

Kilometre-Scale Uplift of the Early Cretaceous Rift Section, Camamu Basin, Offshore North-East Brazil*

Iain Scotchman¹ and Dario Chiossi²

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¹Statoil (UK) Ltd, London, United Kingdom (isco@sstatoilhydro.com)

²Statoil do Brasil Ltda, Rio de Janeiro, Brazil

Abstract

Analysis of vitrinite reflectance data from released wells drilled in the shallow water shelf area of the offshore Camamu Basin, north-east Brazil, indicates considerable post-depositional uplift has affected the early Cretaceous-aged rift sediments.

The present-day shelf area of the Camamu Basin contains a thick succession of late Jurassic to early Cretaceous-aged pre- and syn-rift sediments. These contain a well developed petroleum system and several oil and gas fields have been discovered, sourced by thick, early syn-rift lacustrine black shales. Seismic data shows major unconformities are present, with evidence of tectonic slides particularly within the younger section. Well data confirms the presence of major unconformities with much of the latest syn-rift and post-break up section missing from the basin. By comparison with similar basins to the south in Alamada and Jequintinhonha, the missing section comprises shallow water Albian carbonates overlain by late Cretaceous turbidites.

Analysis of vitrinite reflectance data from wells in the Camamu shelf show a profile with depth typical of an uplifted basin, with higher than expected maturities at relatively shallow depths. Extrapolation of the maturity trends to a surface value indicates a range of potential uplift of between 1.2 and 2.7 km across the shelf area, suggesting that peak oil generation occurred in the past. Apatite fission track and other studies are underway to further constrain the uplift events.



**Kilometre-Scale Uplift, Early Cretaceous Rift
Section, Camamu Basin, Offshore North-East Brazil**

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1. Statoil (UK) Ltd, London, United Kingdom.
2. Statoil do Brasil Ltda, Rio de Janeiro, Brazil.

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Uplift of the Camamu Basin

- Introduction
- Location – South Atlantic Ocean Passive Margin
- Regional Geology / Stratigraphy
- Hydrocarbon Source Rocks
- Evidence of uplift
 - Basin Sections
 - Geochemical data
- Synthesis & Conclusions

