Perspectives from Offshore Argentina & Uruguay

A Prospectivity Overview

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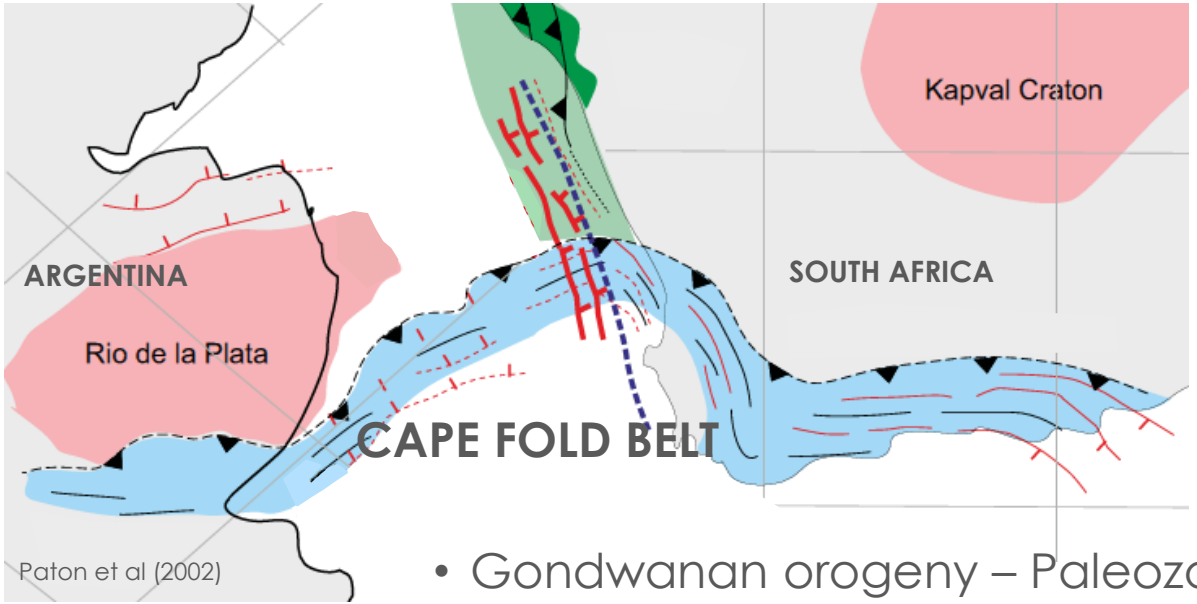
Introduction

- Argentina Offshore License Round 1 – 14 blocks Argentina North, 24 Austral-Malvinas
- Offshore Round 2 – Argentina South
- Proven petroleum system in pre-rift and syn-rift along Atlantic margin
- 52,000 km of long offset 2D data acquired 2017-18, PSTM & PSDM

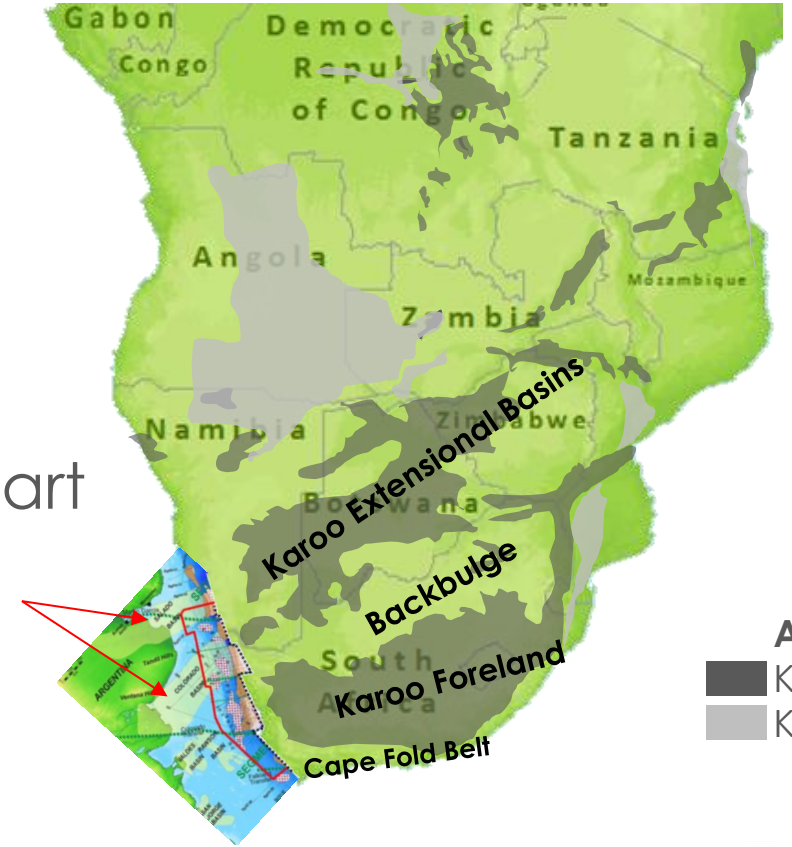
Tectonic Evolution – Pre-Rift (Permo-Triassic)



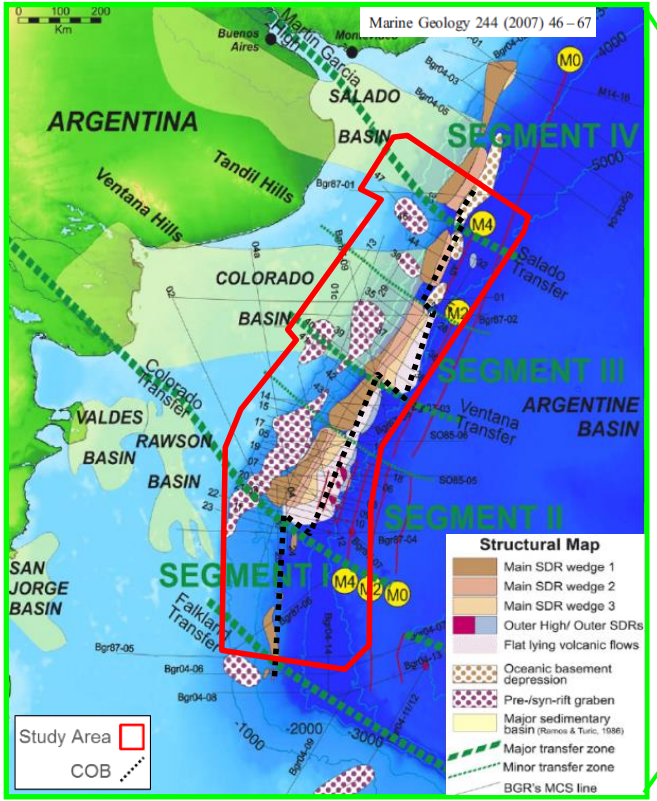
- Gondwanan orogeny – Paleozoic Cape Fold Belt – thrusts & box fold structures onshore
- Folded 'Table Mountain Group' – indurated quartzite with secondary porosity

Tectonic Evolution – Jurassic Rifting

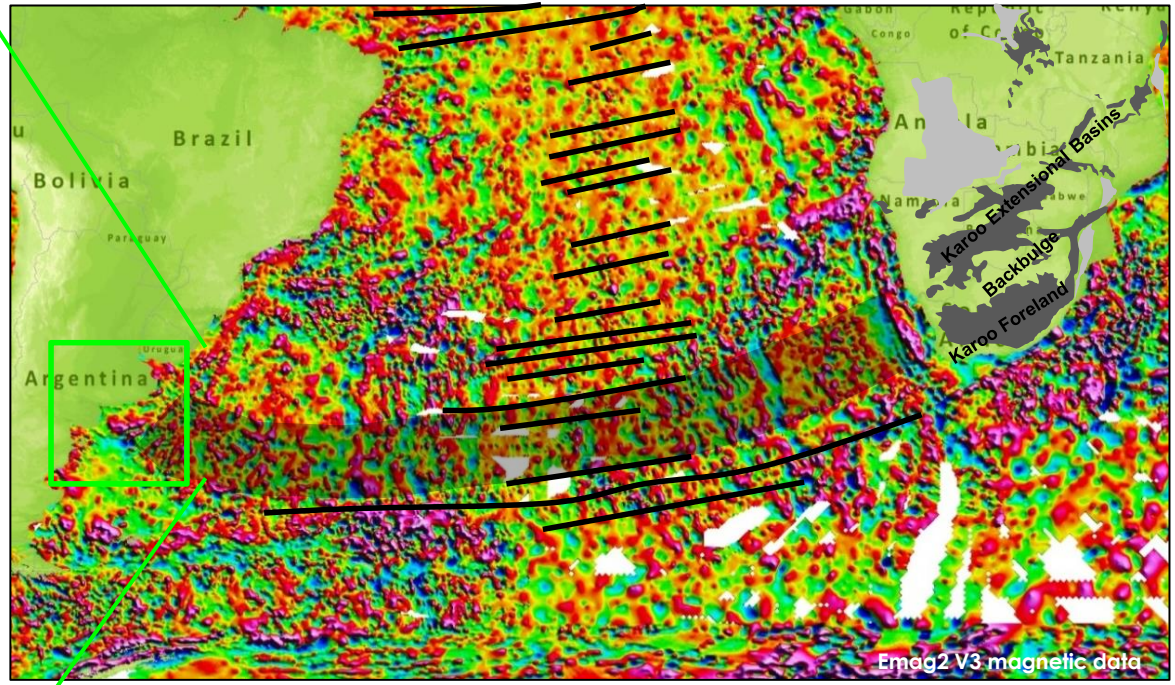
Rio Salado & Colorado Basins part of Jurassic Karoo extensional basins trend



