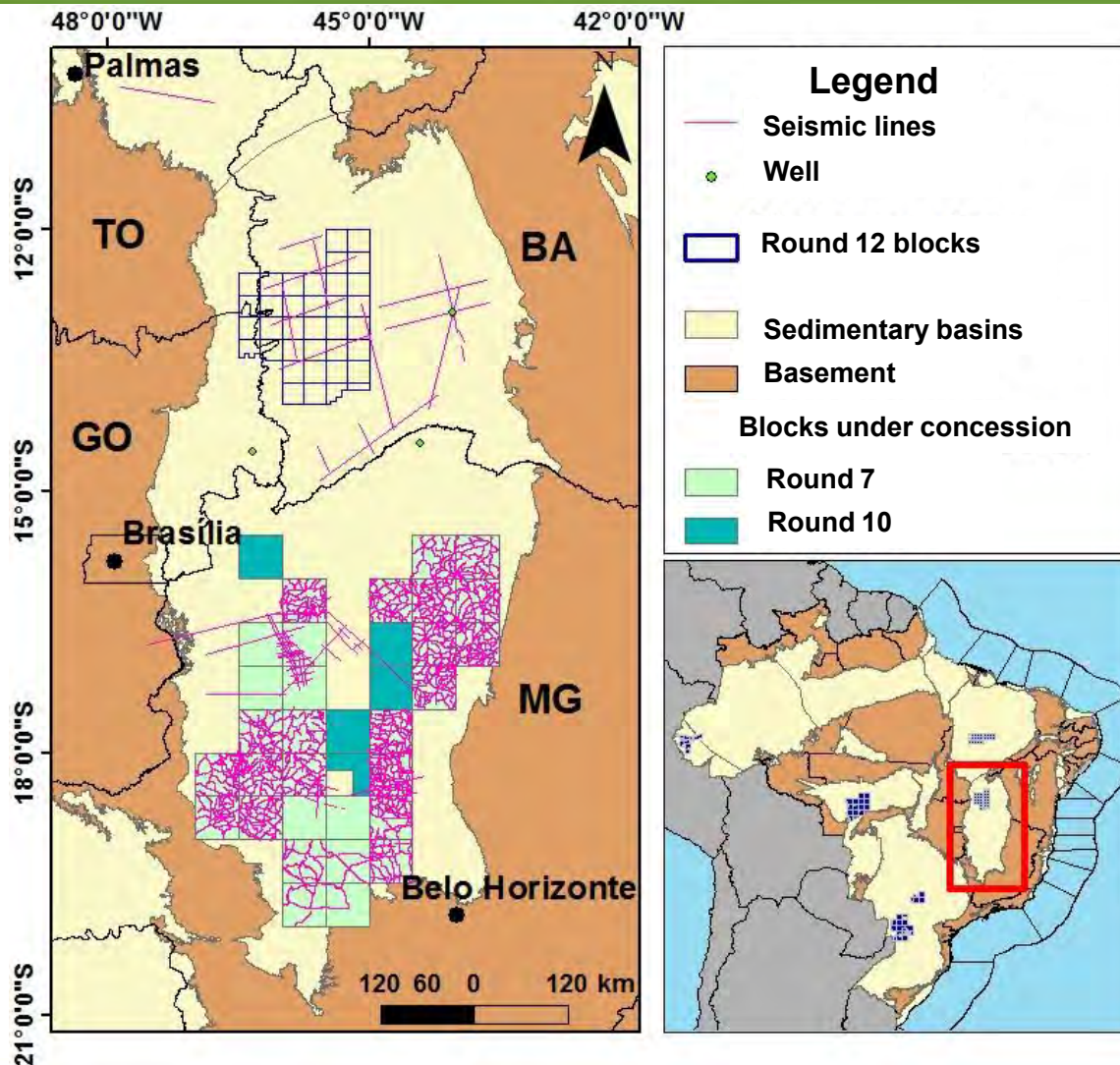
Area on Offer

Final Remarks

# Exploration Overview



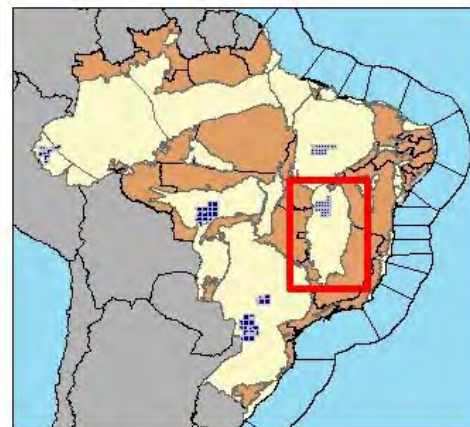
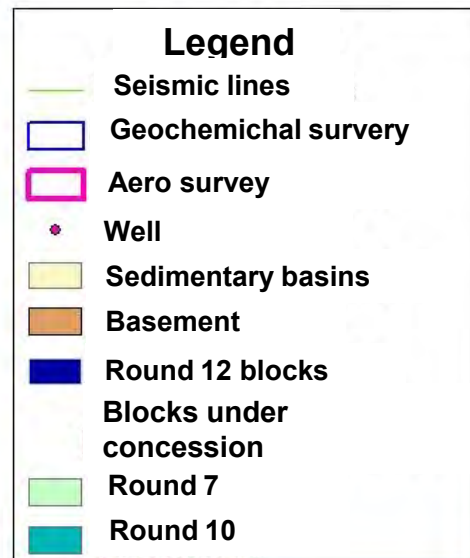
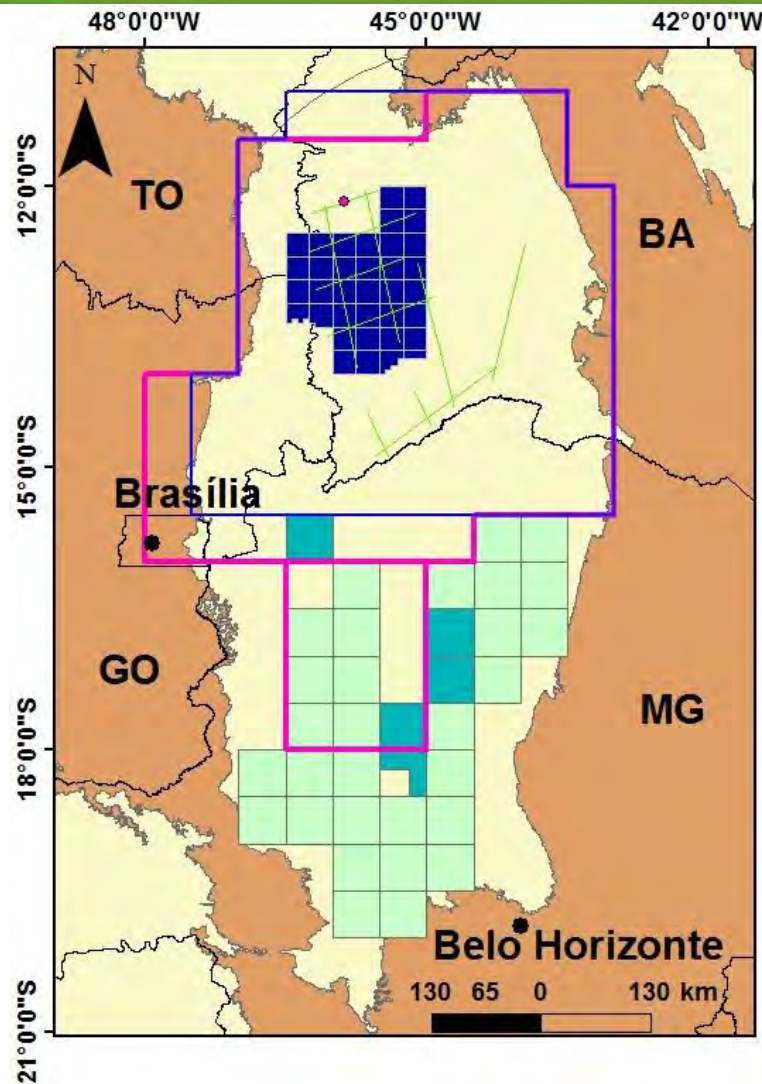
# Exploration Overview



**59 Exploration  
wells**

**~25,000 km of 2D  
seismic**

# Exploration Overview



**ANP investment  
R\$ 108 millions**

**2,000 surface  
geochemistry  
sampling points**

**1,500 km 2D seismic  
survey**

**Gravity and  
magnetics aero  
surveys**

**Stratigraphic well  
drilling  
2-ANP-003-BA**

Location

Infrastructure

Exploration Overview

**Tectonostratigraphic Evolution**

Petroleum Systems

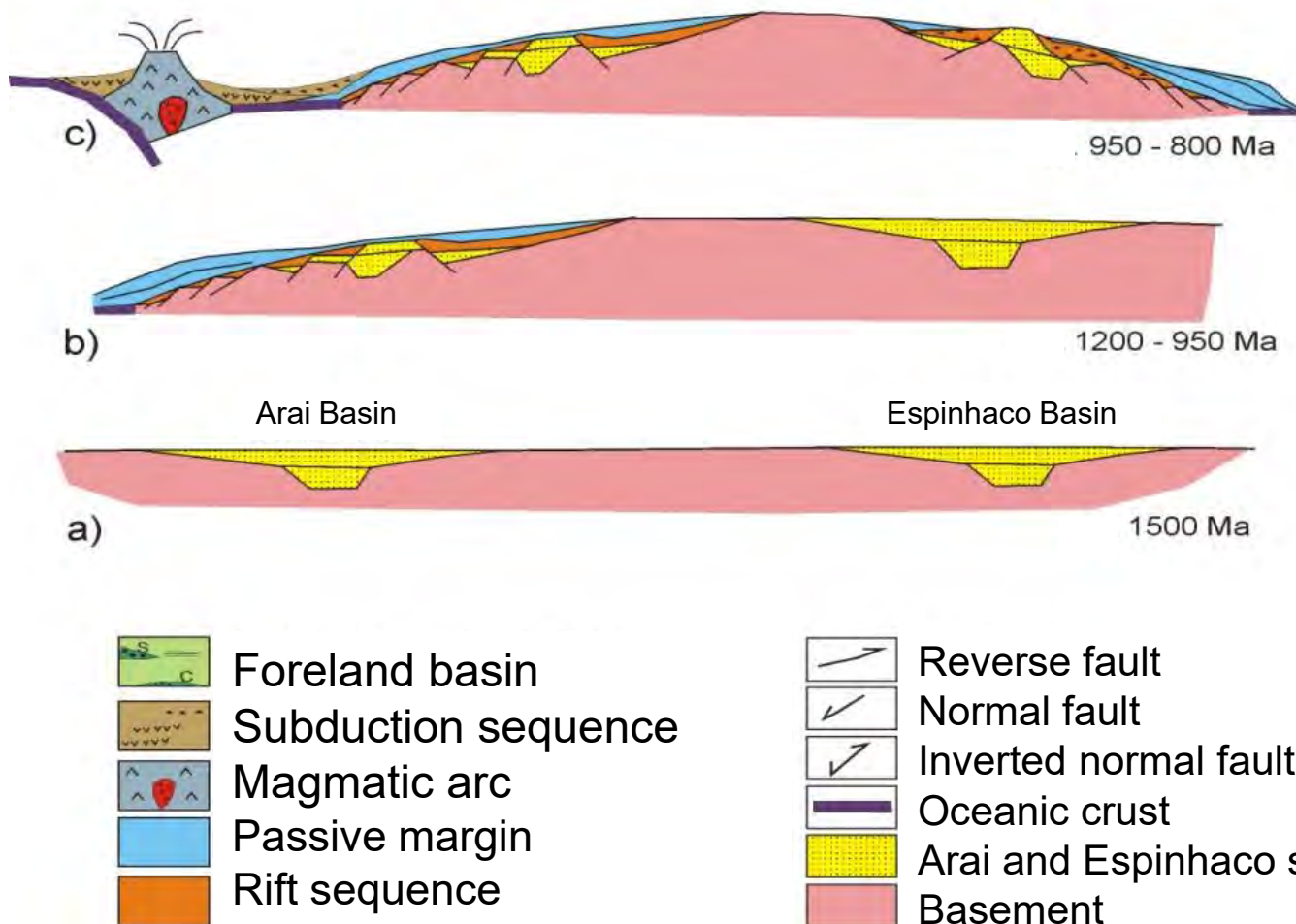
Plays

Proterozoic Basins E&P

Area on Offer

Final Remarks

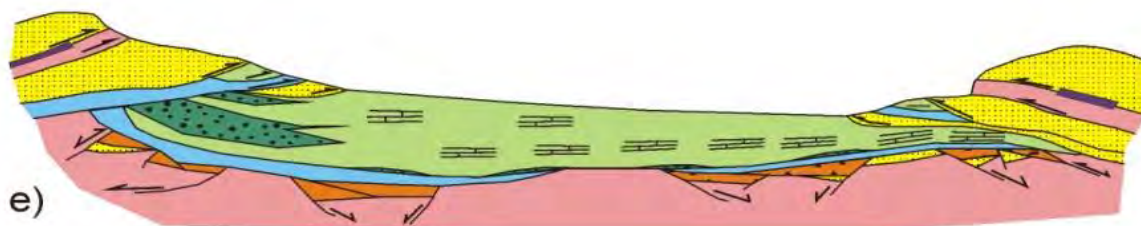
# Tectonostratigraphic evolution



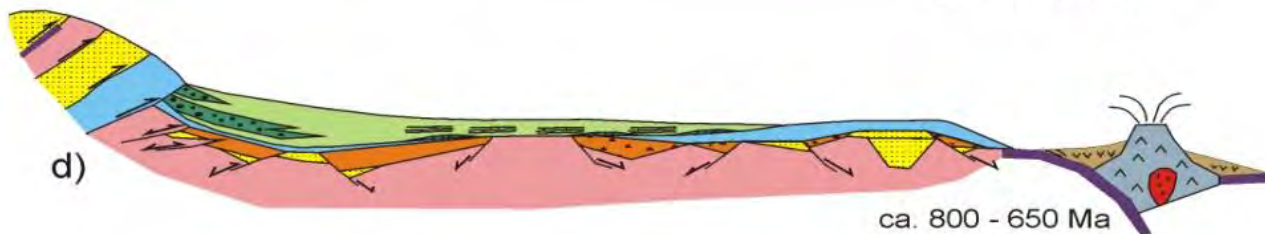
Martins-Neto & Alkmim, 2001

# Tectonostratigraphic evolution




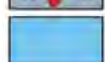
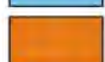
Brasilia Fold Belt      ←      Sao Francisco Craton      →      Aracuai Fold Belt


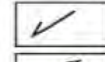
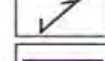


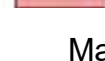


ca. 650 - 500 Ma



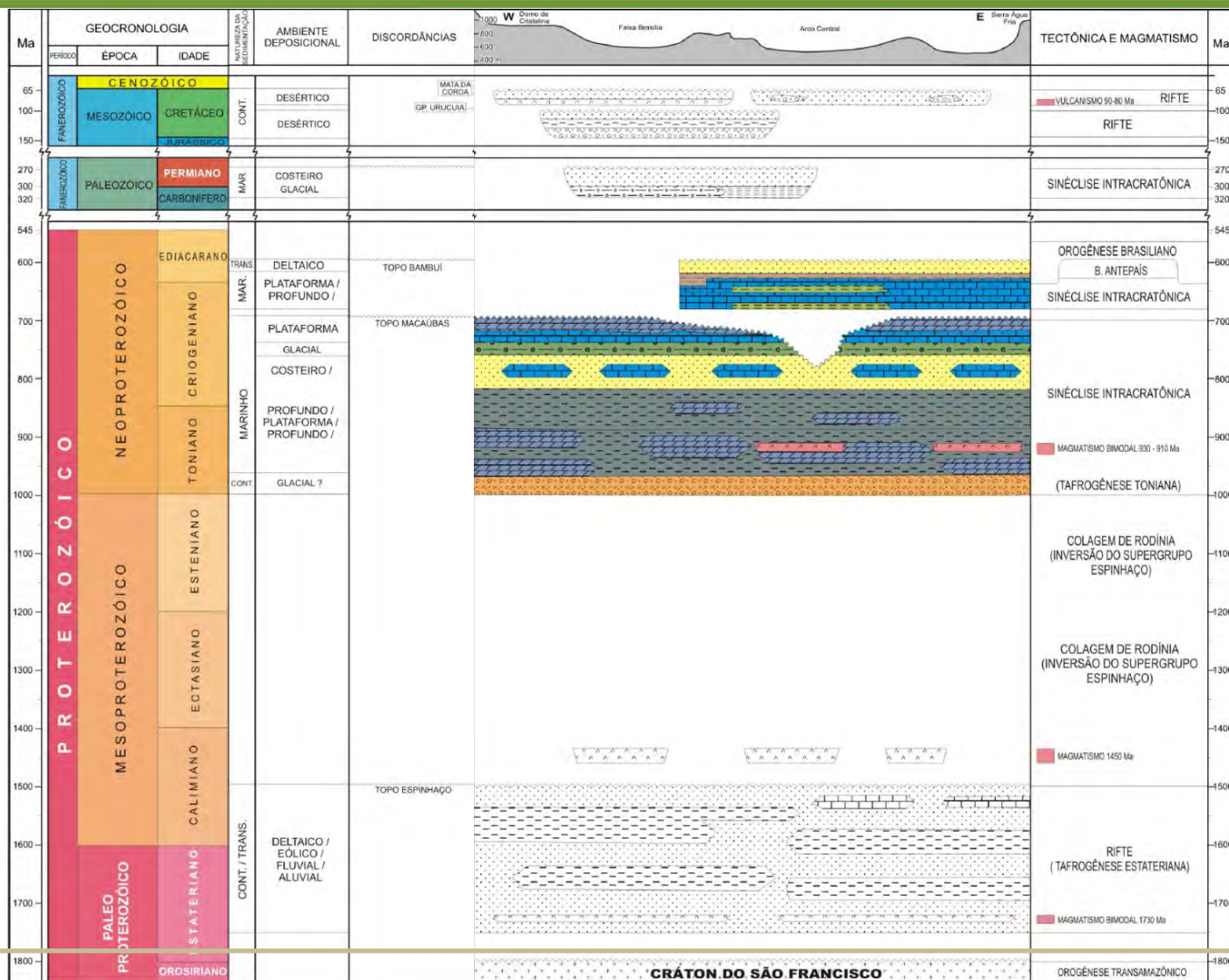
ca. 800 - 650 Ma

-  Foreland basin
-  Subduction sequence
-  Magmatic arc
-  Passive margin
-  Rift sequence