Reconcavo Basin

- mature basin, many small oil & gas fields

Camamu Basin

-frontier basin. Only 3 deep water wells
Oil & Gas Discoveries in shallow water

Manati Field

17 BMm³ (GIP)

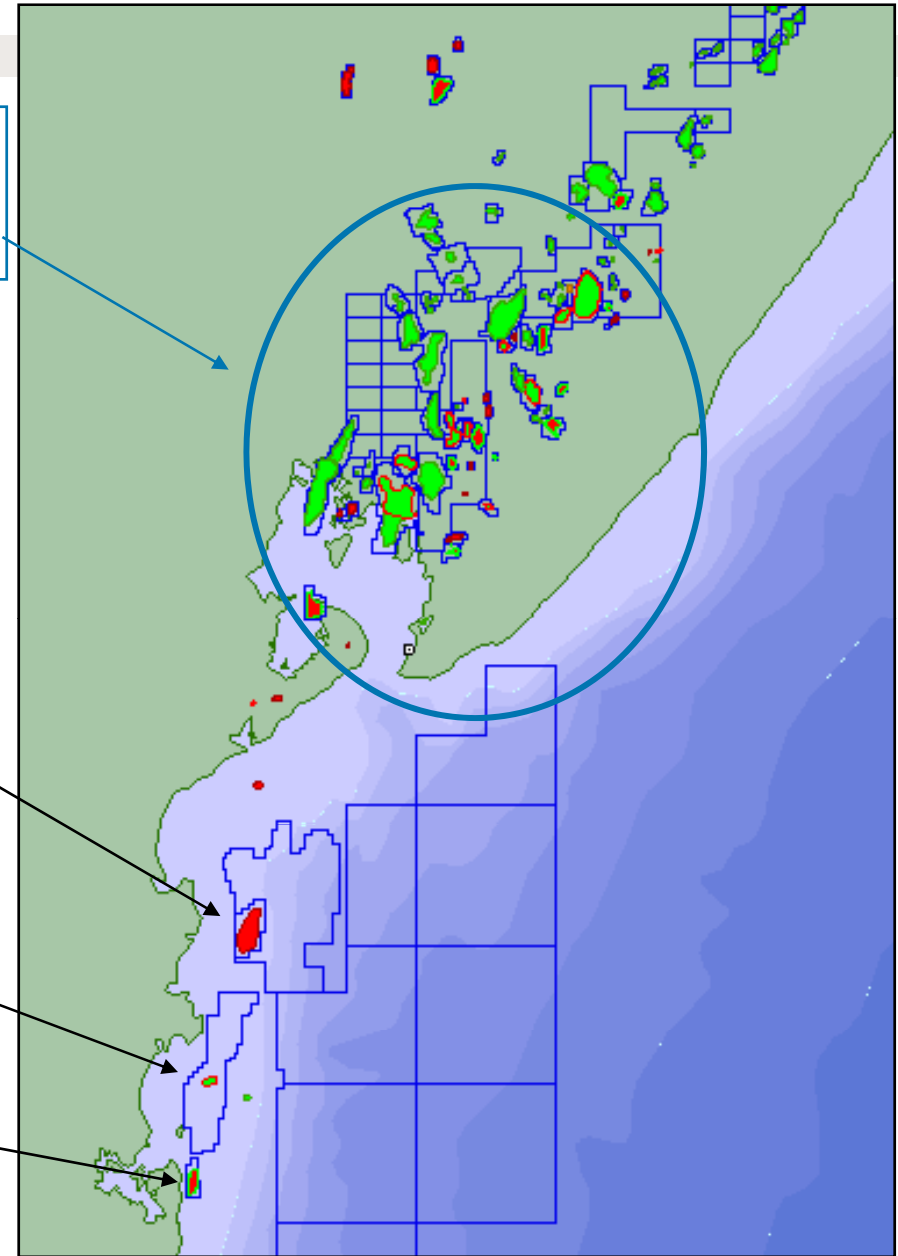
Pinauna Field

10,8 MMm³ (OIP)

Sardinha Field

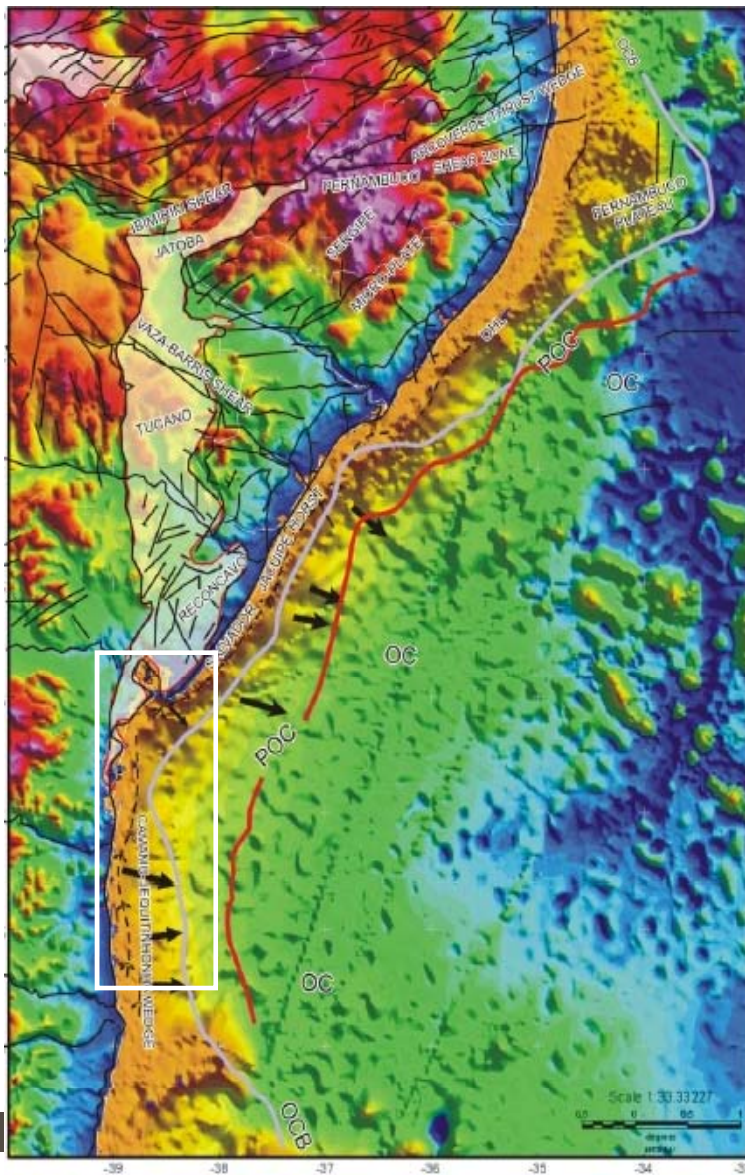
12 MMm³ (OIP)