Tectonic Evolution – Early Cretaceous Rifting

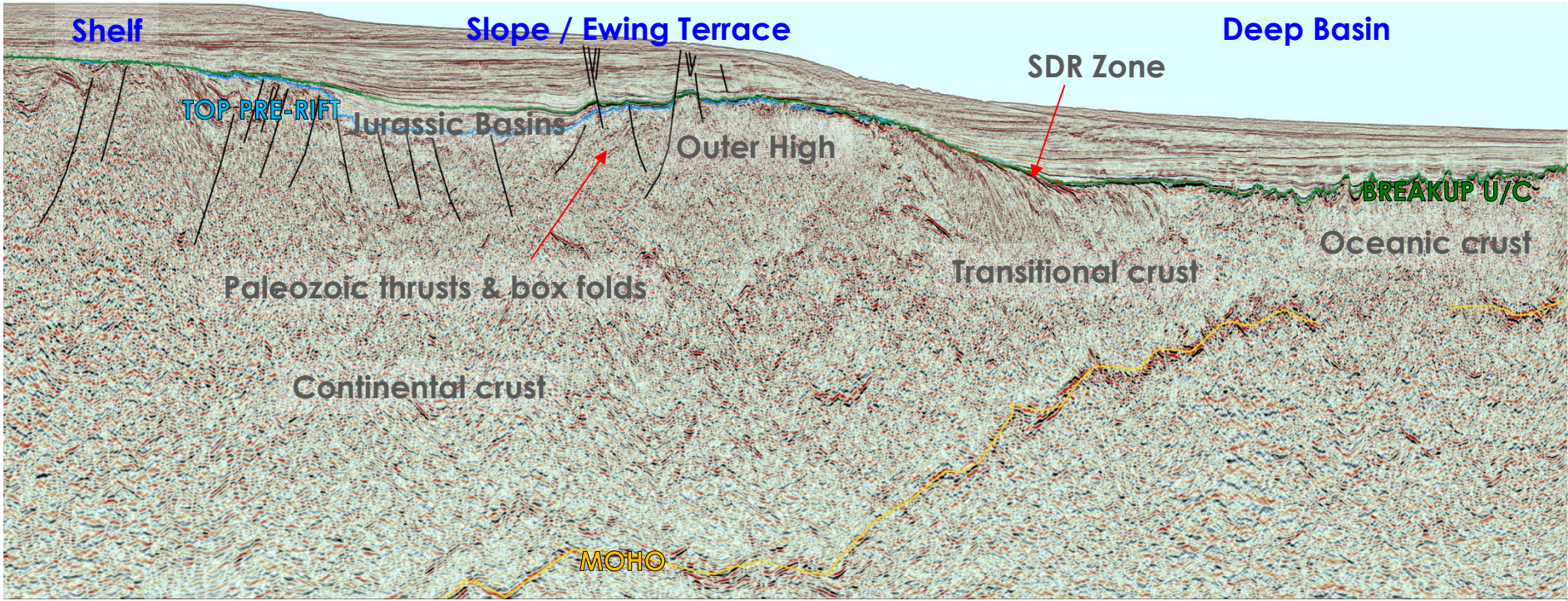


From Franke et al (2007)



- Early Cretaceous Atlantic rifting
- Argentina conjugate to Orange Basin

Atlantic Margin Structure



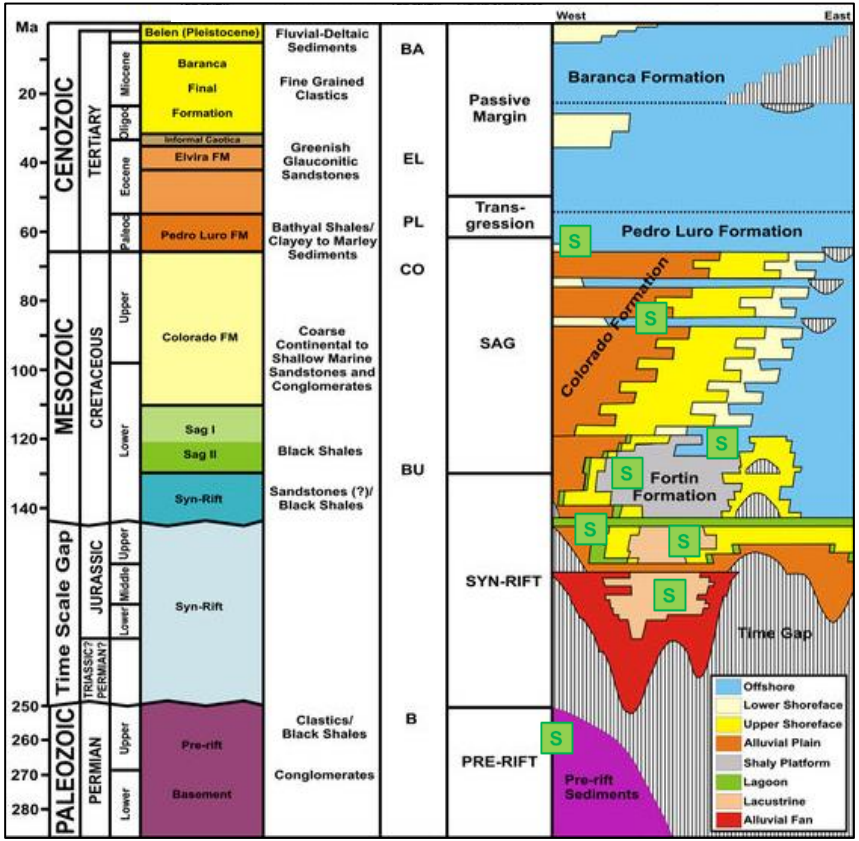
Atlantic Margin Stratigraphy

Proven Sources: S

- Permian
- Lower & Upper Syn-Rift (Early J to K; Early K) – marine

Probable Sources:

- Pedro Luro Fm (Paleocene) – Type II, high TOC
- Cenomanian-Turonian (OAE 2)
- Early Post-Rift (Aptian-Albian) (OAE 1a)

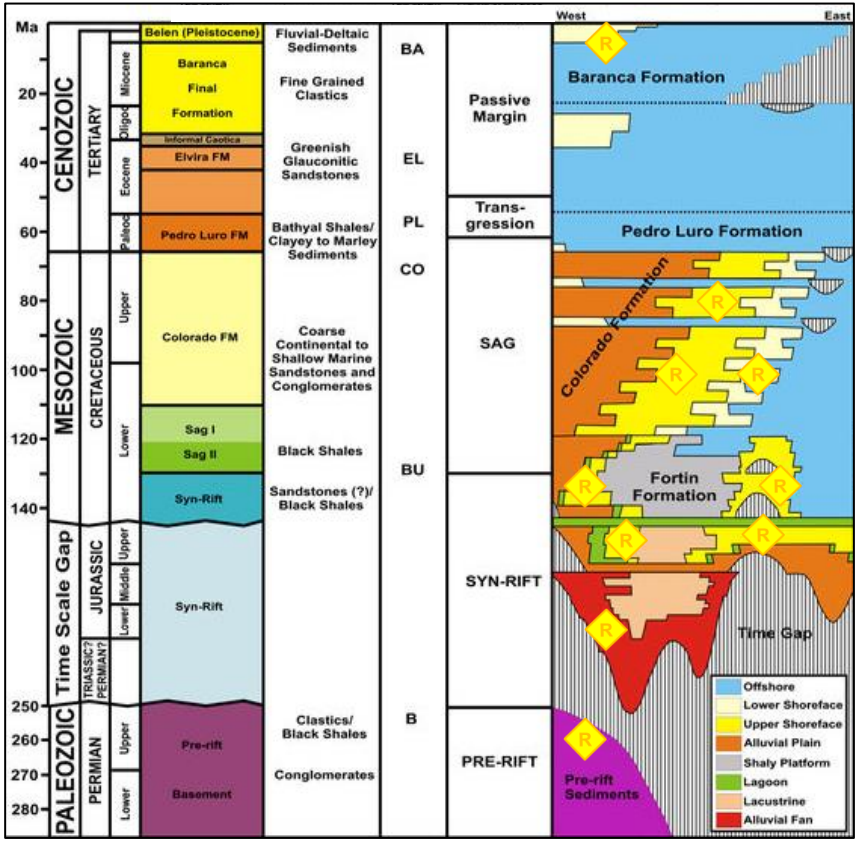


Loegering et al (2013)