-  Reverse fault
-  Normal fault
-  Inverted normal fault
-  Oceanic crust
-  Arai and Espinhaco sediments
-  Basement

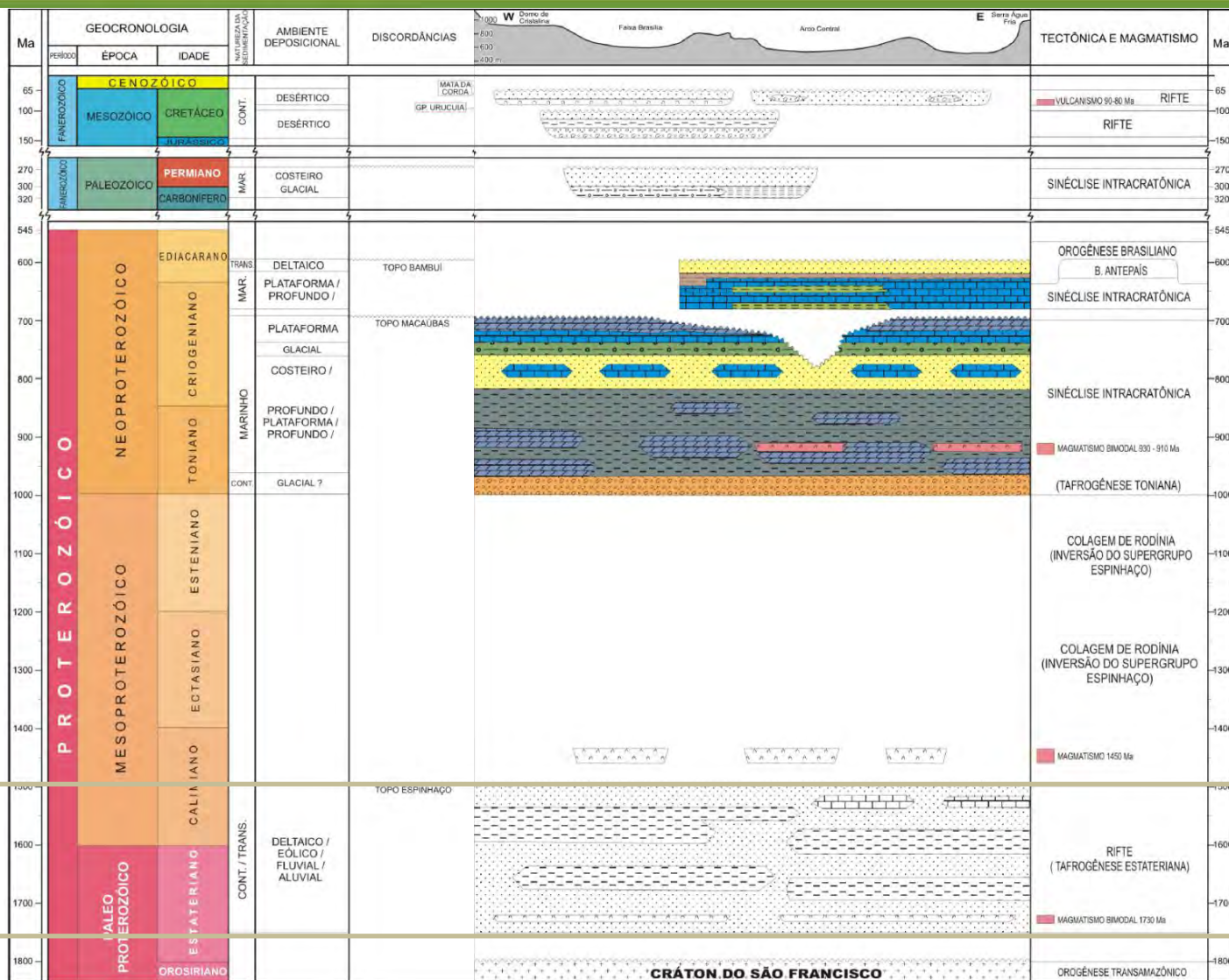
Martins-Neto & Alkmim, 2001

# Tectonostratigraphic evolution



Basement

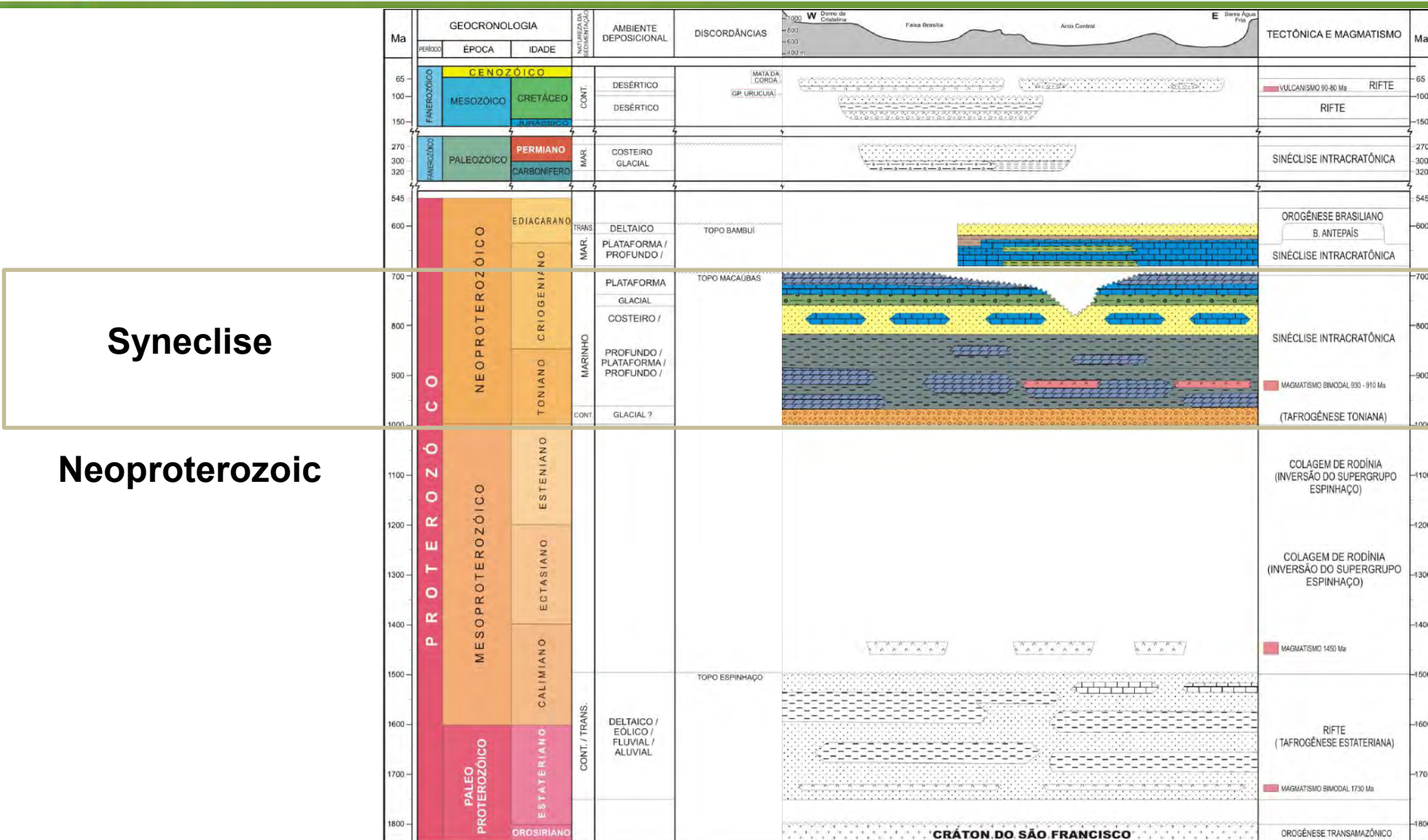
# Tectonostratigraphic evolution



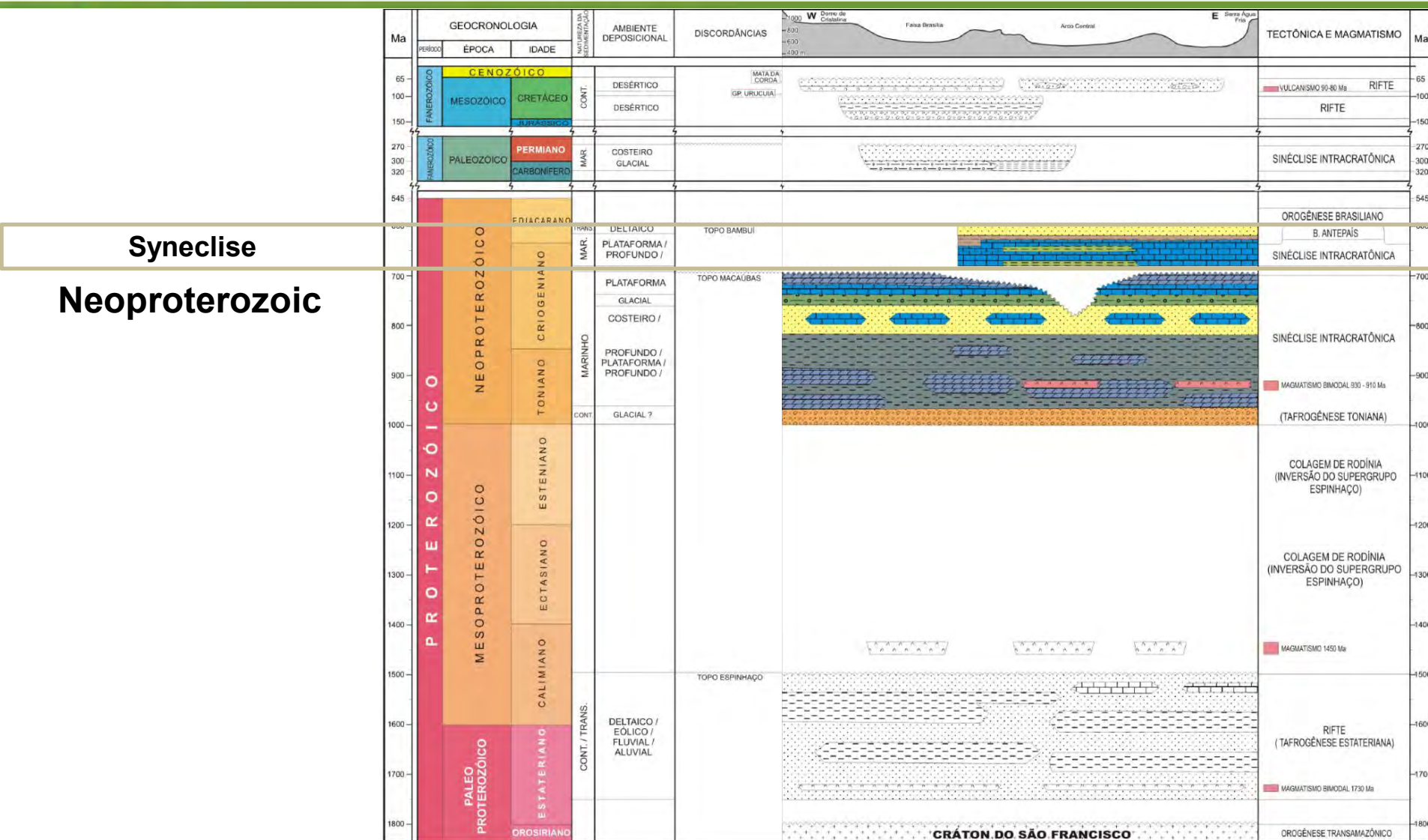
**Paleo-  
Mesoproterozoic**

**Rift Sequence**

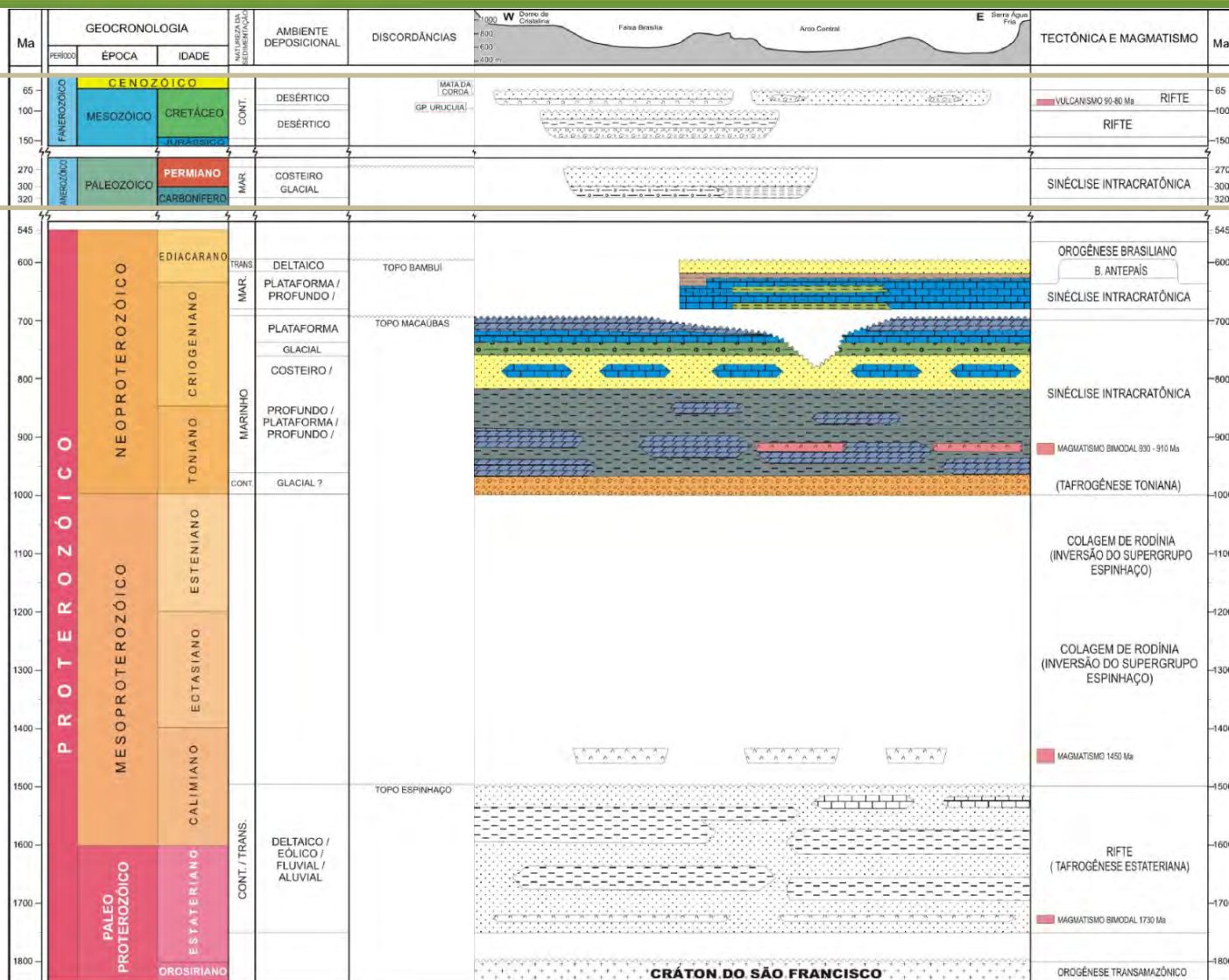
# Tectonostratigraphic evolution



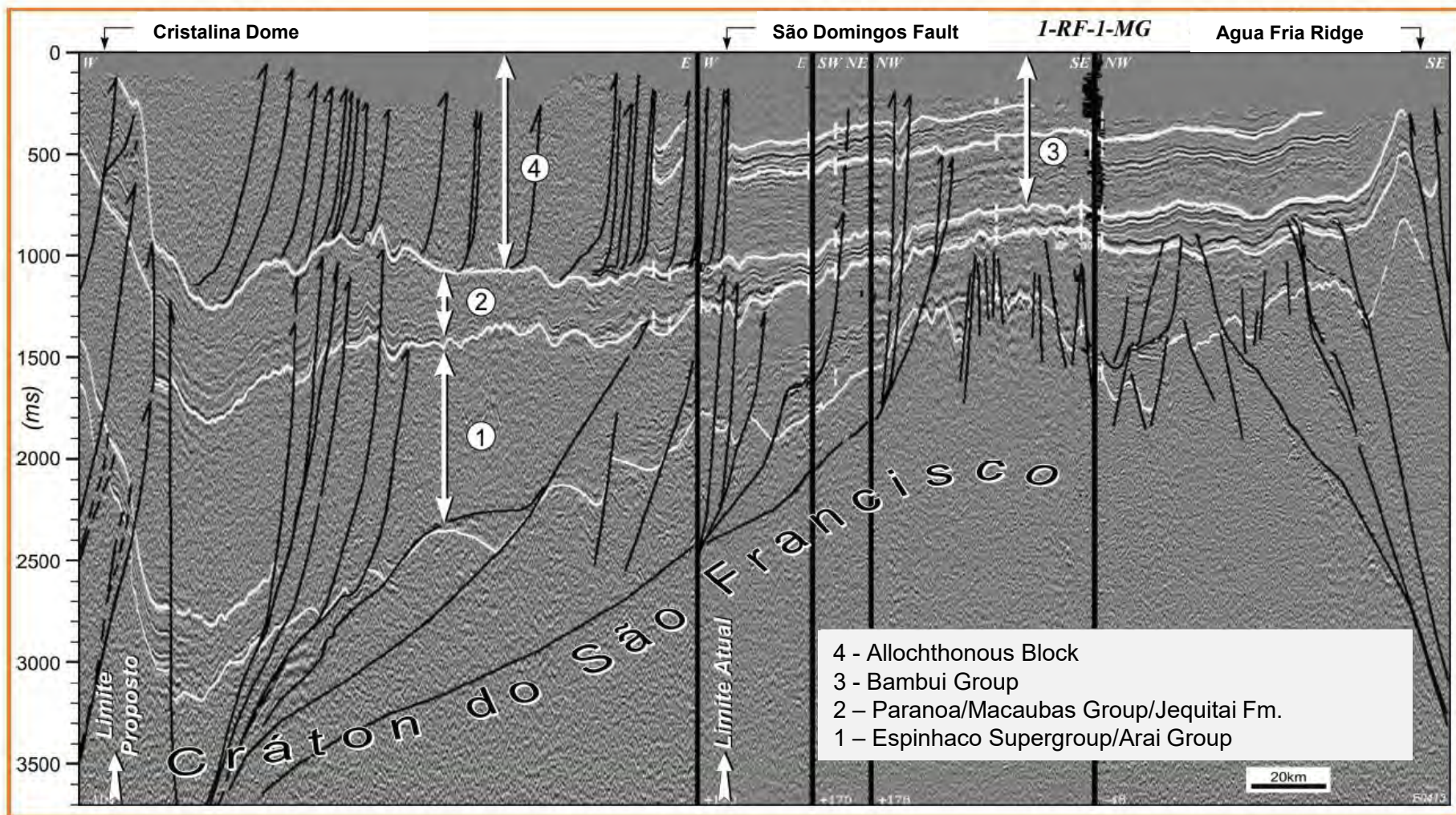
# Tectonostratigraphic evolution



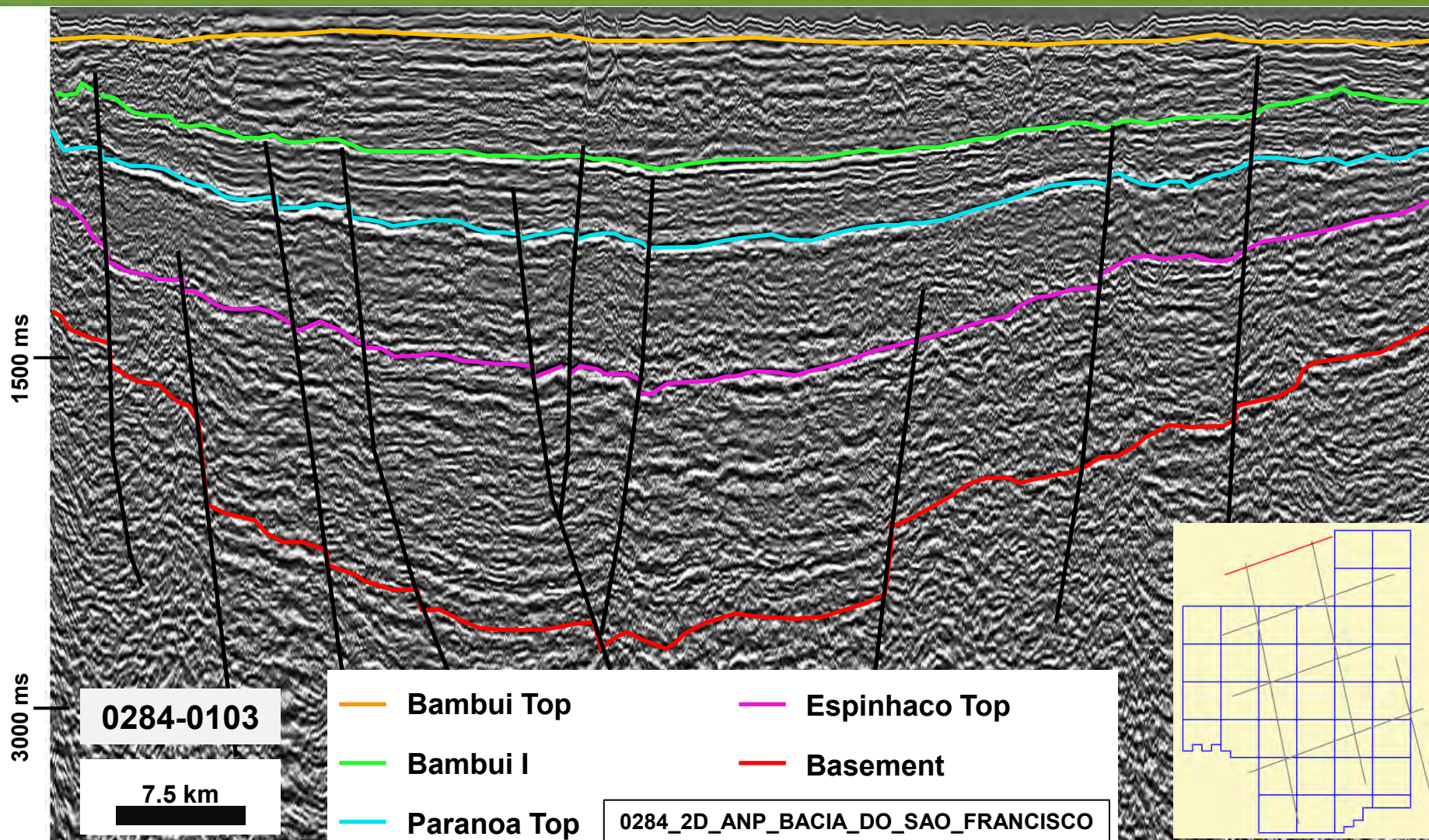
# Tectonostratigraphic evolution



# Tectonostratigraphic evolution



# Tectonostratigraphic evolution



Location