5,4BMm³ (GIP)

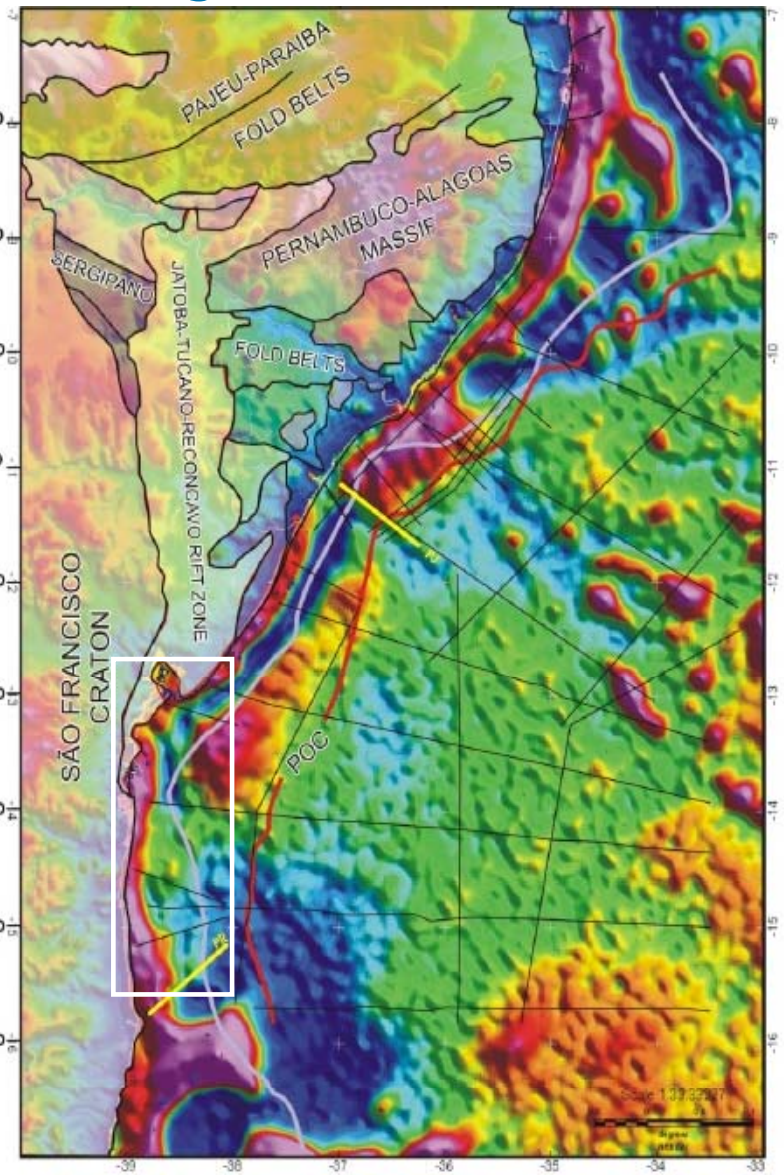


Camamu Basin – Location Map

Camamu Basin - Structural Setting

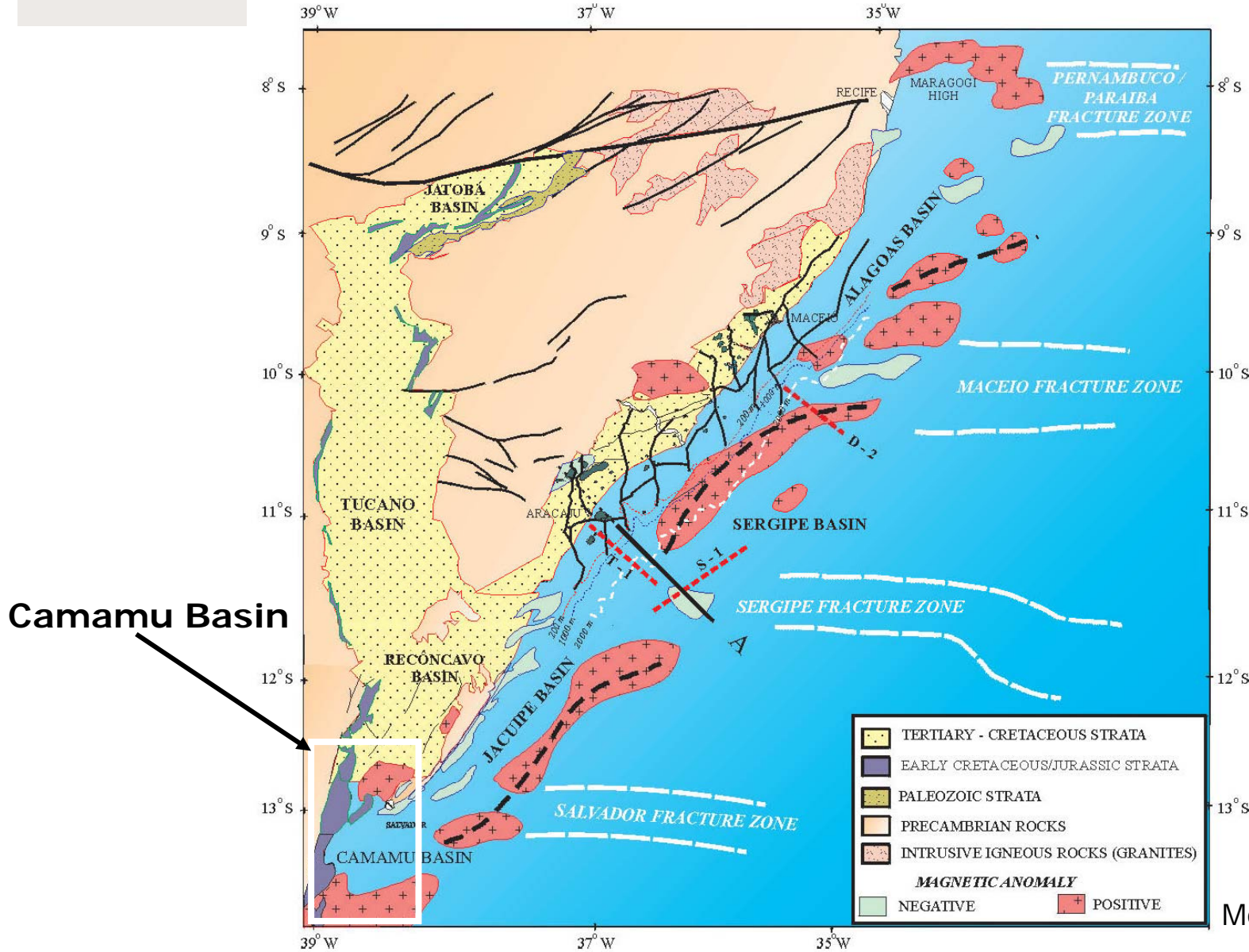


Bathymetry