Atlantic Margin Stratigraphy

Potential Reservoirs: R

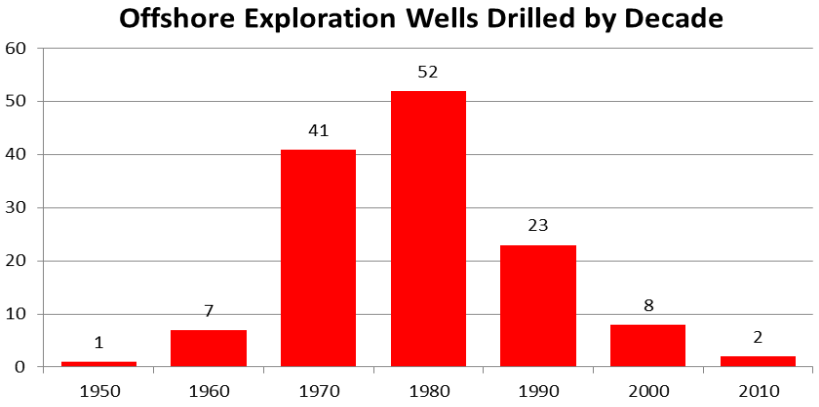
- Oligo-Miocene Barranca Final marine sandstones
- Paleocene Elvira Fm sandstones
- Upper K (Colorado Fm) sandstones
- Lower K (Fortin Fm)
- Lower K carbonate build-ups
- Upper & Lower Syn-Rift sandstones
- Permian sandstones

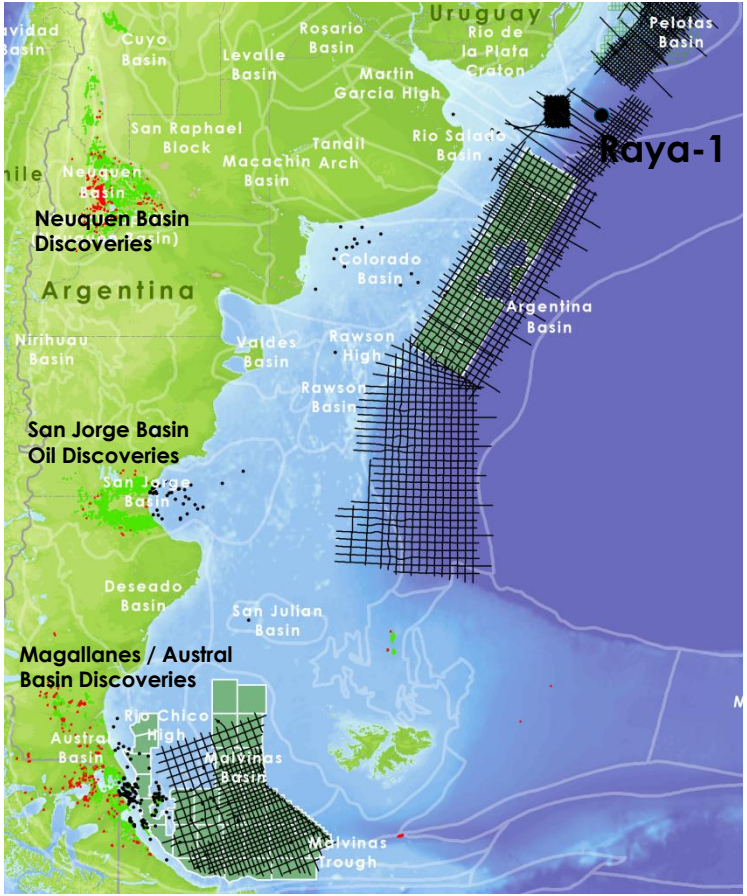


Loegering et al (2013)

Offshore Exploration

- First well 1956, first discovery 1970 – San Jorge Basin
- Deep water exploration – Raya-1 (2016) Uruguay

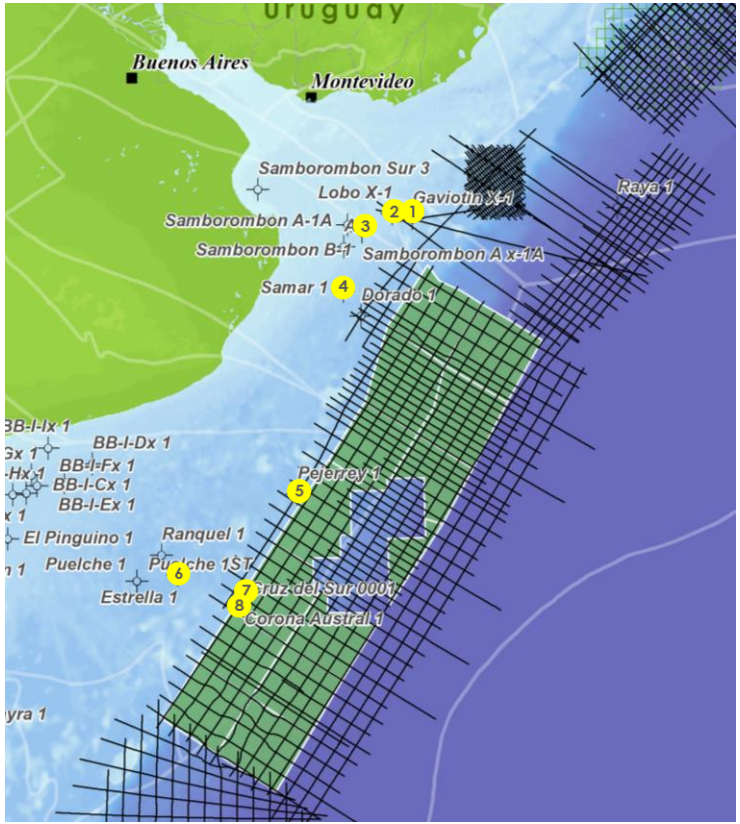




Atlantic Margin Offshore Exploration

- Proven sources on shelf – 8 wells with HC
- 1 deep water well (Raya-1) – TD: 6000m (3400m water)
- No wells in Argentina deep water, Aptian source proven in conjugate (HRT wells, Namibia)

	Well	Observations
1	Gaviotin 1	**Shows** in Lower Cretaceous
2	Lobo 1	**Shows** in Lower Cretaceous
3	Samborombon B	Residual **hydrocarbons** in Paleocene
4	Samar 1	Residual **oil** in Cenozoic & Cretaceous
5	Pejerrey 1	**Gas shows**
6	Estrella 1	**Gas shows**
7	Corona Austral 1	**Gas shows**
8	Cruz del Sur 1	**Oil** in Jurassic & Cretaceous syn-rift Mature sources in syn-rift and Permian