Infrastructure

Exploration Overview

Tectonostratigraphic Evolution

**Petroleum Systems**

Plays

Proterozoic Basins E&P

Area on Offer

Final Remarks

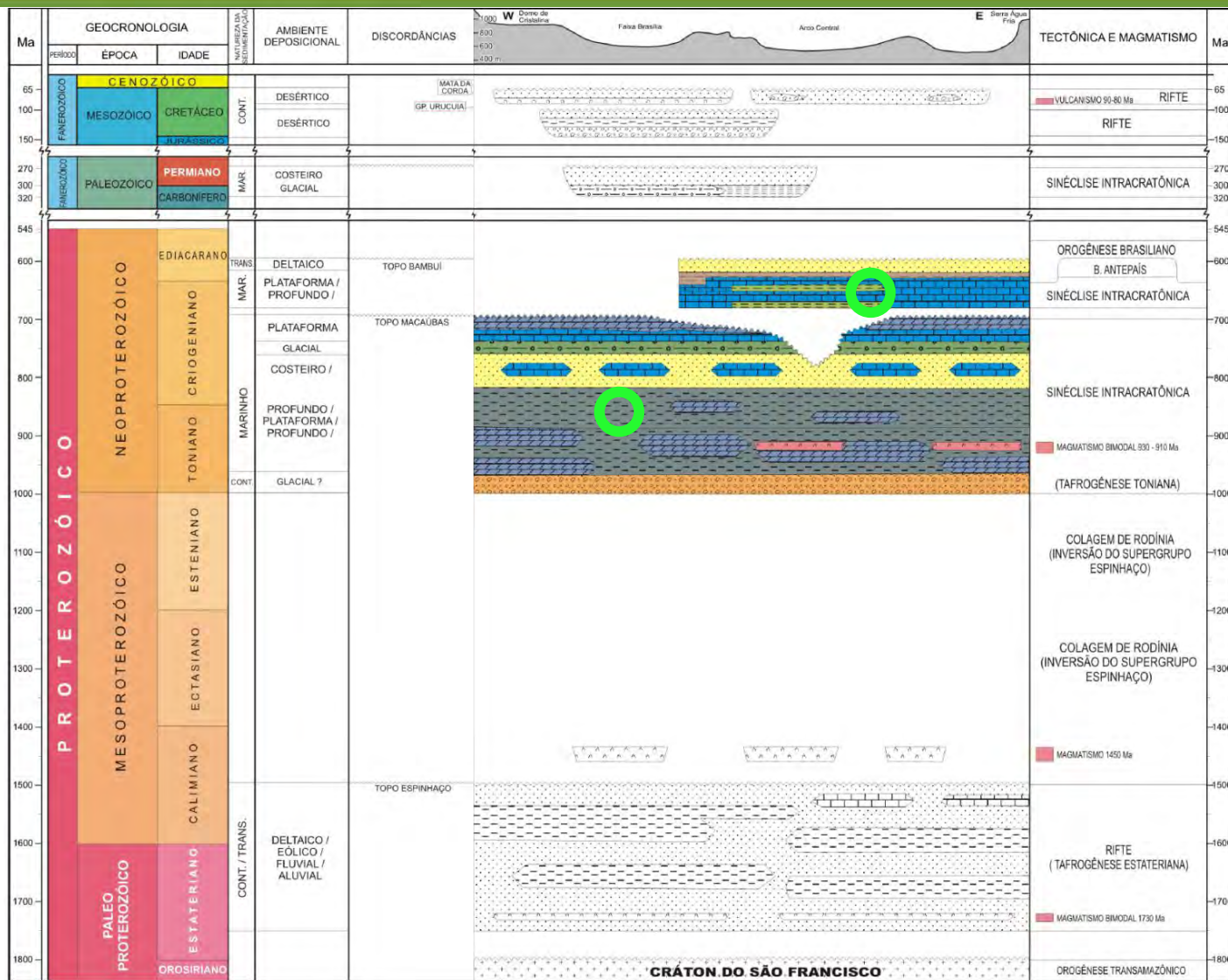
# Source Rocks

**Possible  
cryogenian source  
rocks:**

Lagoa do Jacare Fm.  
And Sete Lagoas Fm.  
carbonates and black  
shales (Bambui Gr.)

**TOC up to 15%**

Paranoa Group black  
shales

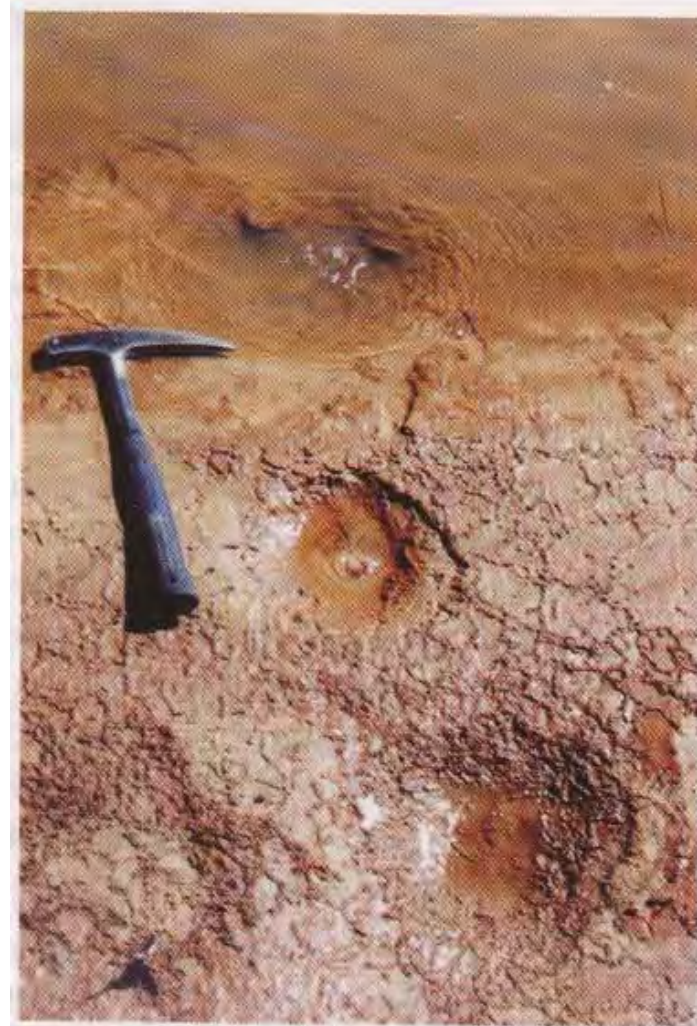


# Petroleum Systems

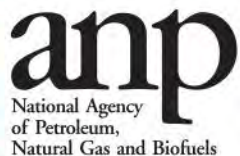
## Gas Seeps Along Paracatu River



Meister *et al.*, 2007

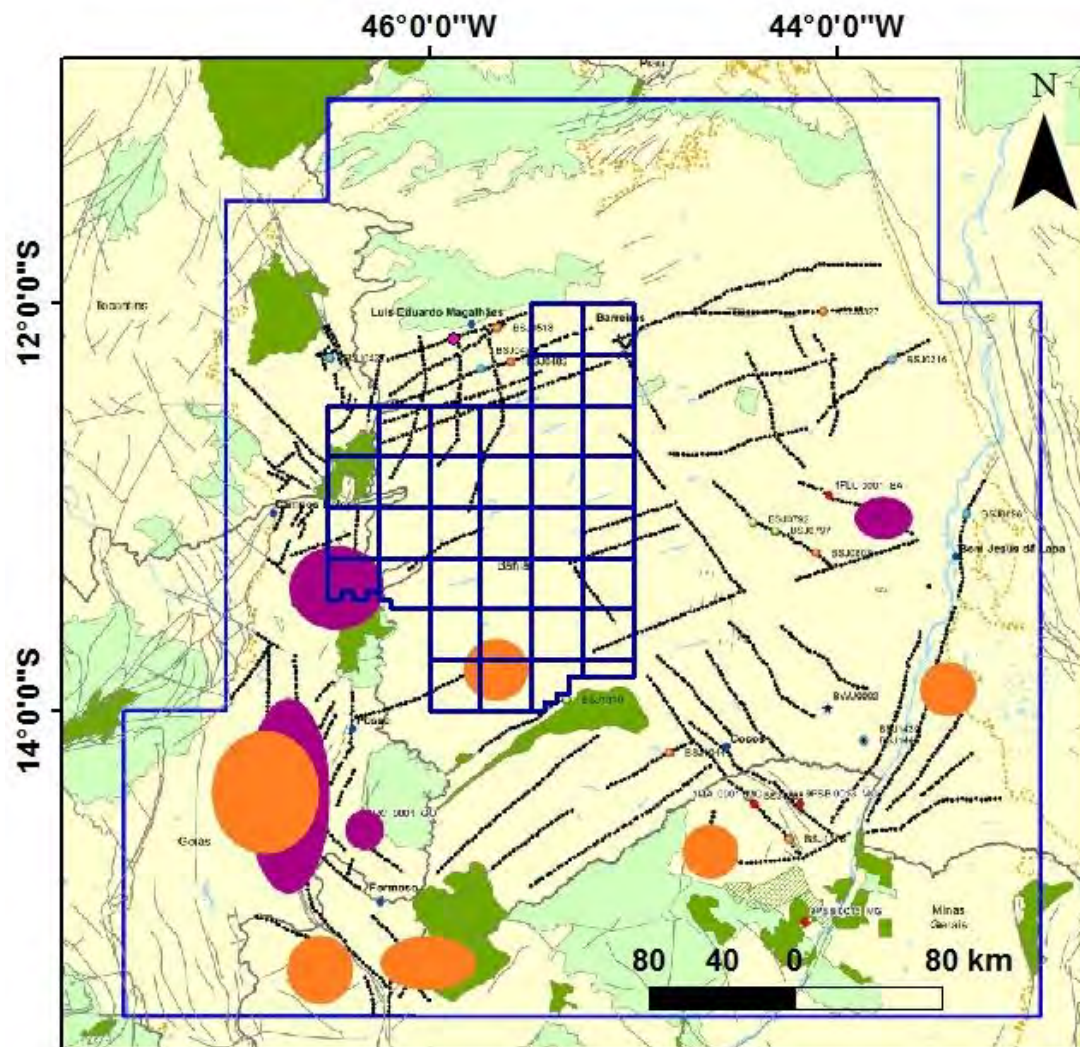
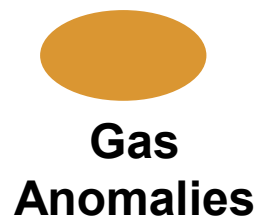
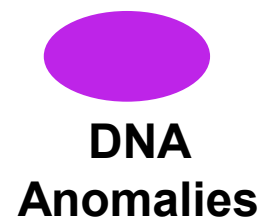