Free air gravity

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Mohriak et al 2000

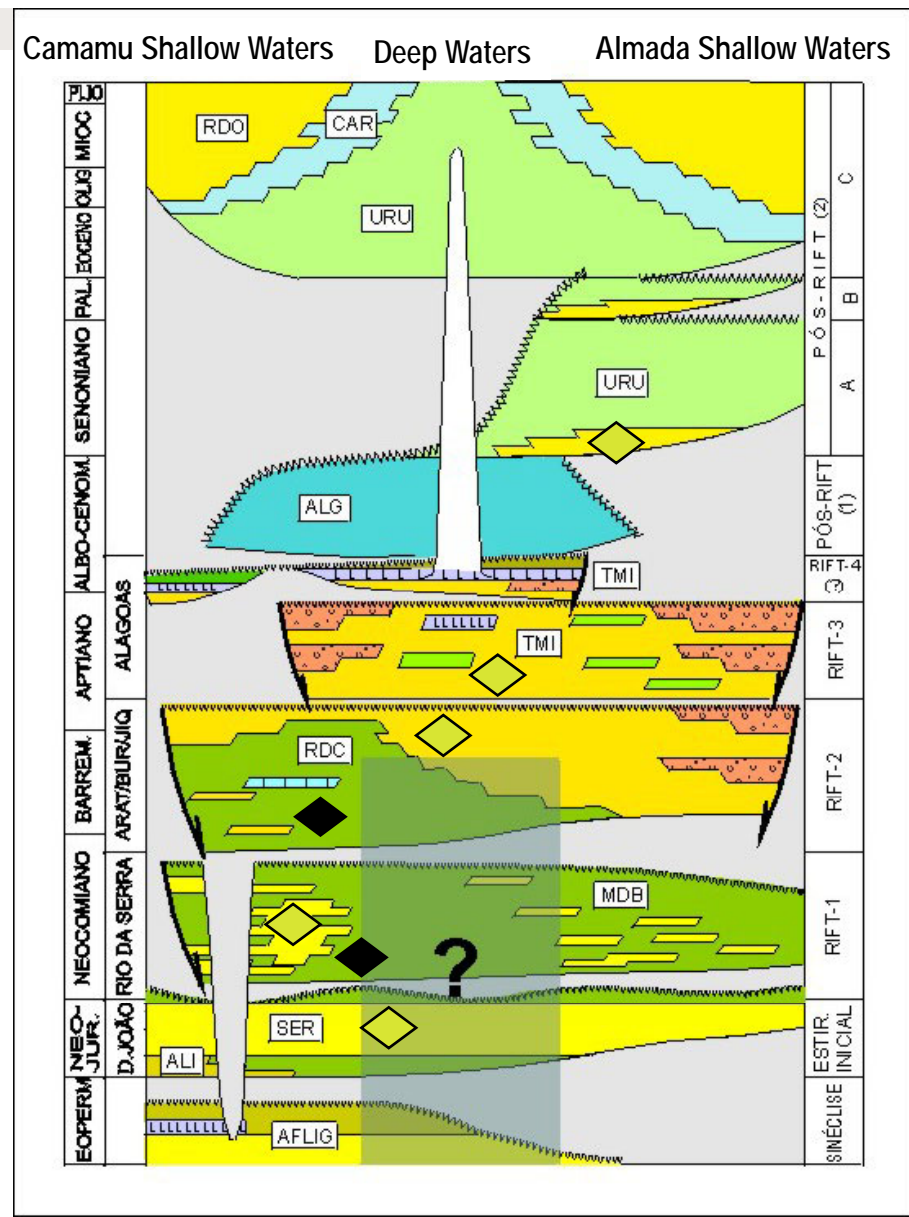
Regional Tectonic Framework, NE Brazil



Camamu & Almada basin