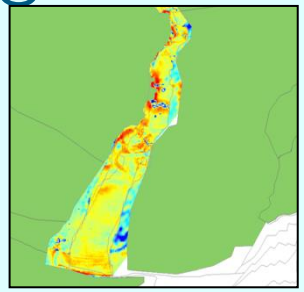


Aptian Source – Regional Correlation

Argentina Basin

Aptian source

From seismic character & correlation with conjugate

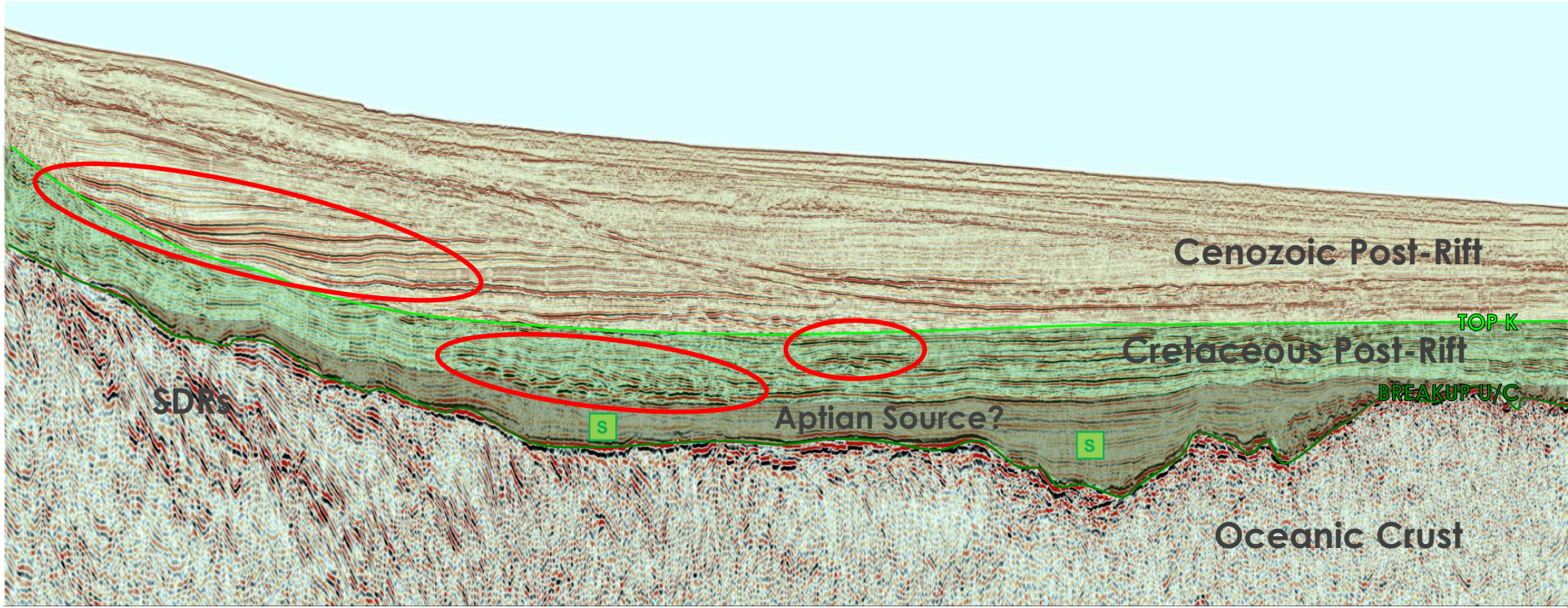


Orange Basin

Aptian source

Proven in wells in Namibia

Southern Pelotas Basin, Uruguay

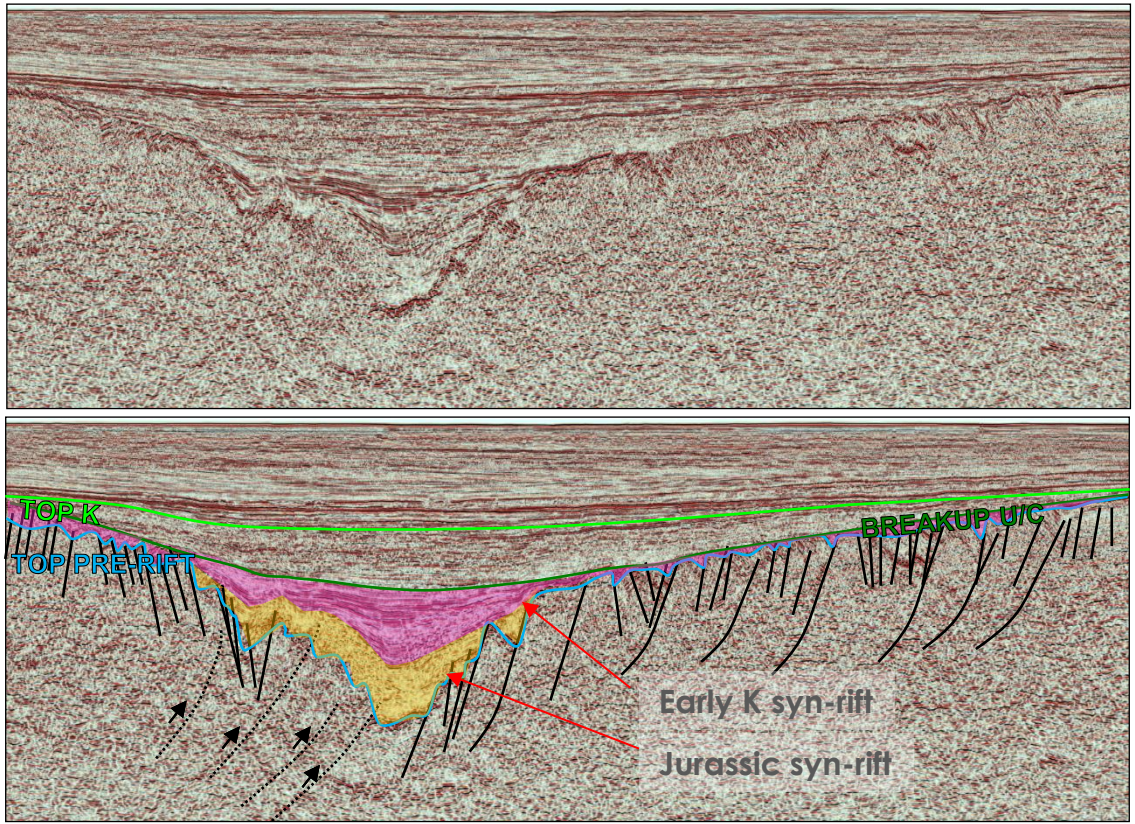


Raya-1 only penetrated Cenozoic sediments
Excellent reservoir quality in Cenozoic sandstones, but no charge

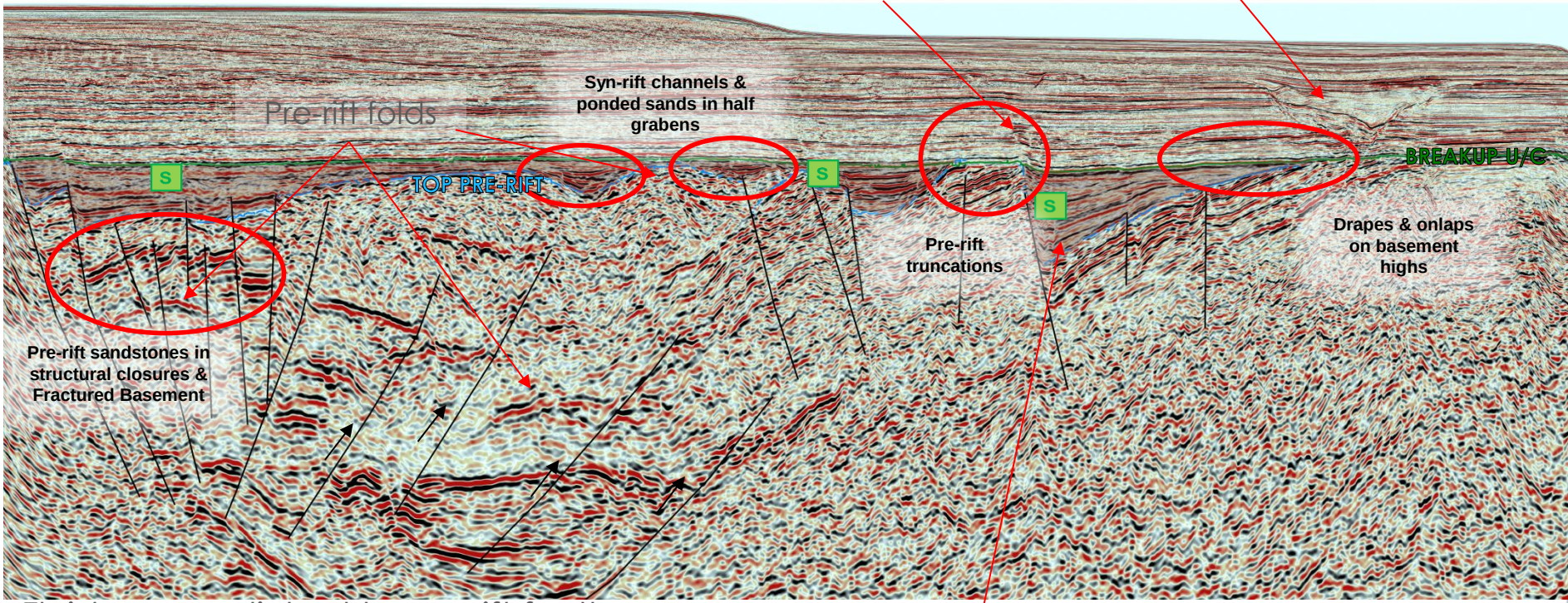
Argentina Shelf – Structure

2 rift phases superimposed on compressional pre-rift:

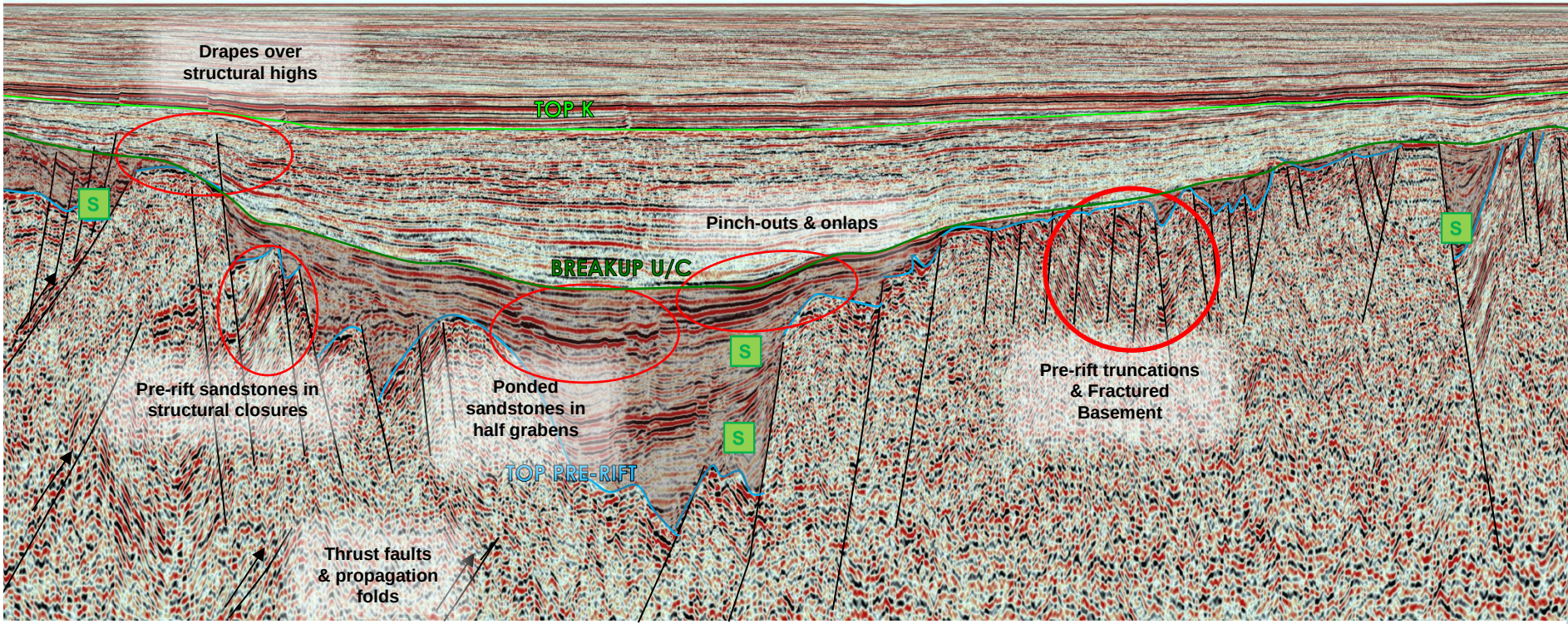
- Jurassic Rifting – Rio Salado & Colorado Basins
- Early Cretaceous – W/E volcanic rifting, South Atlantic opening
- Both syn-rift intervals have proven source potential



Shelf – Rio Salado / Punta del Este Basin

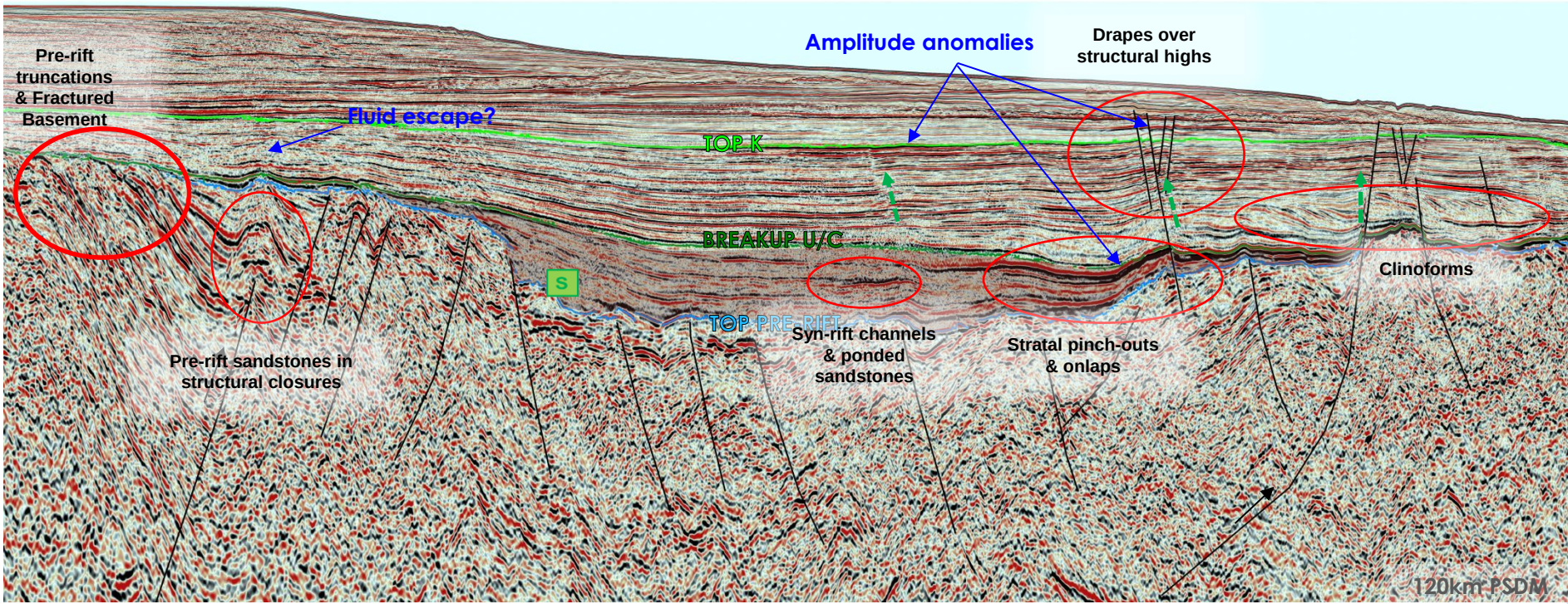


Shelf – Colorado Basin



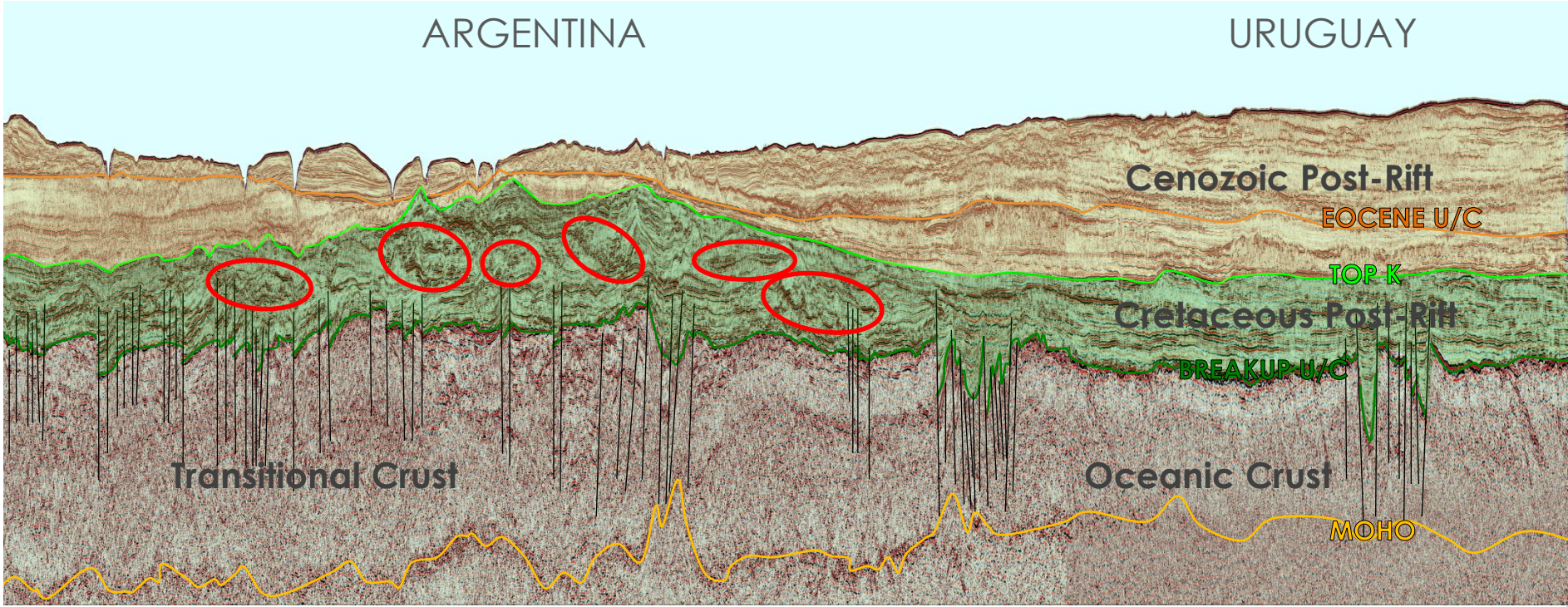
Proven syn-rift and pre-rift source potential in wells

Slope – Ewing Terrace & Outer High



Thickening of Cretaceous sediments associated with Rio Colorado fan
Post-rift faults may act as migration pathways charging shallow reservoirs