Pinto *et al.*, 2001



**Brasil**  
**12<sup>th</sup> Round**  
Oil & Gas Bidding Rounds

# Petroleum Systems



# Reservoir Rocks

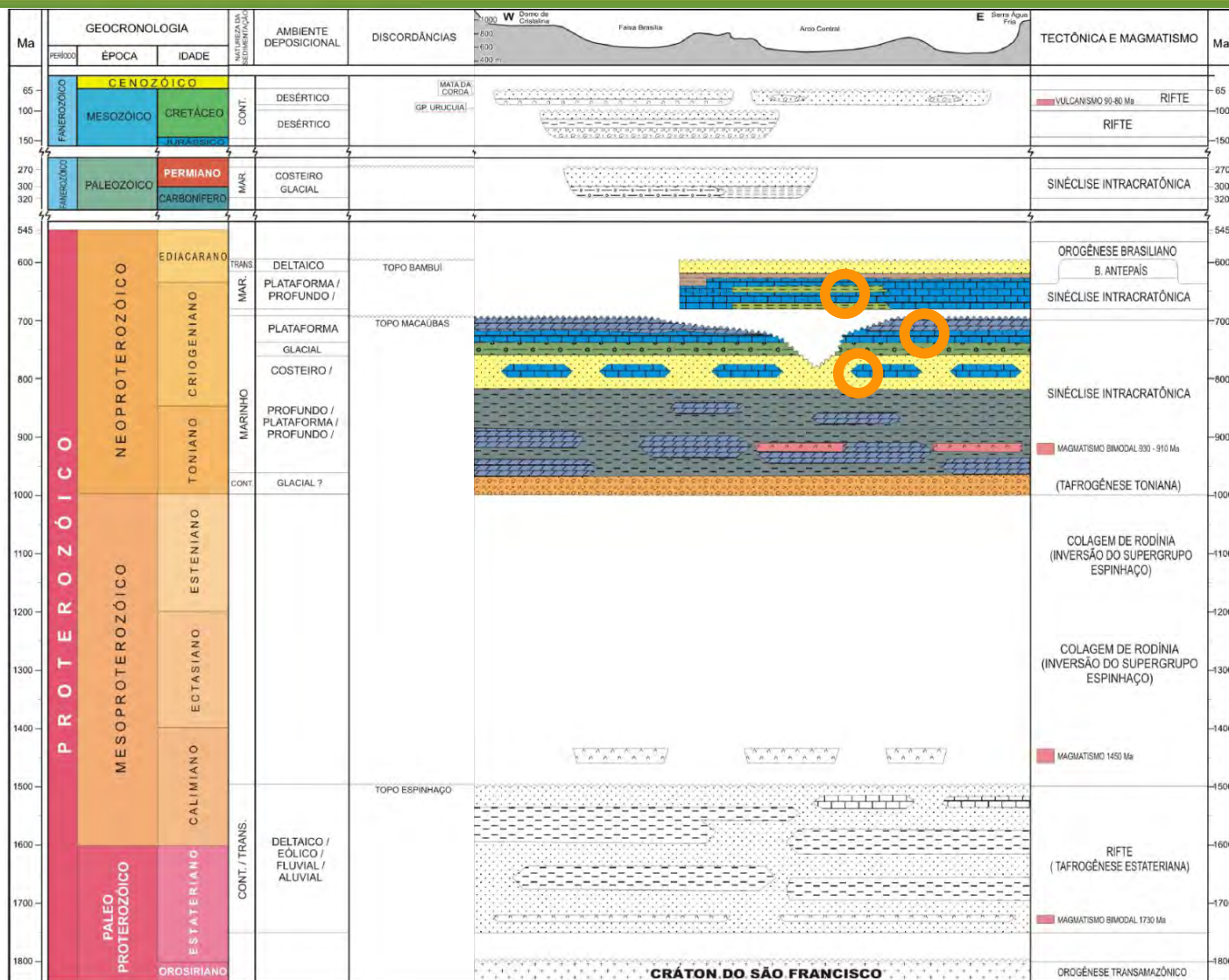
**Possible  
cryogenian  
reservoirs:**

Bambui Group  
carbonates

Bambui Group  
fractured shales  
- Porosity up to 8%  
(Toledo *et al.*, 1998)

Parana Group  
carbonates

Parana Group  
sandstones



# Petroleum Systems

## Hydrocarbon signs in wells

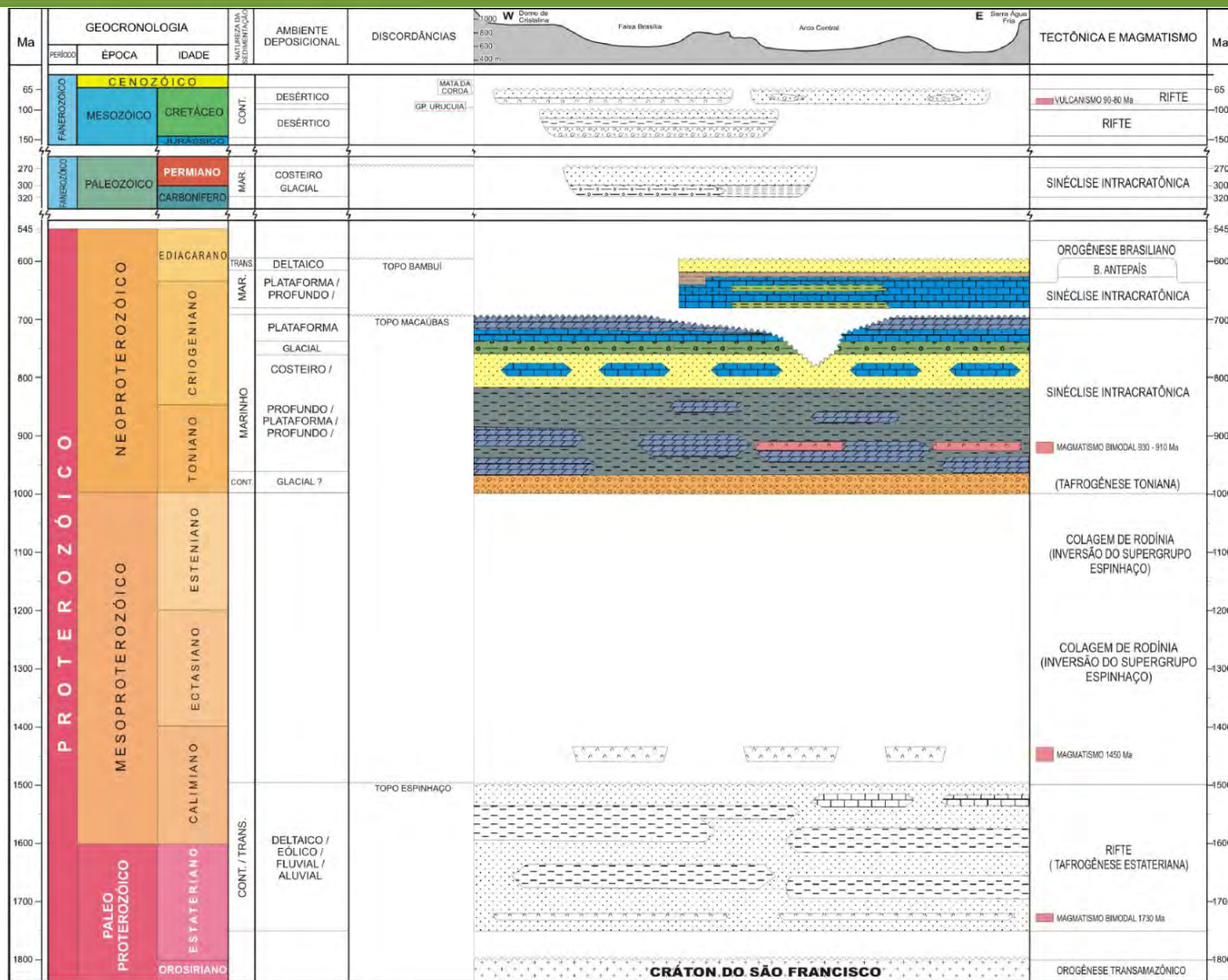
Well	Hydrocarbon presence	Lithology	Unit
1-RC-1-GO	Gas show	Carbonates and shales	Bambui Gr.
1-RF-1-MG	Recovered gas (FT)	Carbonates and shales	Bambui Gr.
1-MA-1-MG	Recovered gas (FT)	Carbonates	Bambui Gr.
1-FLU-1-BA	Recovered gas (FT)	Carbonates	Bambui Gr.

# Petroleum Systems

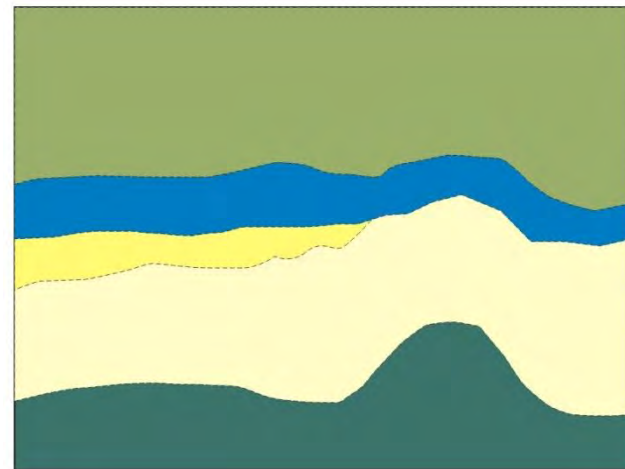
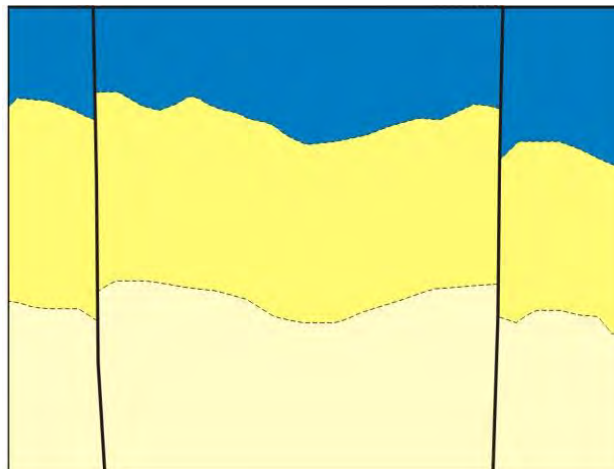
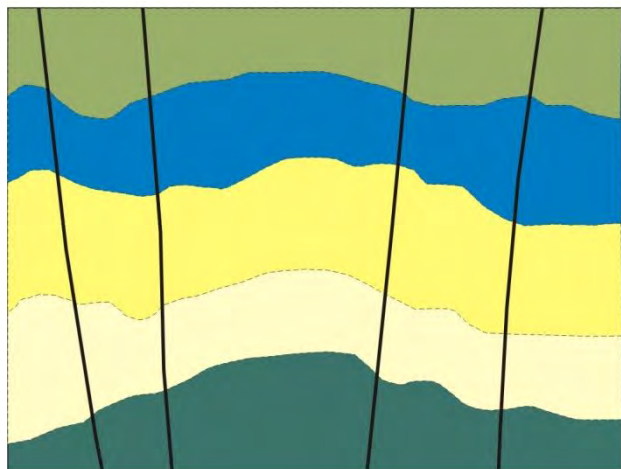
## 1-ORT-1-MG

Test	Unity	Result
FT 2	Siltstone/Sandstone Sete Lagoas Formation <b>Neoproterozoic</b>	Recovered gas
FT 3A	Siltstone/Sandstone Sete Lagoas Formation <b>Neoproterozoic</b>	Recovered gas
FT 4	Sandstone/Carbonate Canastra Group/Paranoa Group <b>Neoproterozoic</b>	Recovered gas
FT 5	Sandstone/Conglomerate Canastra Group/Paranoa Group <b>Neoproterozoic</b>	Recovered gas

# Seals



# Migration and Traps



**Anticline structures**  
**Migration through**  
**associated faults**

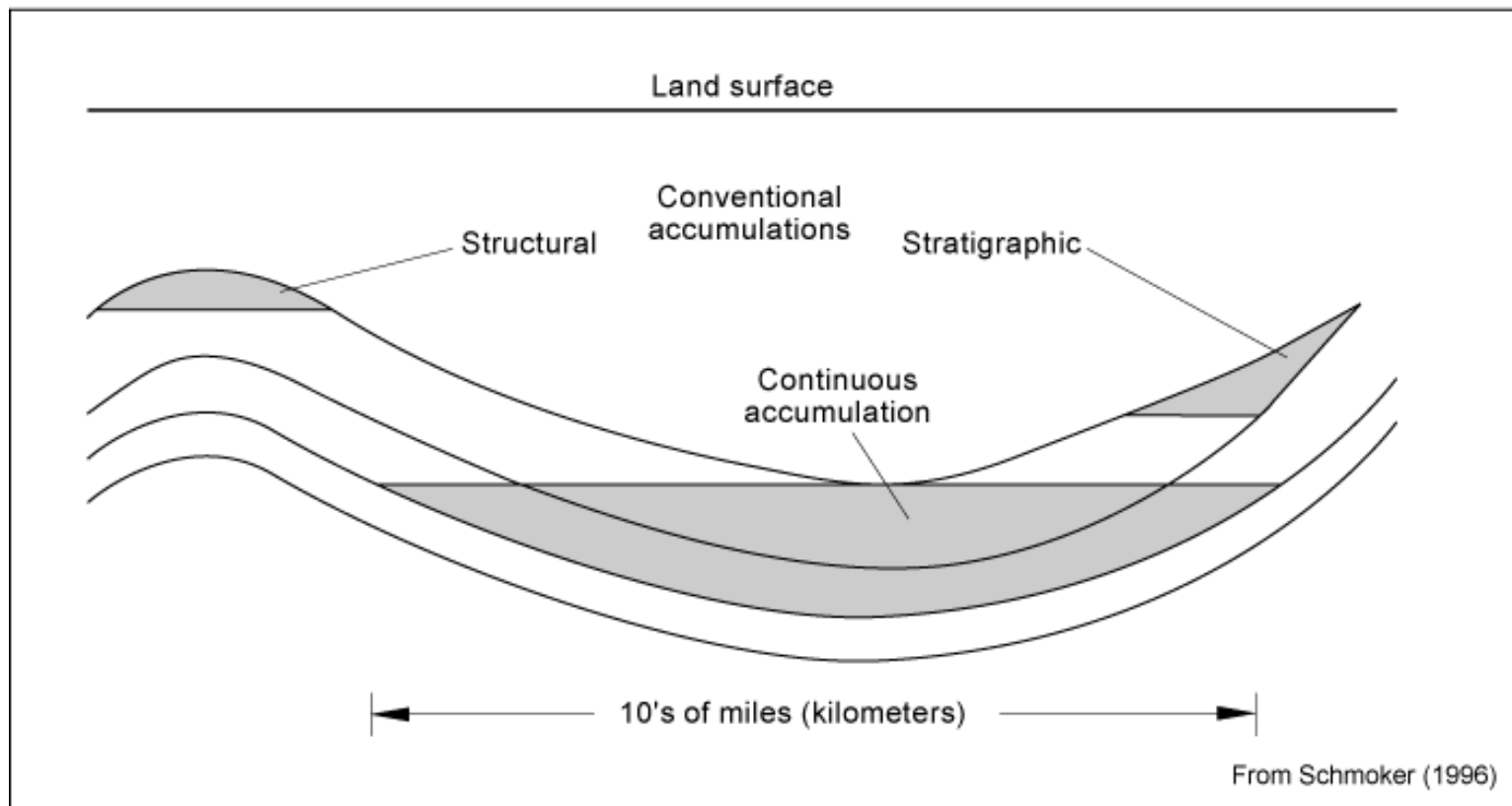
**Trapping in structural**  
**highs limited by faults**

**Migration along the**  
**faults**

**Stratigraphic traps**

**Medium to long**  
**distances direct**  
**migration**

# Migration and Traps



Klett & Charpentier, 2003  
<http://pubs.usgs.gov/of/2003/ofr-03-354/ofr-03-354.html>

Location

Infrastructure

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

**Plays**

Proterozoic Basins E&P

Area on Offer

Final Remarks

# Plays

Play	Exploration target
Neoproterozoic (Bambui Group)	Carbonates
Neoproterozoic (Paranoa Group)	Carbonates
Neoproterozoic (Paranoa Group)	Sandstones