Simplified stratigraphic chart

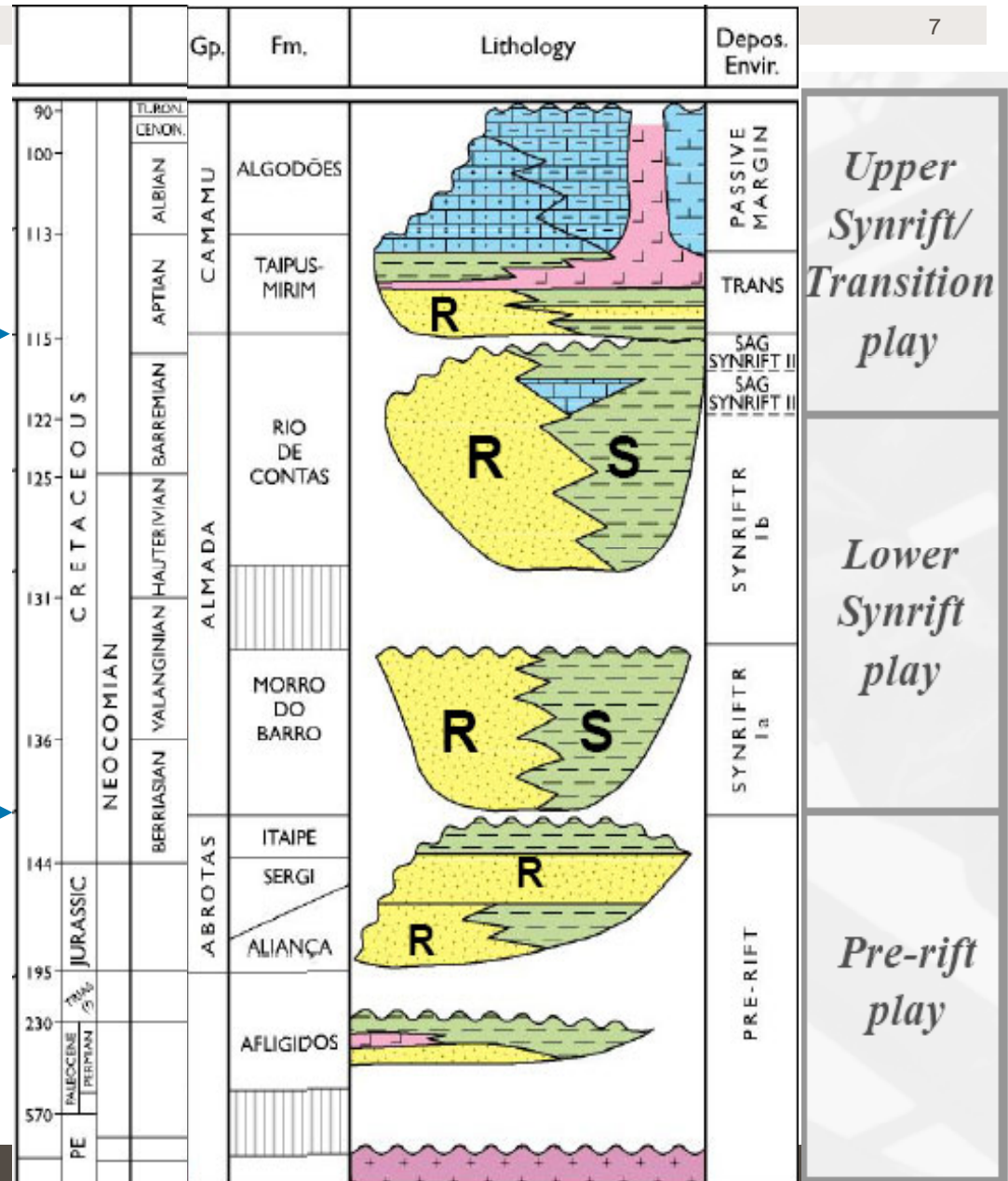
- ◆ Reservoirs (Pre, Syn and Post-Rift)
- ◆ Source Rocks (Morro do Barro and Rio de Contas Fm. – Lacustrine)