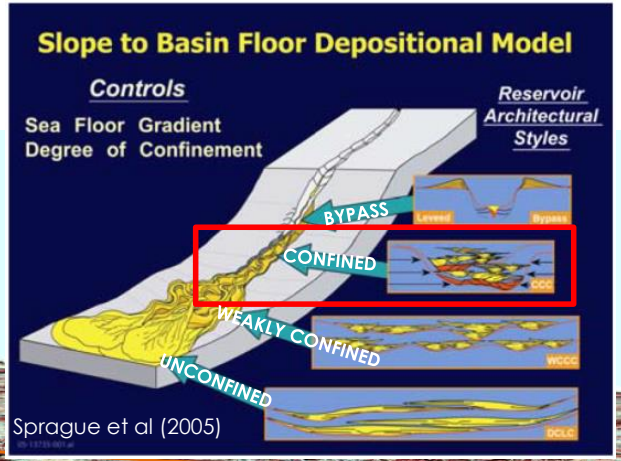
Argentina Basin

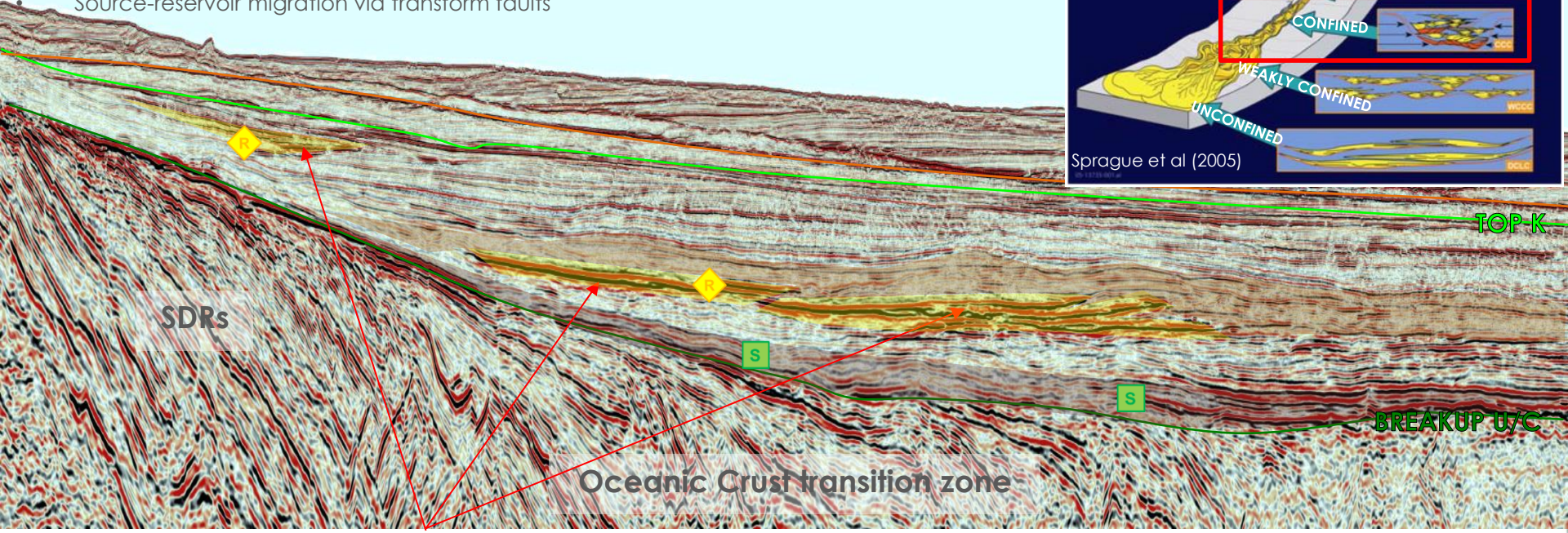


Rio Colorado Fan was a key sediment source in Cretaceous in Argentina
Numerous confined channel complexes in Rio Colorado Fan sediment wedge

Argentina Basin – Play Example

- Coarse-grained channels and fine-grained contourite drifts formed by deep water processes
- Well-sorted, high N:G reservoirs predicted, sealed by fine-grained drift deposits
- Aptian sapropel source modelled in oil window, proven in conjugate
- Source-reservoir migration via transform faults

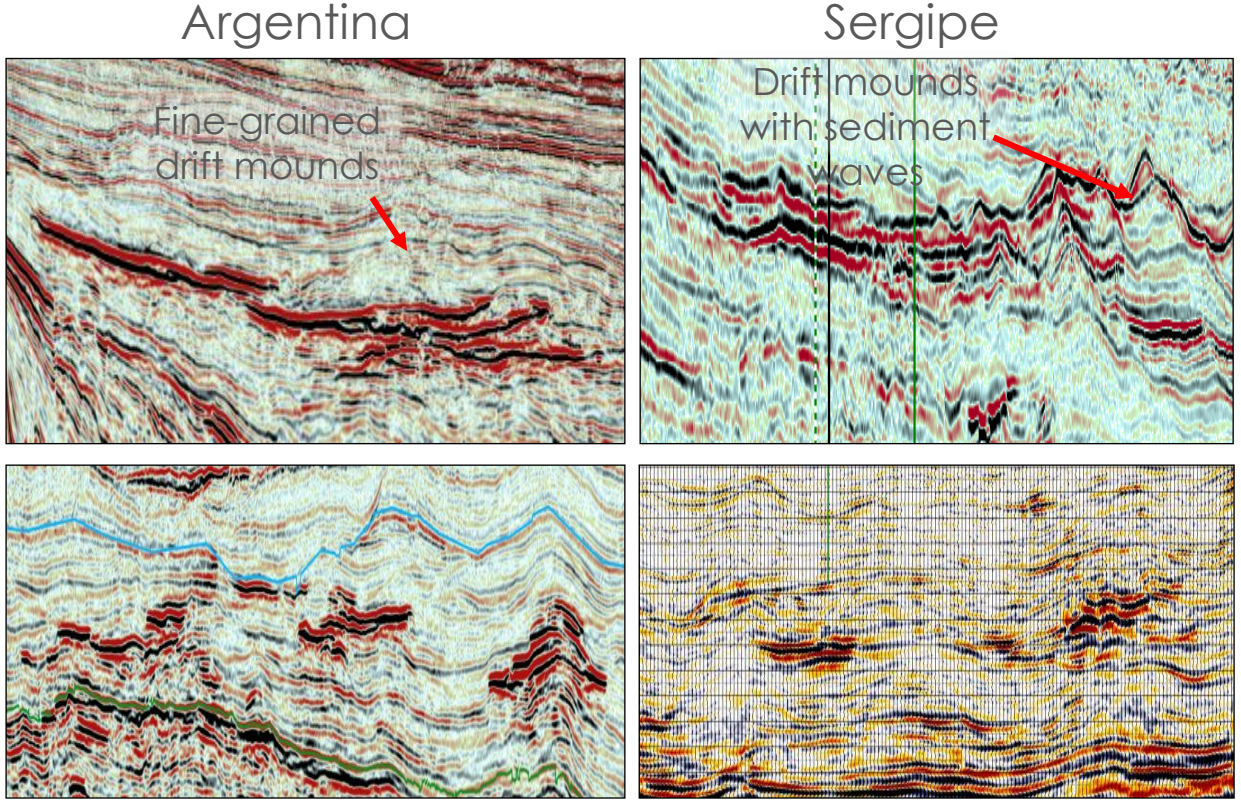




Confined channel complexes – High amplitude anomalies, AVA supported

Argentina Basin – Play Example

- Sergipe 1900km² (3BBO) Argentina 5700km²
- AVA anomalies
- Overlie oil-mature Aptian source
- Sealed by fine-grained drift mounds