Location

Infrastructure

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

Plays

**Proterozoic Basins E&P**

Area on Offer

Final Remarks

## Hydrocarbons discoveries reported in several basins

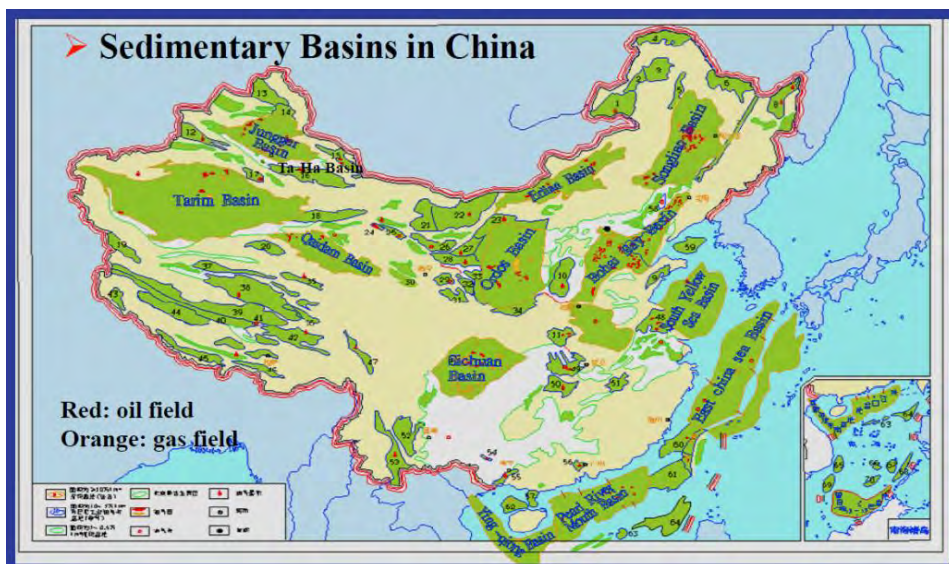
- Russia
- Oman
- China
- Australia

## Lena-Tunguska Petroleum Province Russia

- More than 20 discoveries
- Bigger volumes on the proterozoic section
- Structural and stratigraphic traps
- Mainly gas

# Proterozoic Basins

## Sichuan Basin - China



**Source rocks:** proterozoic carbonates

**Reservoir rock:**  
Proterozoic fractured dolomite  
Porosity: 3.5-4.5%  
Permeability: 0.1-2.0 mD



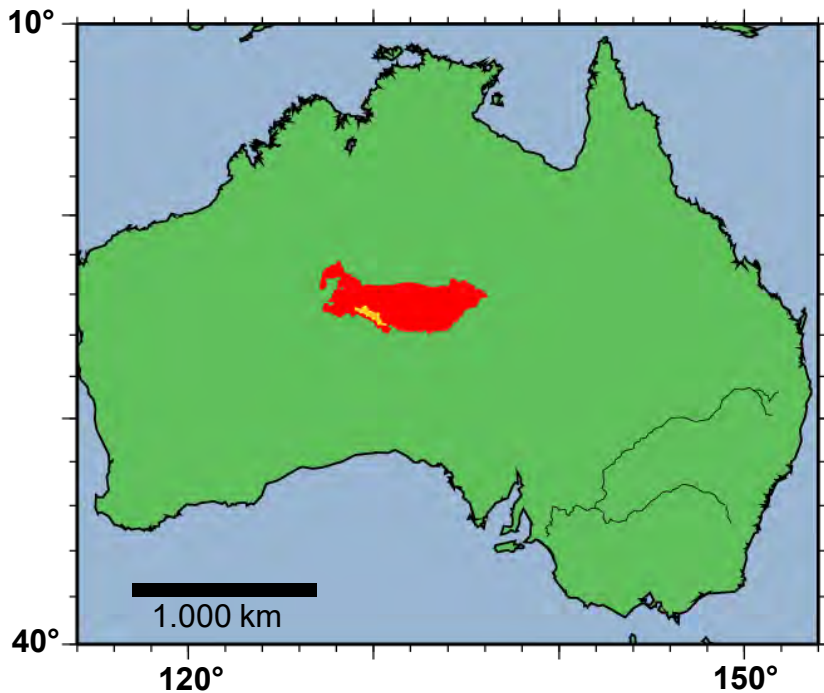
Guoqi Wei *et al.*, 2008

# Proterozoic Basins

## Amadeus Basin Australia

1 Magee well – 2,342 m  
(63.1 Mscfd)

Unidentified source rock on the  
well – migration from deeper areas  
of the basin

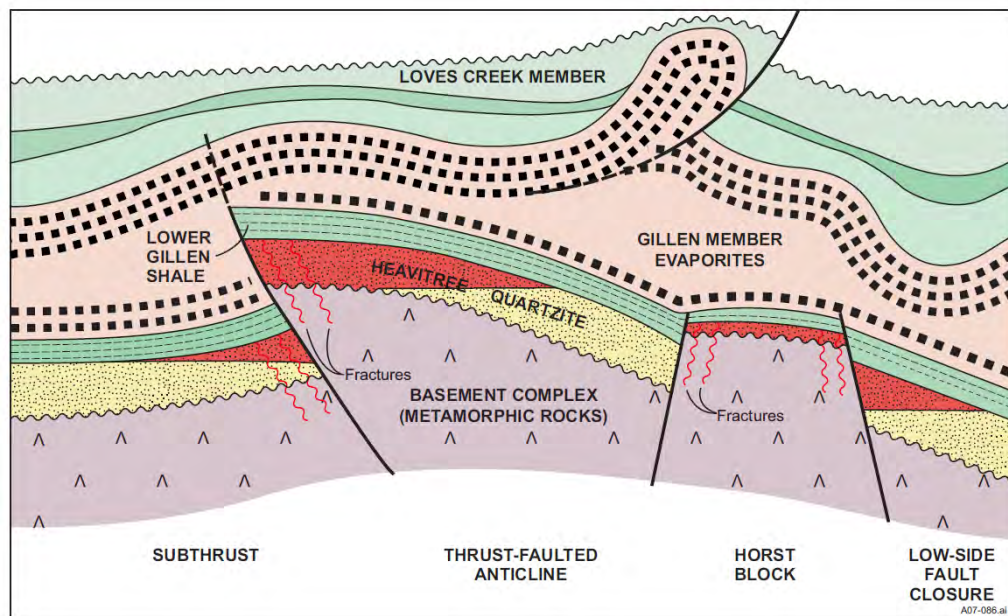


Heine, 2008

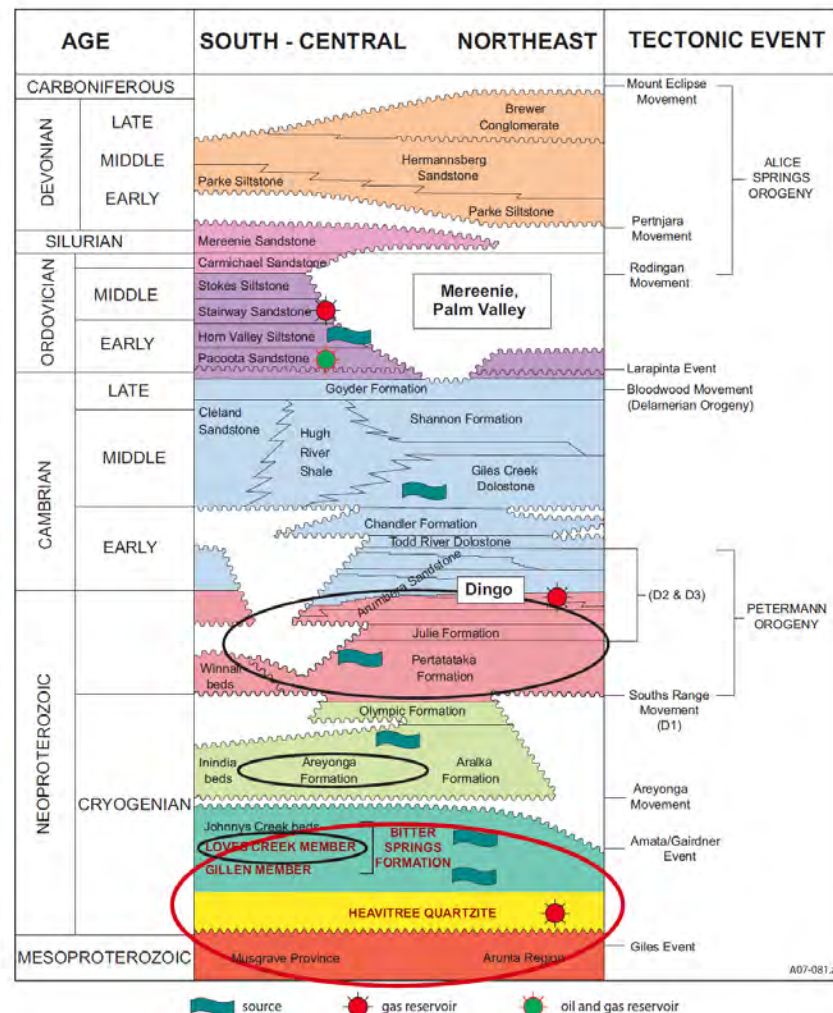
Wakelin-King, 1994

# Proterozoic Basins

## Amadeus Basin Australia



Young & Ambrose, 2007



Location

Infrastructure

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

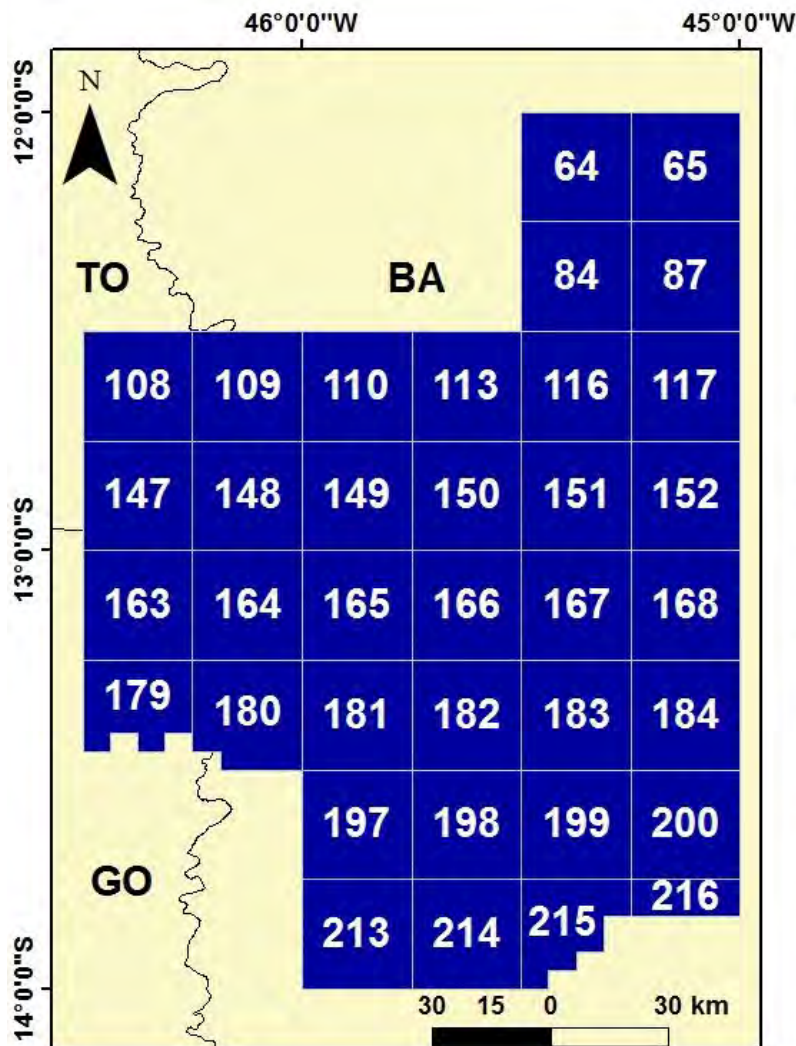
Plays

Proterozoic Basins E&P

**Area on Offer**

Final Remarks

# Area on Offer



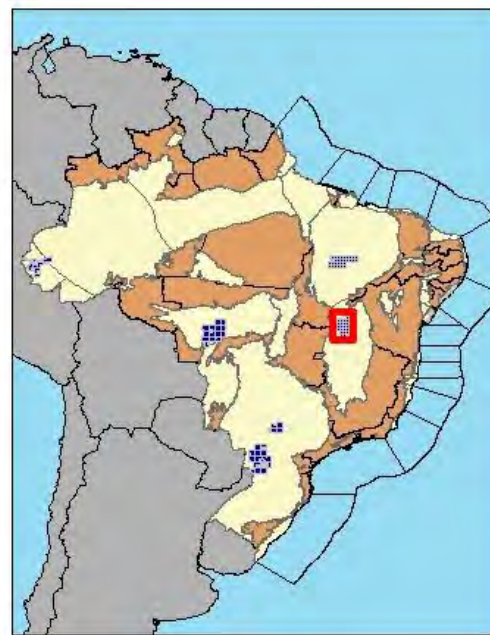
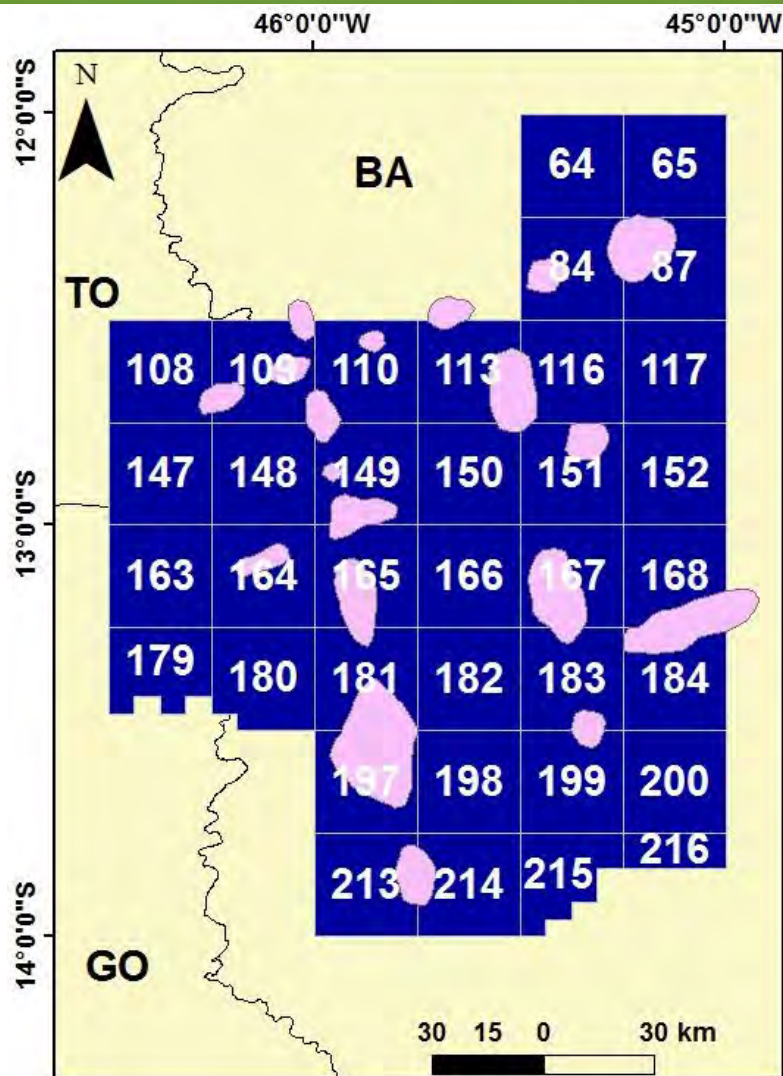
**Sao Francisco  
Basin**

**Sector on Offer:  
SF-N**

**Blocks on Offer:  
36**

**Area on Offer:  
~26,000 km<sup>2</sup>**

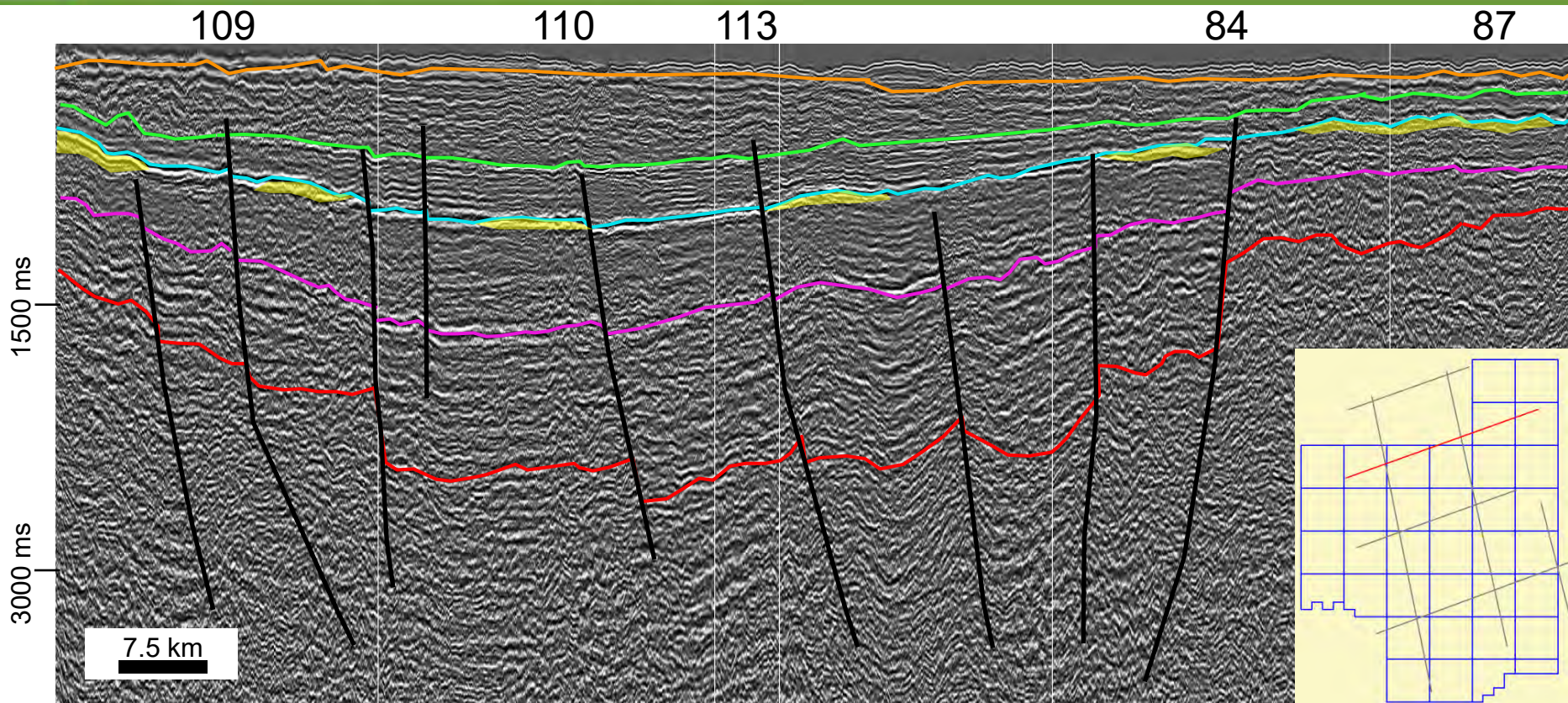
# Area on Offer



**Leads total  
area:**

**~2,800 km<sup>2</sup>**

# Leads

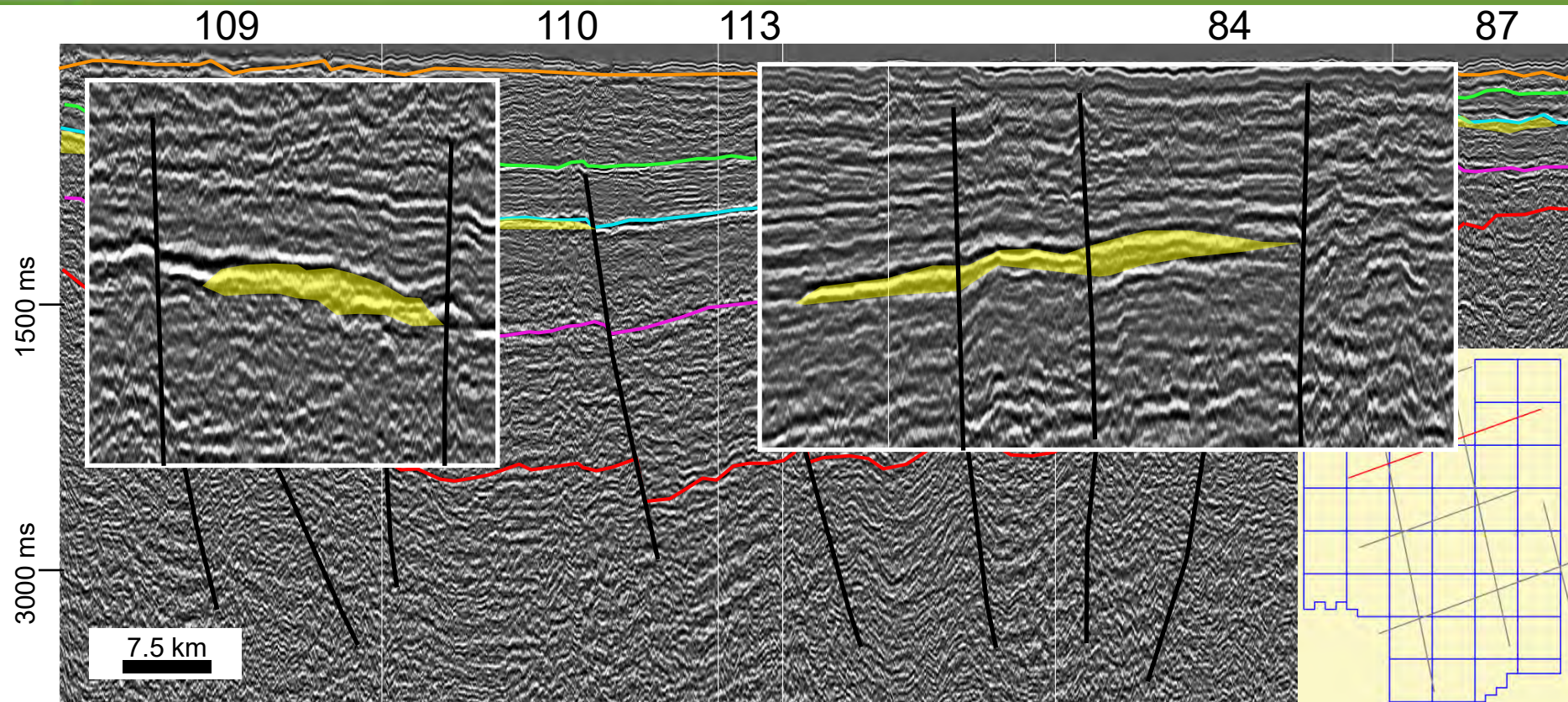


- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

**0284-0104**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

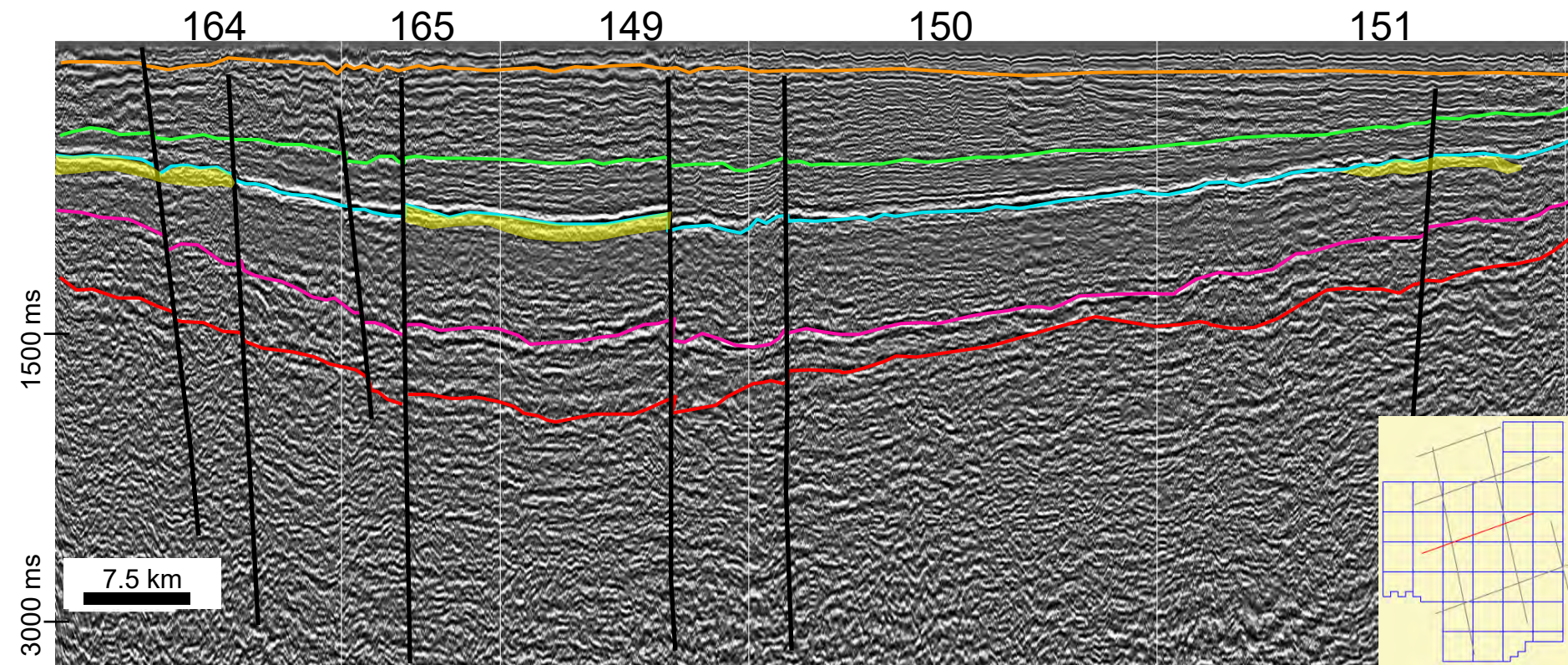
# Leads



- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

# Leads

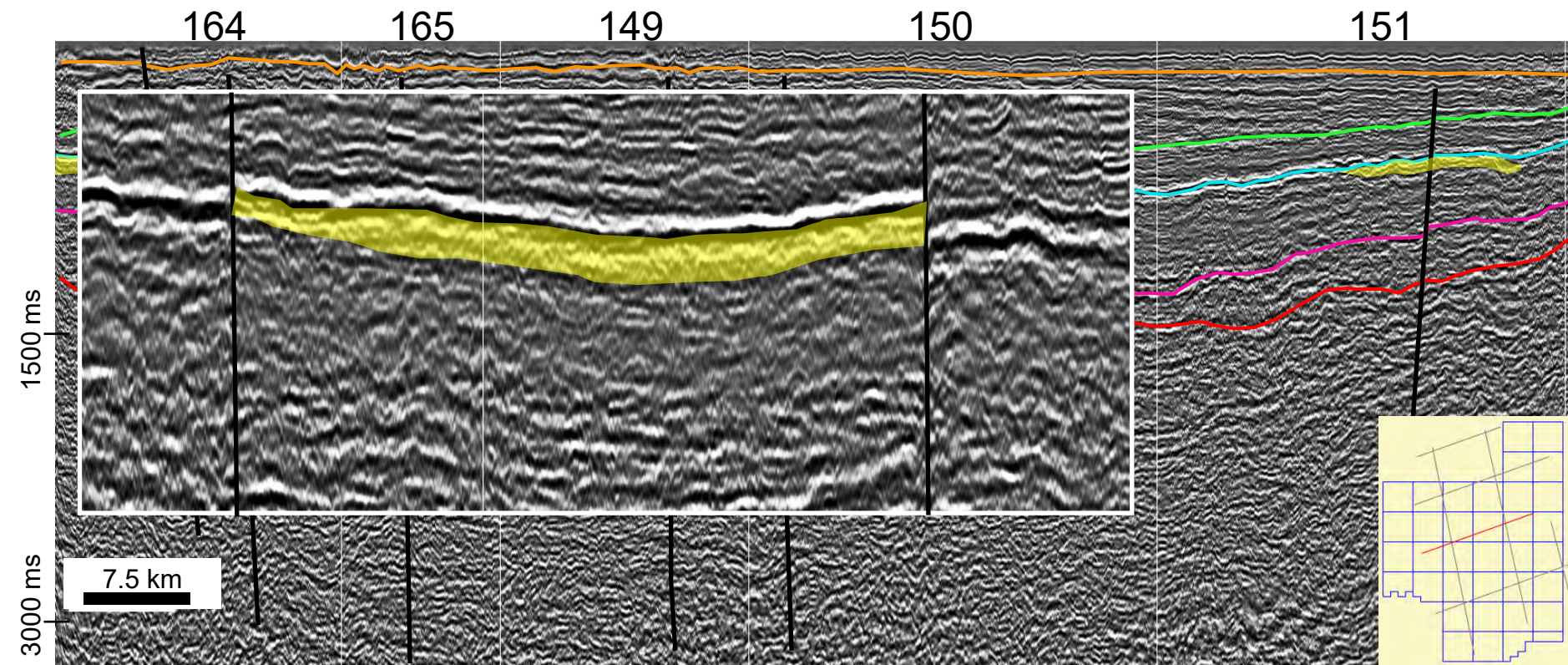








- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

**0284-0105**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

# Leads

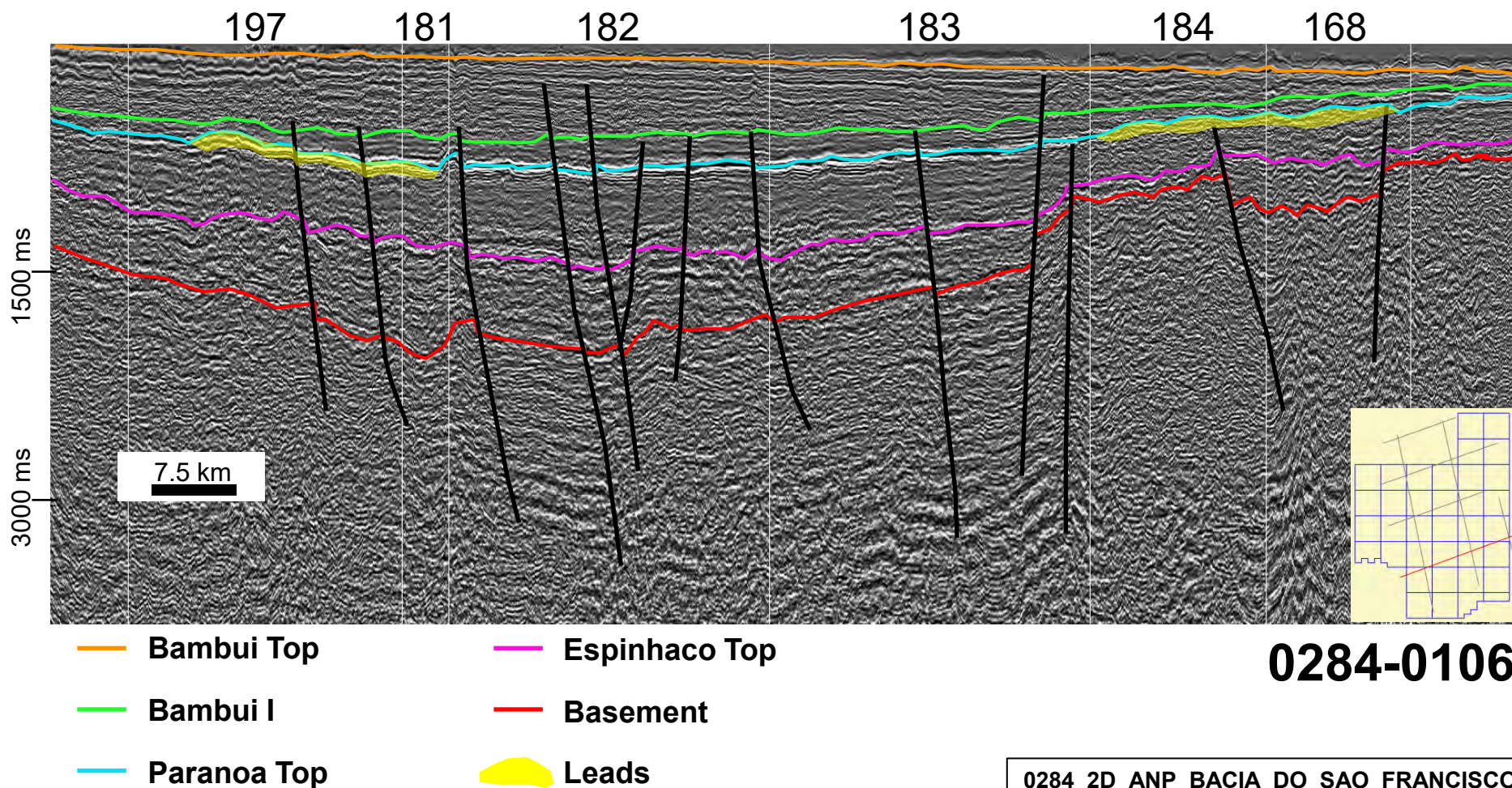


- |   |   |
|---|---|
|  Bambui Top  |  Espinhaco Top |
|  Bambui I    |  Basement      |
|  Paranoa Top |  Leads         |

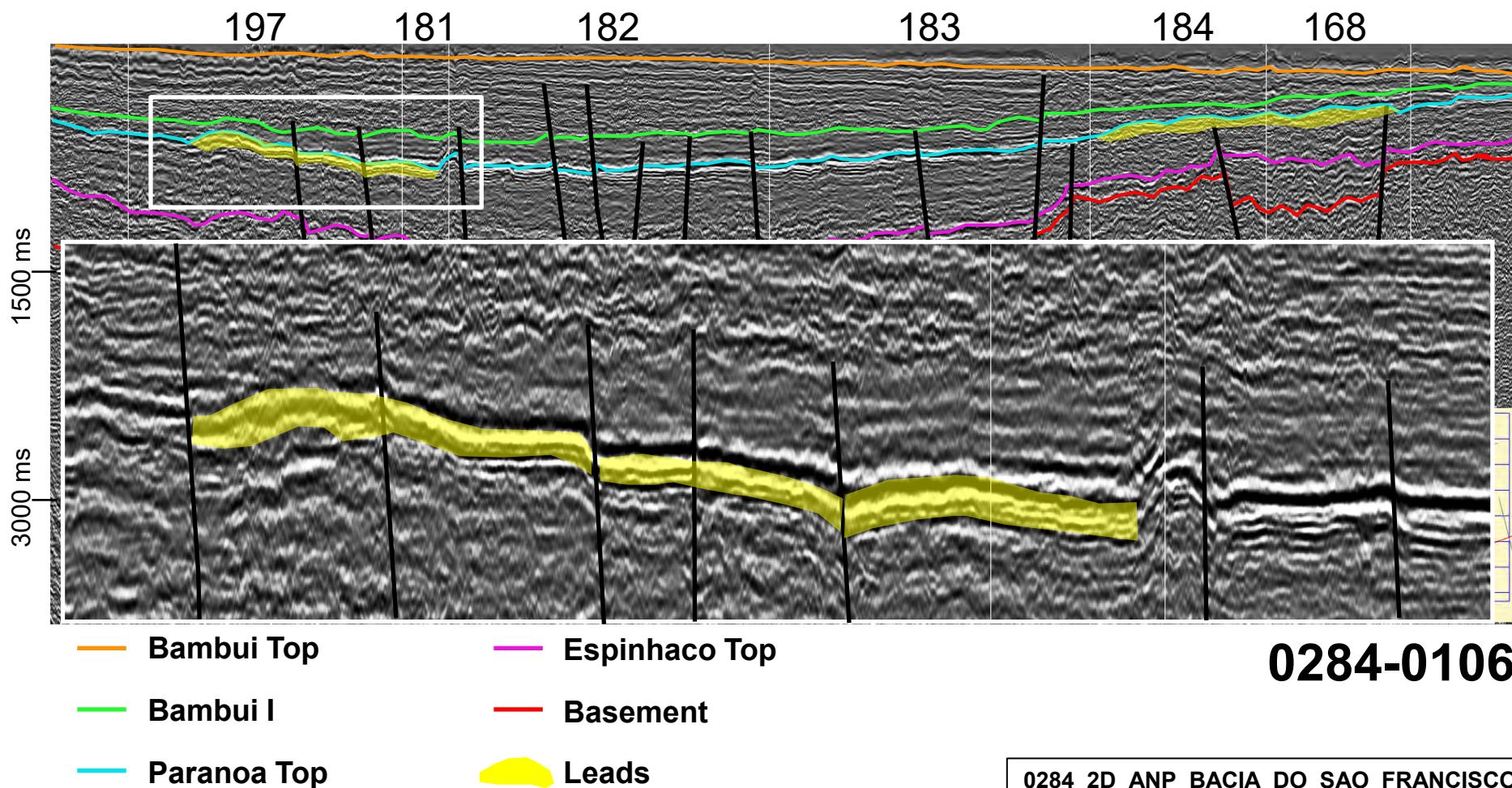
**0284-0105**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