Summary Atlantic Margin

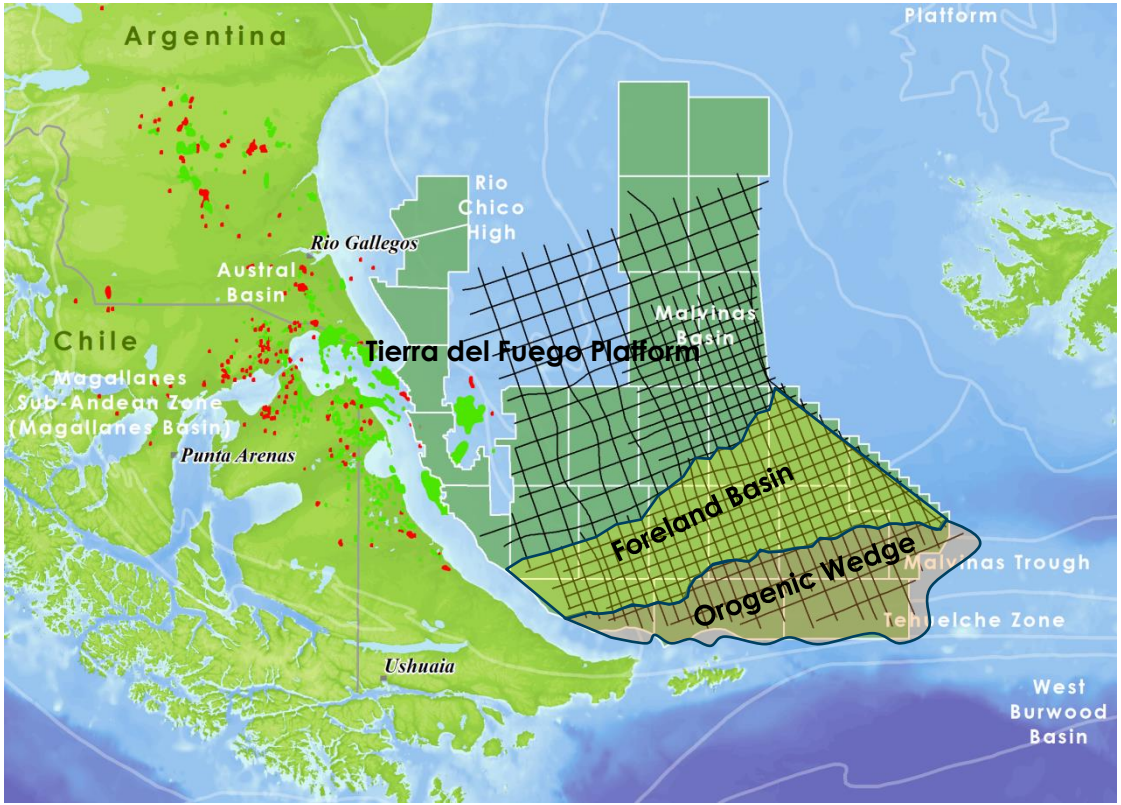
- Shelf and Ewing Terrace extend shallow water region
- Pre- and syn-rift sources proven oil-mature
- In deep water, early post-rift sources oil-mature, Aptian source identified from conjugate margin reconstruction
- Numerous play types with significant potential identified

Austral-Malvinas Basin

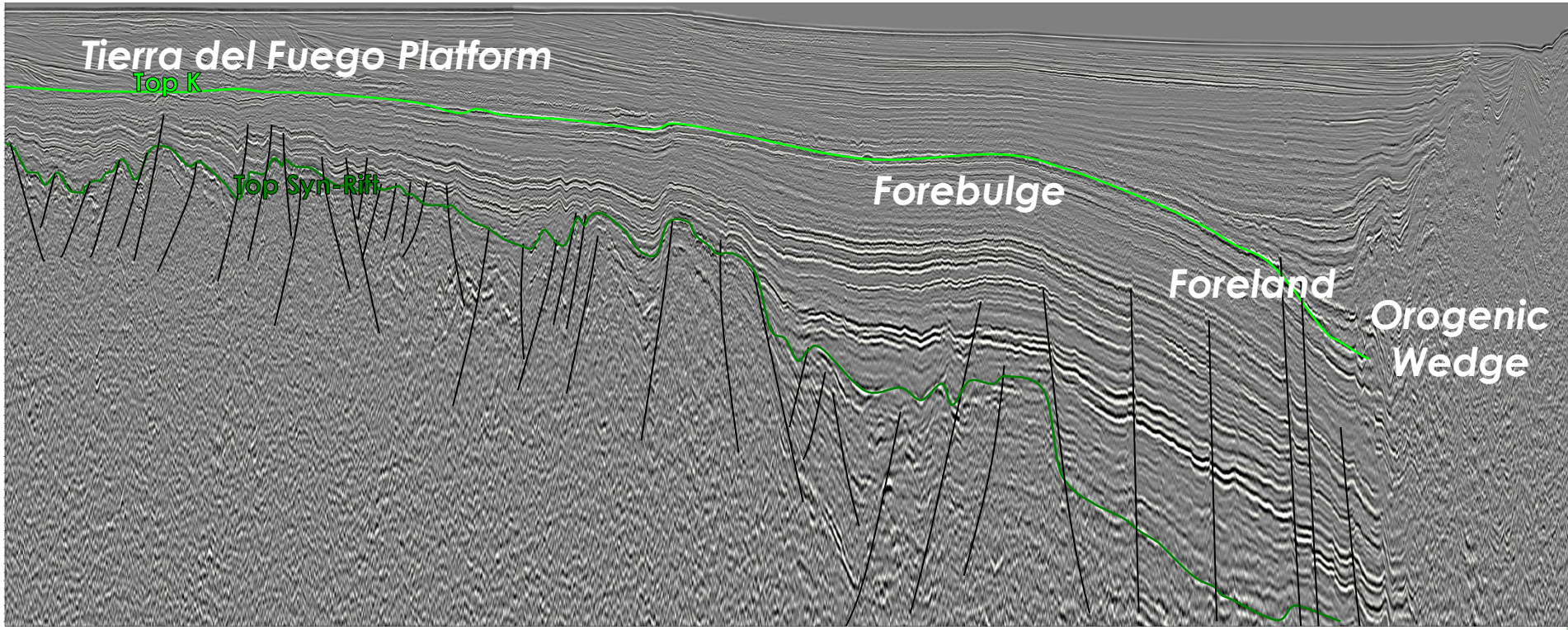
- Previous exploration success – 7 bboe recoverable discovered in Austral basin
- Relatively shallow water – up to 500m
- Proven petroleum system
- PSTM & PSDM 2D data available

Austral-Malvinas Regional Geology

- Late Jurassic/ Early K separation from Antarctica
- Thrust belt & foreland basin development in Cenozoic



Austral-Malvinas Basin Architecture



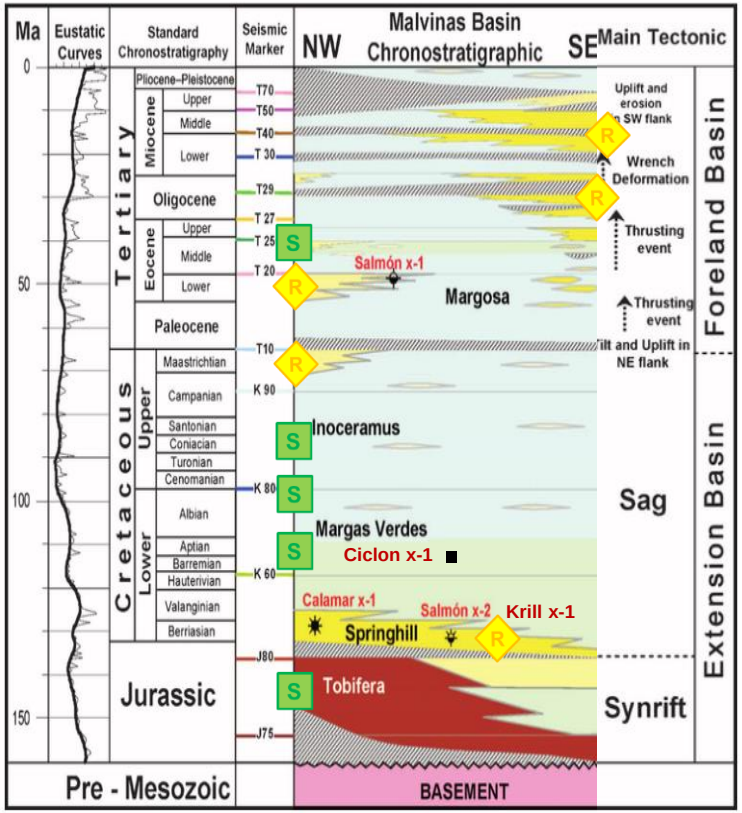
Austral-Malvinas Stratigraphy

Sources S

- Late Jurassic **Tobifera Fm** (syn-rift)
- Early K **Margas Verdes** and **Lower Inoceramus** Fm shales
- Potential in Albian, Coniacian & Eocene marine shales