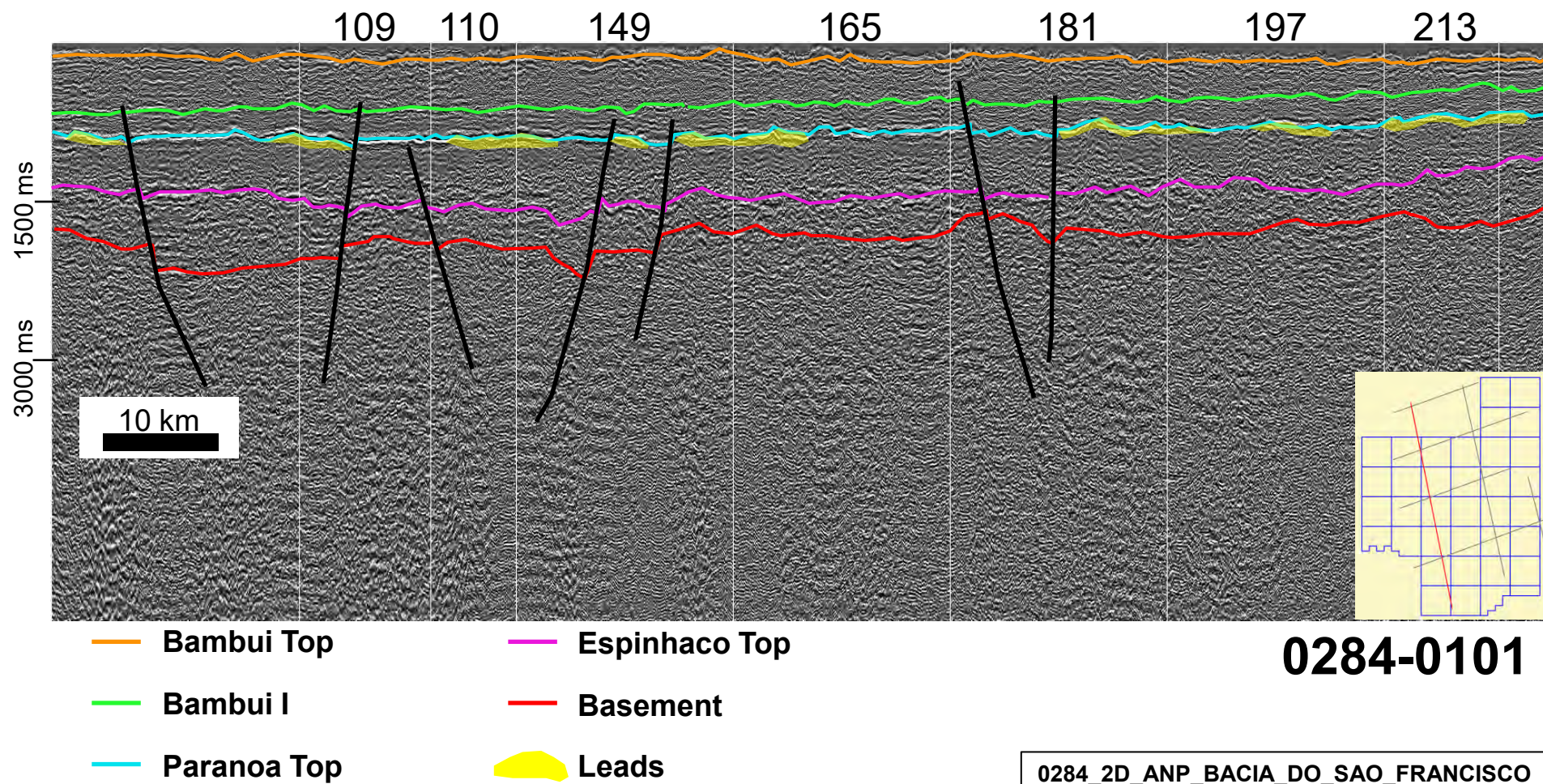
# Leads



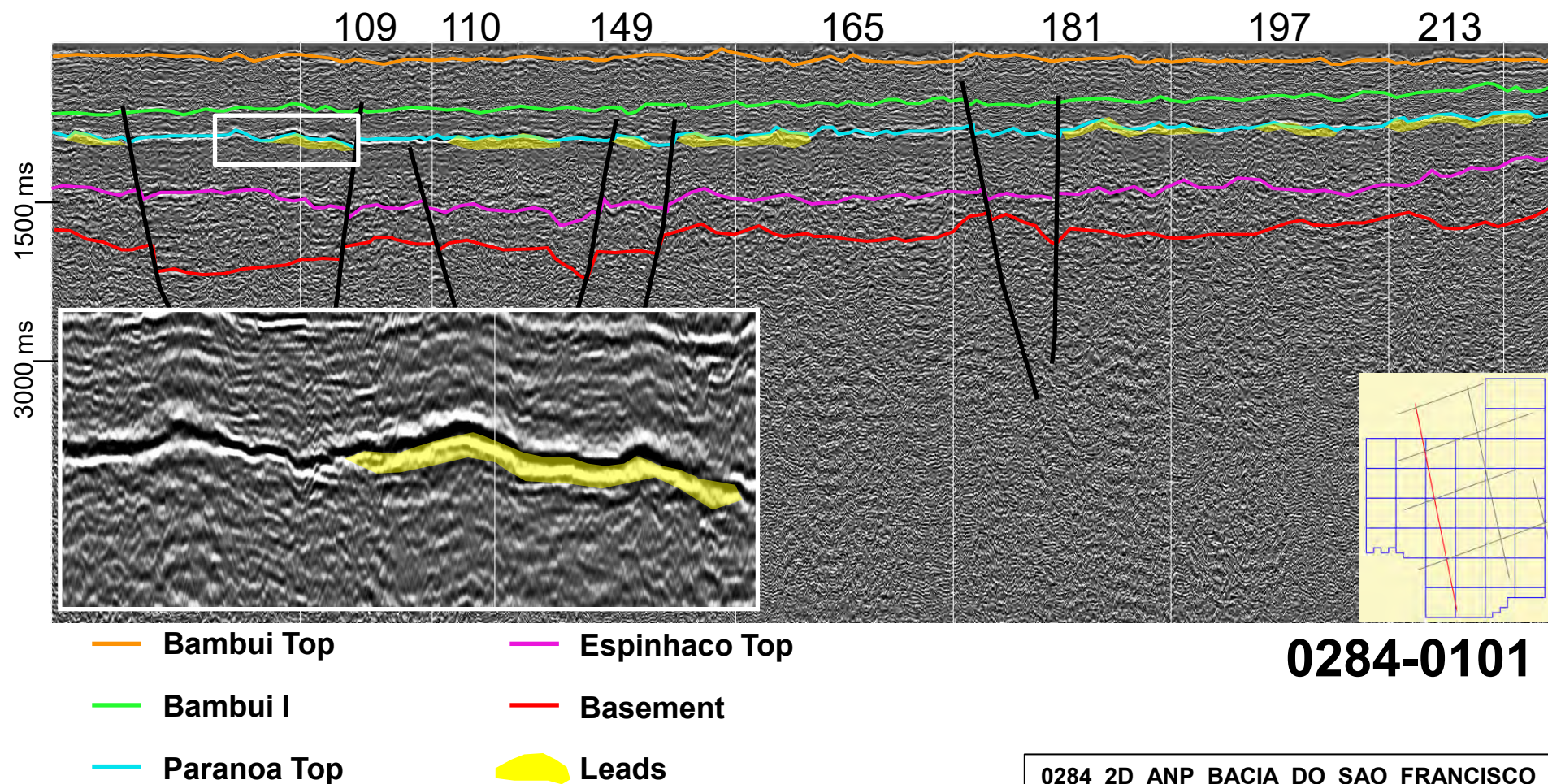
# Leads



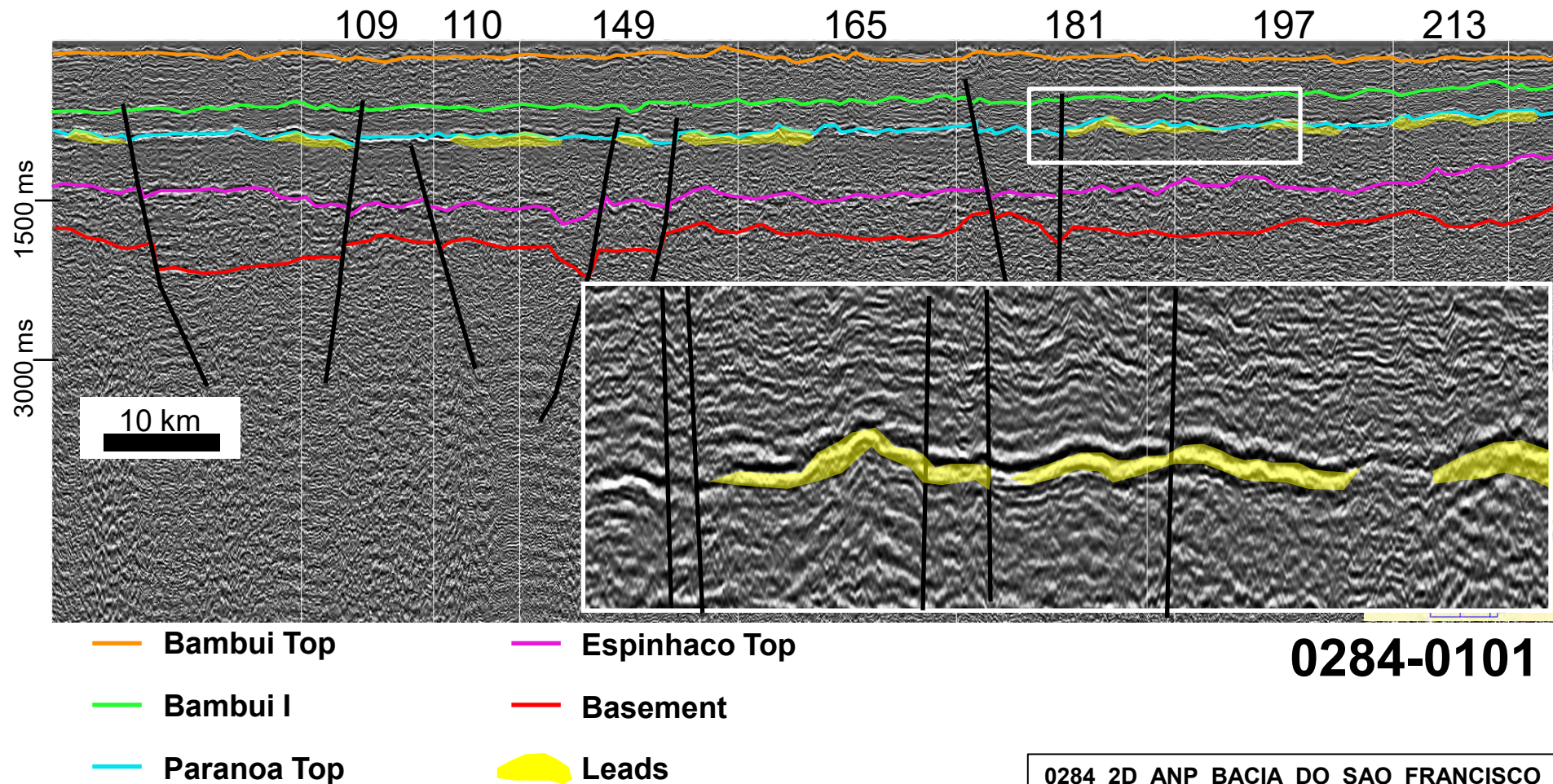
# Leads



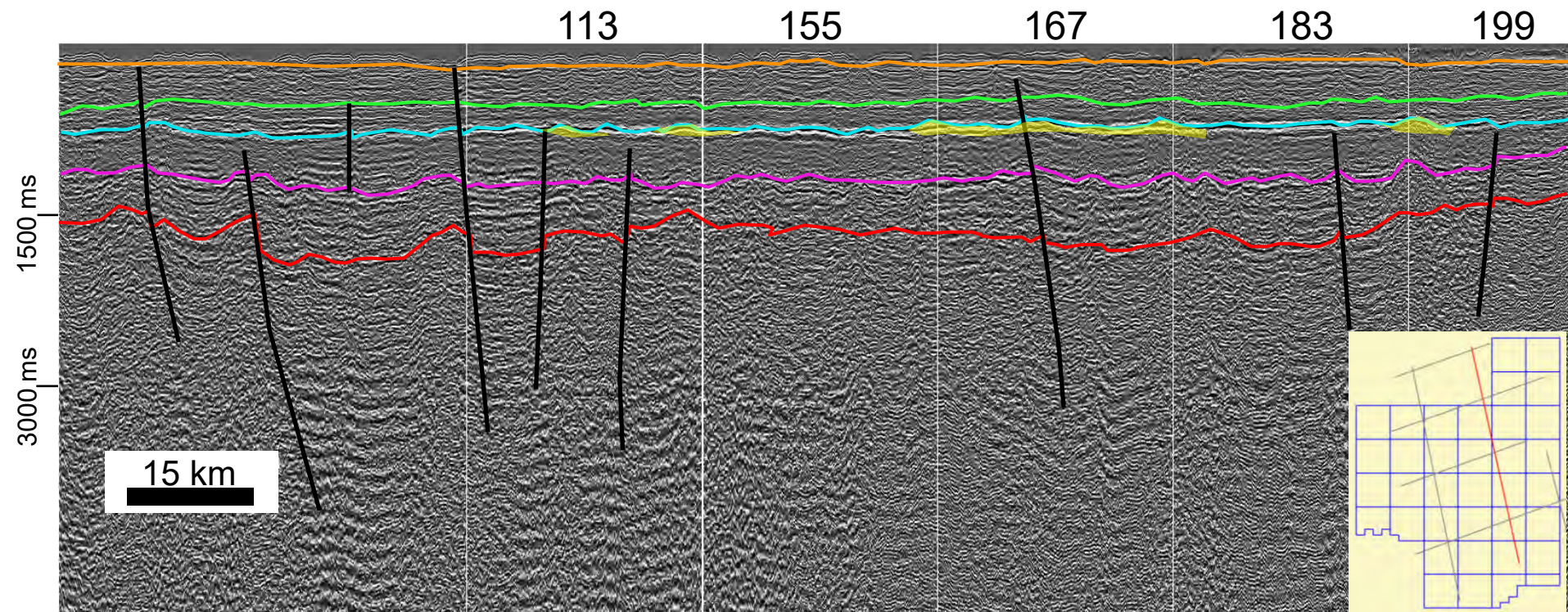
# Leads



# Leads



# Leads

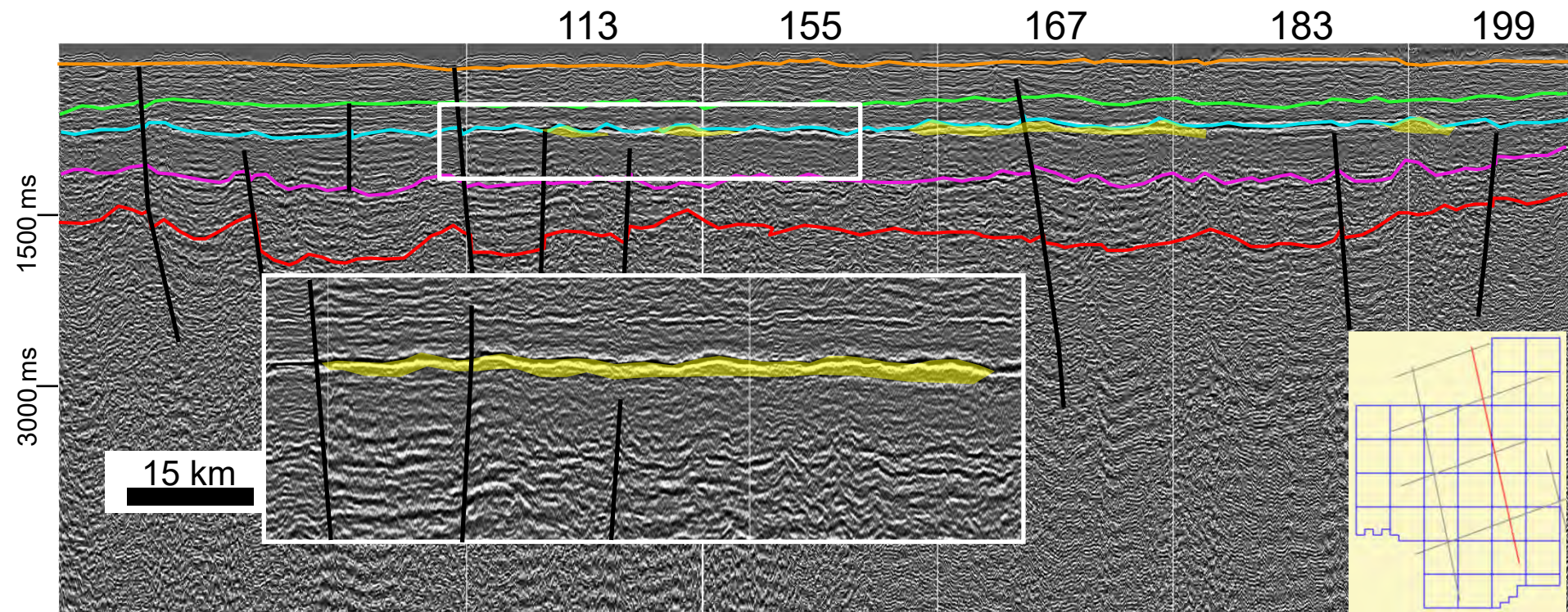


- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

**0284-0102**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

# Leads

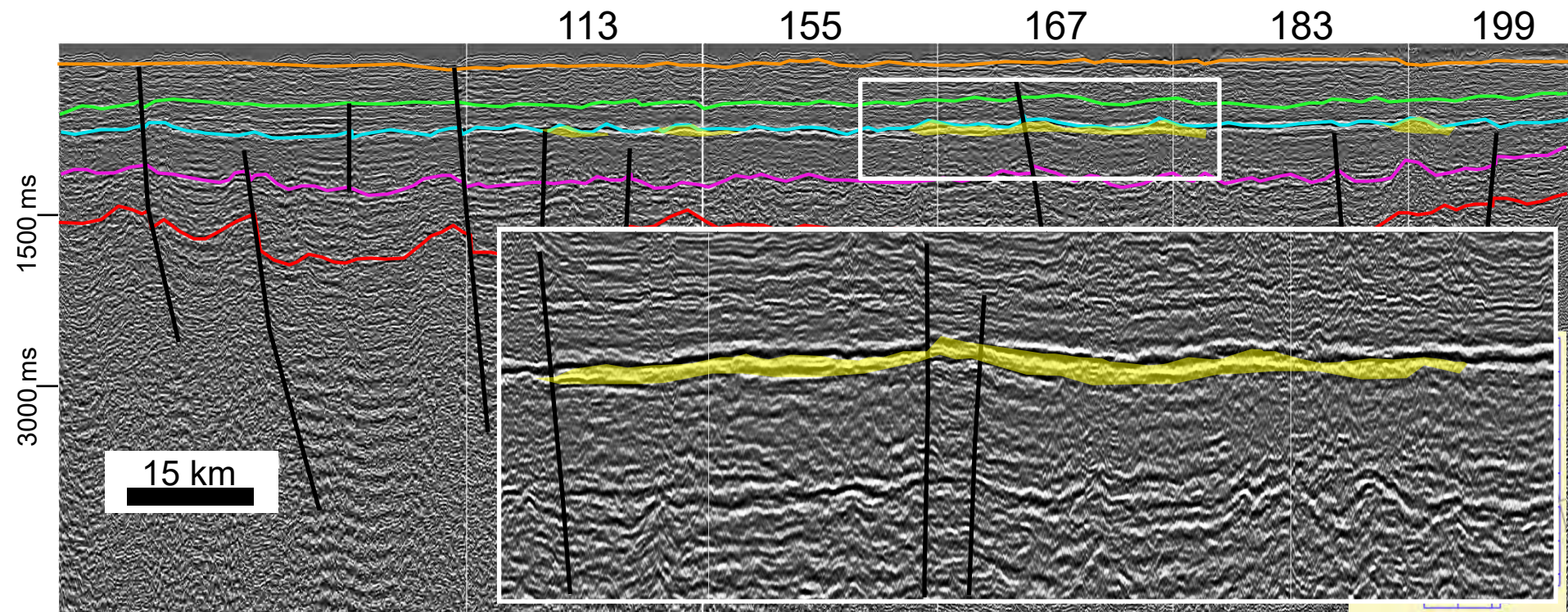


- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

**0284-0102**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

# Leads

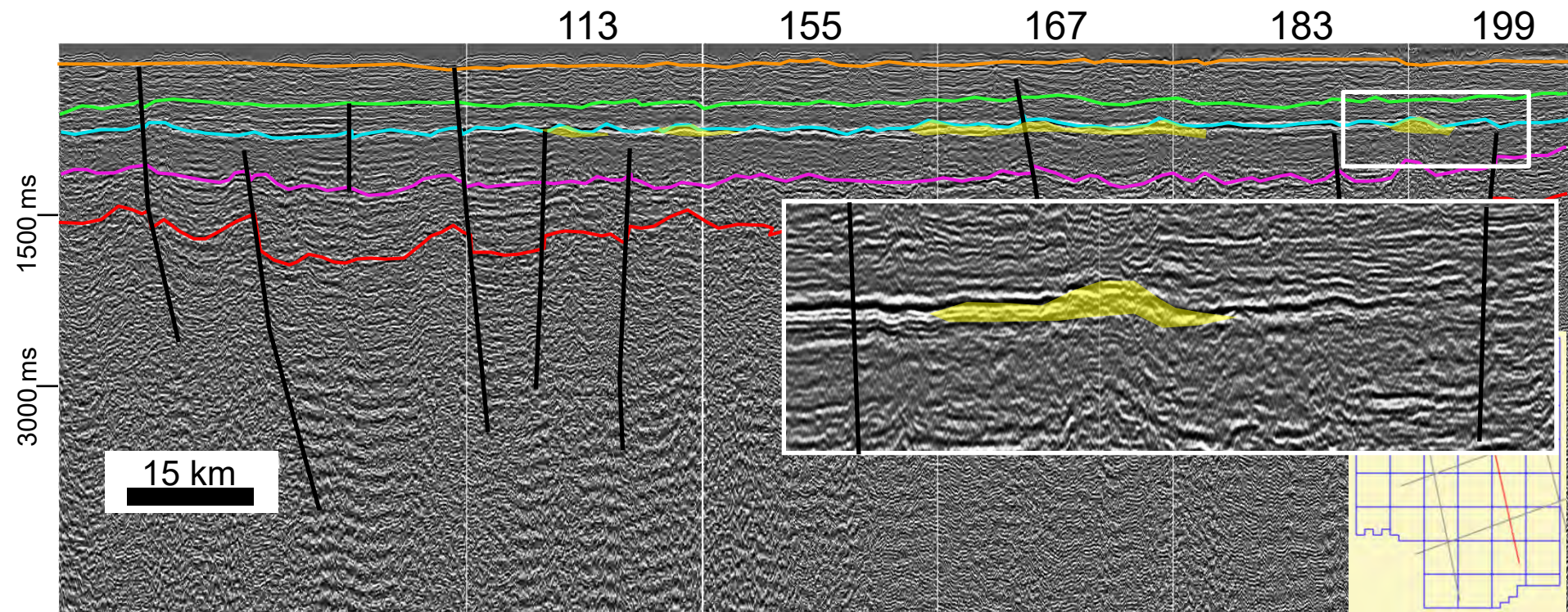








- Bambui Top
- Bambui I
- Paranoa Top
- Espinhaco Top
- Basement
- Leads

**0284-0102**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

# Leads

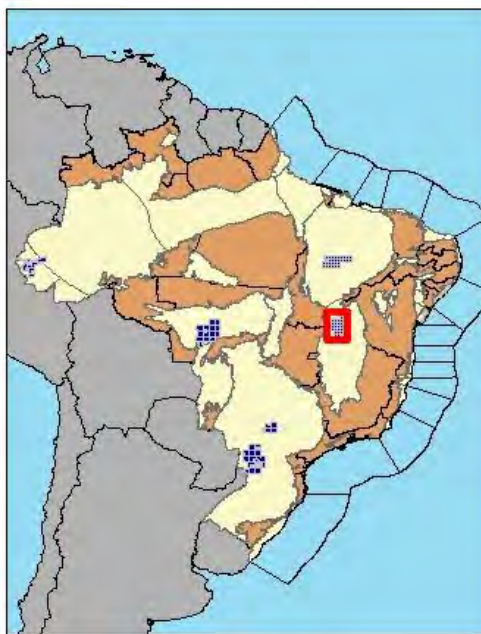
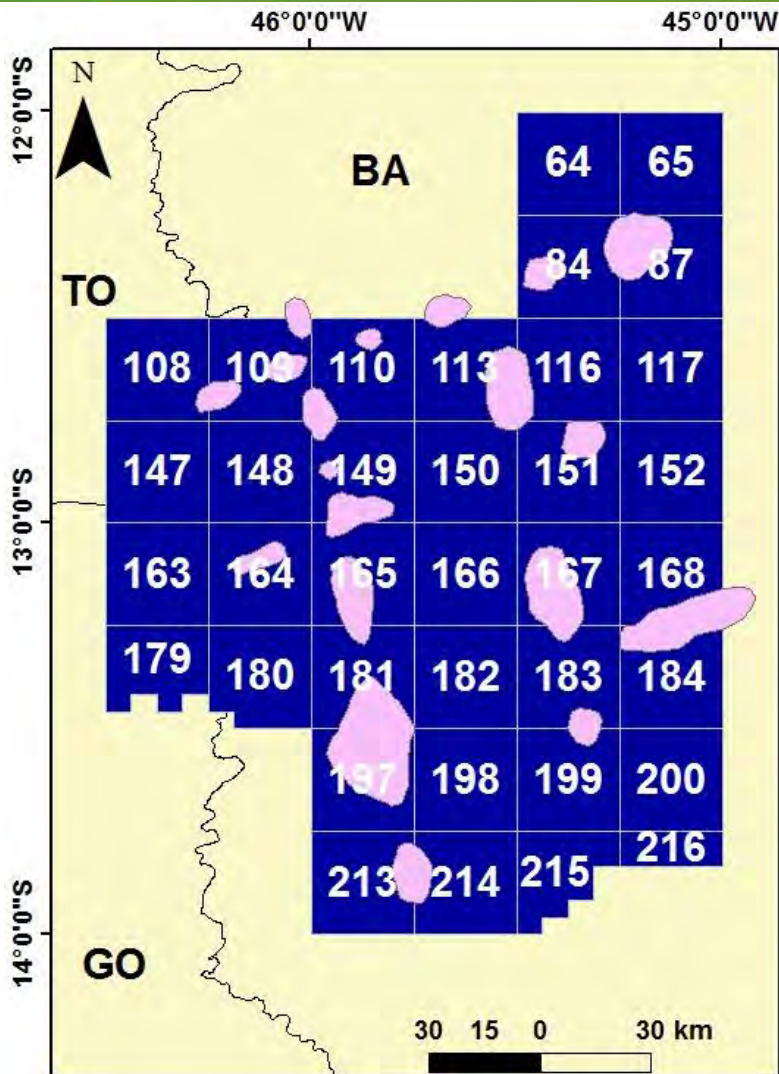


- |   |   |
|---|---|
|  Bambui Top  |  Espinhaco Top |
|  Bambui I    |  Basement      |
|  Paranoa Top |  Leads         |

**0284-0102**

0284\_2D\_ANP\_BACIA\_DO\_SAO\_FRANCISCO

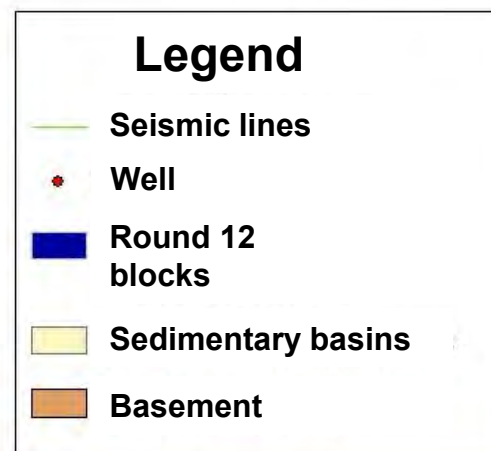