Reservoirs R

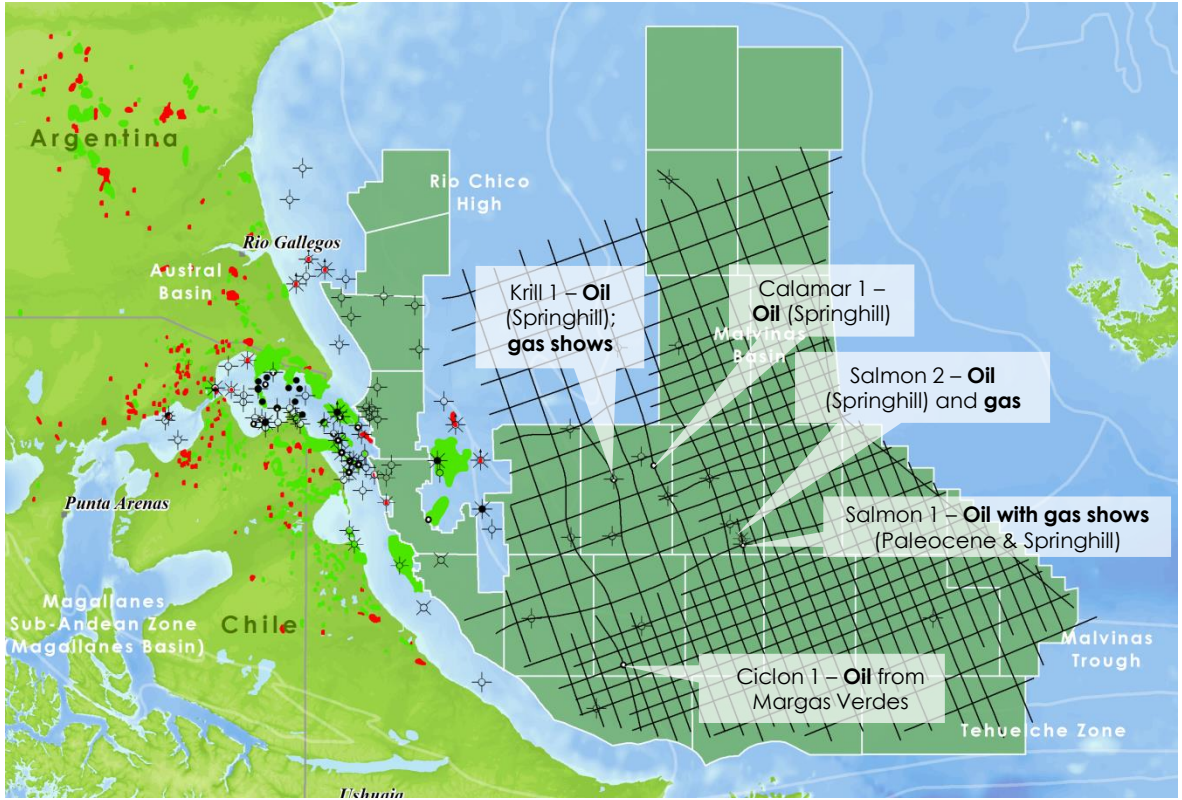
- Lower K / Upper J **Springhill Fm** – fluvial channels, estuarine bars, marine sandstones
- Upper K turbidites & shelf carbonates
- Cenozoic turbidites & foreland deposits



Vayssaire (2012)

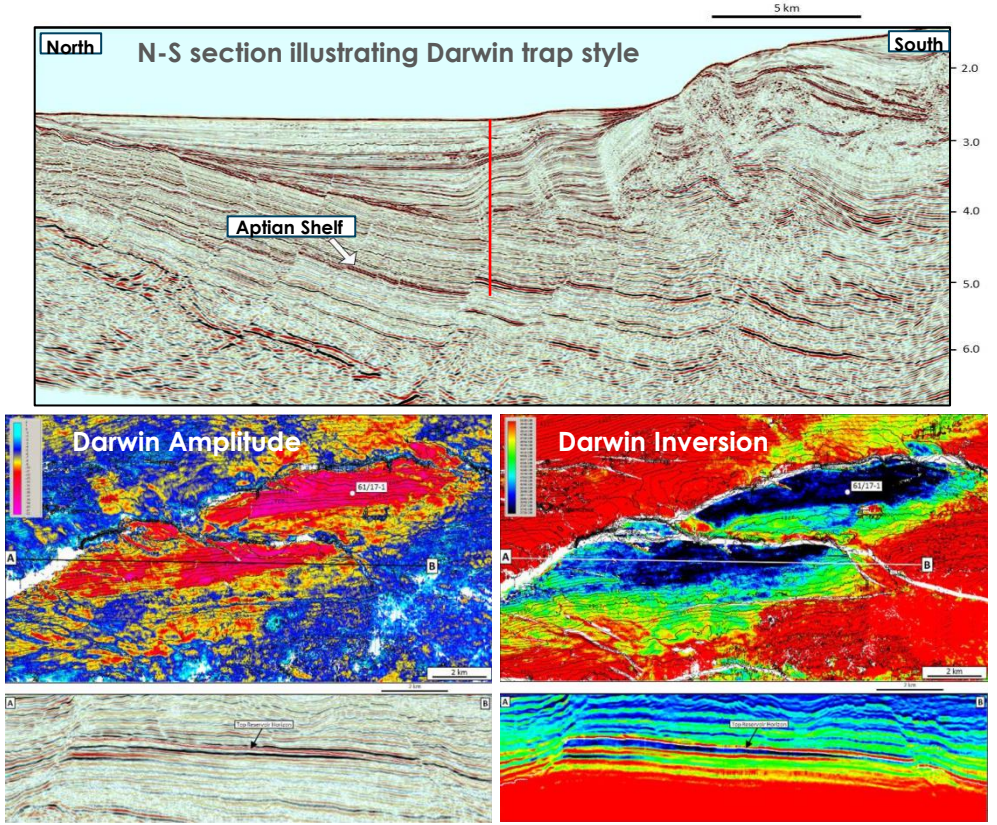
Austral Malvinas – Offshore Exploration History

- 51 exploration wells in Austral Basin, 20 in Malvinas Basin
- Most success from Lower K/ Upper J Springhill Fm sandstones
- Fold and thrust belt unexplored



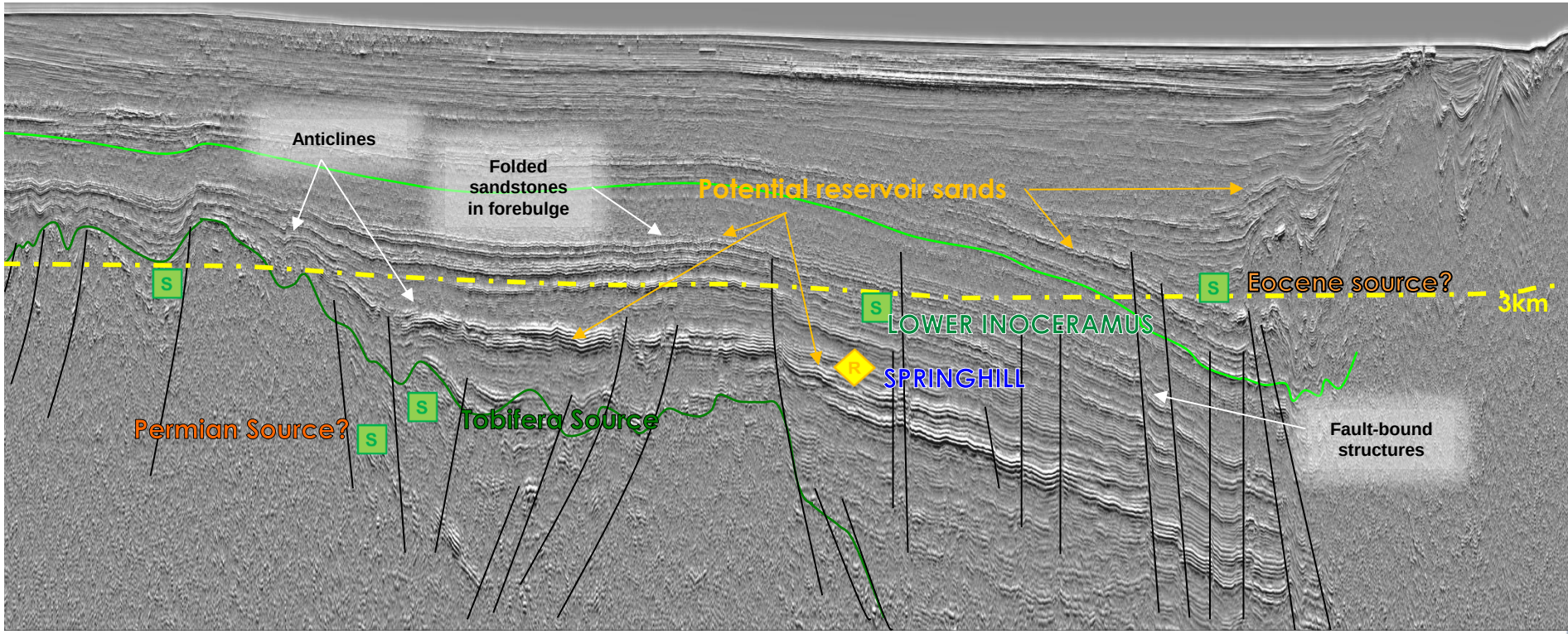
Austral Malvinas – Offshore Exploration History

- Darwin East condensate discovery (2012)
- 85m thick Aptian shallow marine sandstones in tilted fault block (Springhill equiv)
- Av ϕ 22%, av K 337mD
- Oil predicted updip of where source interval shallows



From Borders & Southern / RPS (2015)

Forebulge & Foreland Basin – Pseudo Relief



Summary

- Offshore Licensing Round announced
- Underexplored basins with proven petroleum systems, shallow to moderate water depths
- 52,000 km of long offset 2D data acquired 2017-18, PSTM & PSDM processing
- First regional seismic grid using modern long streamer data