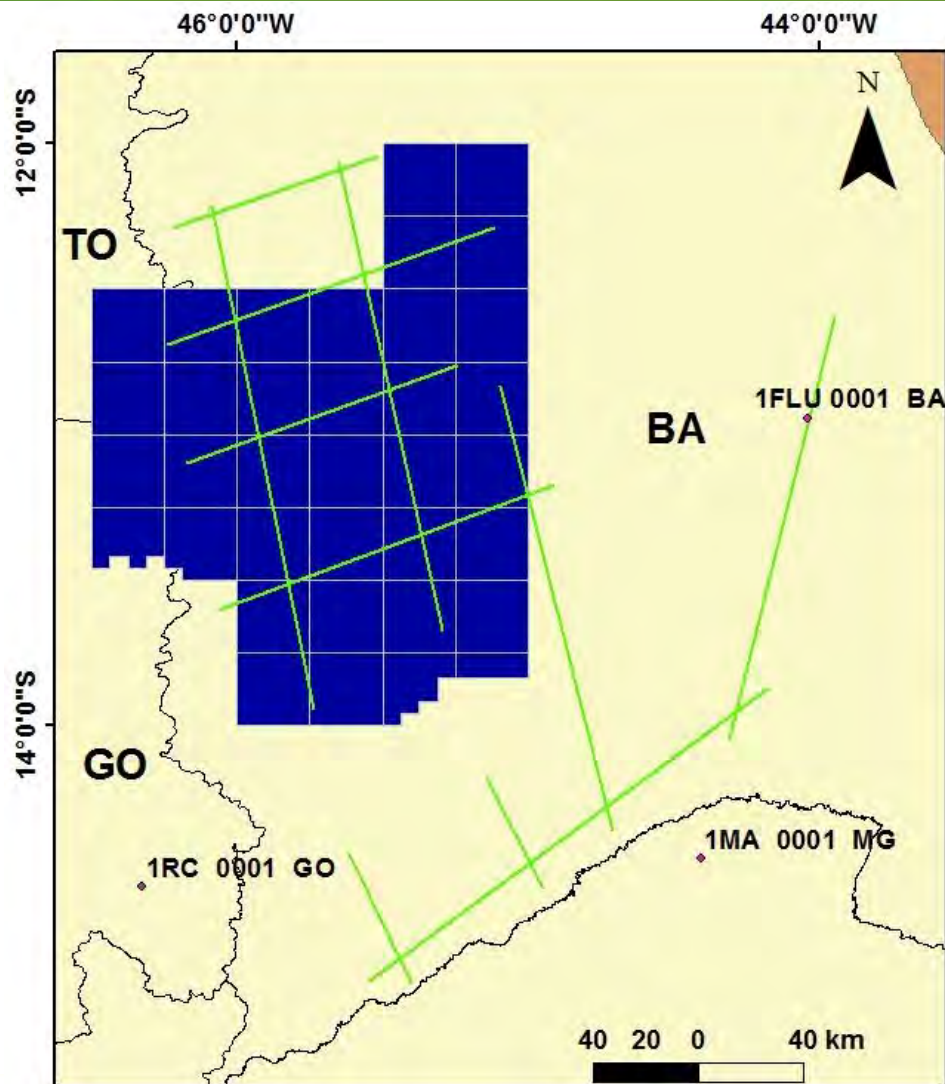
# Area on Offer



**In place gas  
volume – Upper  
Paranoá leads:**

**~1.5 – 4.5 TCF**

# Data Package



**3 Wells**

**1,500 km  
2D seismic**

**Potential  
methods data**

# Contractual Aspects

Sector	SF-N
Exploration Model	Frontier Basin
Number of Blocks	36
Area on Offer	~26,059 km <sup>2</sup>
Exploration Phase	6 years
Exploration Period	4 + 2 years
Technical Qualification of the Operator	C
Minimum Bonus	R\$ 98,757.92 – R\$ 512,863.69
Exploration Objective	Paranoa Group (Neoproterozoic)
Stratigraphic Objective	Paranoa Group (Neoproterozoic)

Location

Infrastructure

Exploration Overview

Tectonostratigraphic Evolution

Petroleum Systems

Plays

Proterozoic Basins E&P

Area on Offer

**Final Remarks**

- Proterozoic basin
- Frontier basin
- Several signs of natural gas presence
- Identified opportunities in place volume:  
1.5 to 4.5 TCF

# National Agency of Petroleum, Natural Gas and Biofuels

Andrei Dignart: [adignart@anp.gov.br](mailto:adignart@anp.gov.br)

[www.anp.gov.br](http://www.anp.gov.br)