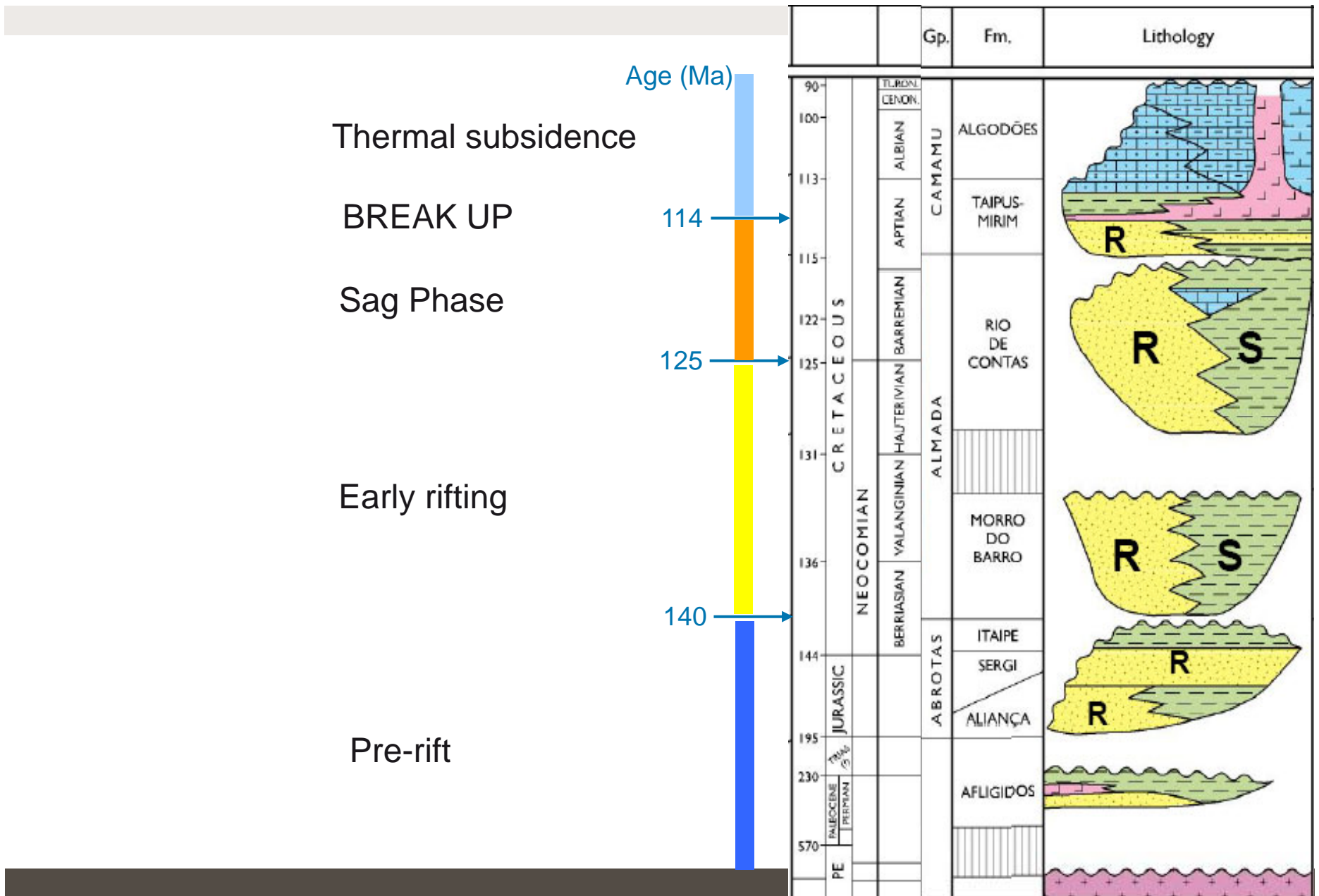


Camamu Stratigraphy

Continental breakup? →

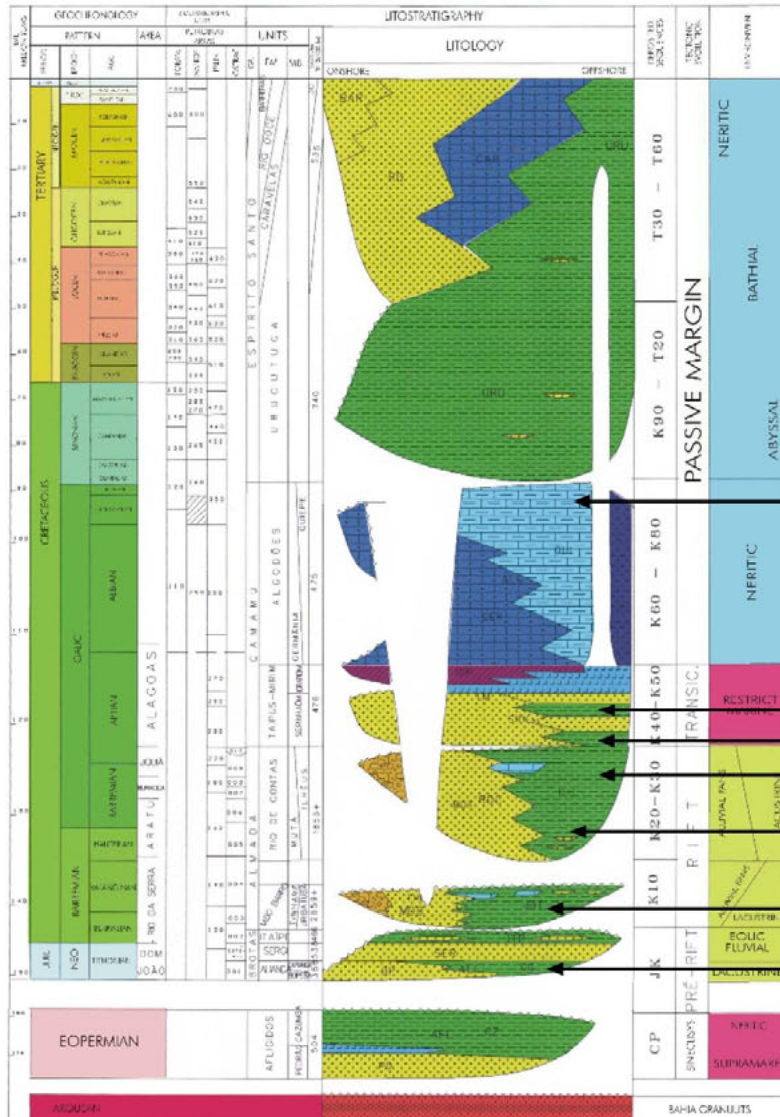
Onset of rifting? →





Camamu Basin – Syn-Rift Tectonic Model

SCHEMATIC STRATIGRAPHIC CHART - CAMAMU BASIN



Cenomanian - Turonian
 Anoxic marine source rocks. Likely to be present on deep water flank of basin. Proven in Sergipe - Alagoas Basin.

Late Aptian: Transitional Unit
 Brackish / Restricted marine source rocks (Taípus-Miris Fm.) Generally poorly developed ?

Early Aptian-Barremin-Hauterivian:- Late Synrift
 Brackish/Saline lacustrine source rocks of Rio de Contas Fm.
 Eg. I-BAS-64
 TOC: 1.7-7.6wt% (Coals up to 21.8 wt%) HI: 360-726

Neocomian (Berriasian-Valanginian):- Early Synrift
 Freshwater/Brackish Lacustrine source rocks of Morro Do Barro Fm.
 TOC: 1.3-8.7 wt% HI: 324-734. Eg. I-BAS-64

Tithonian/Berriasian:- Pre-Rift
 Fluvial/Lacustrine Source Rocks of Sergi & Itaípe Fms.
 TOC: < 3.0 wt%, HI: < 680 Eg. I-BAS-36 Good oil-prone source

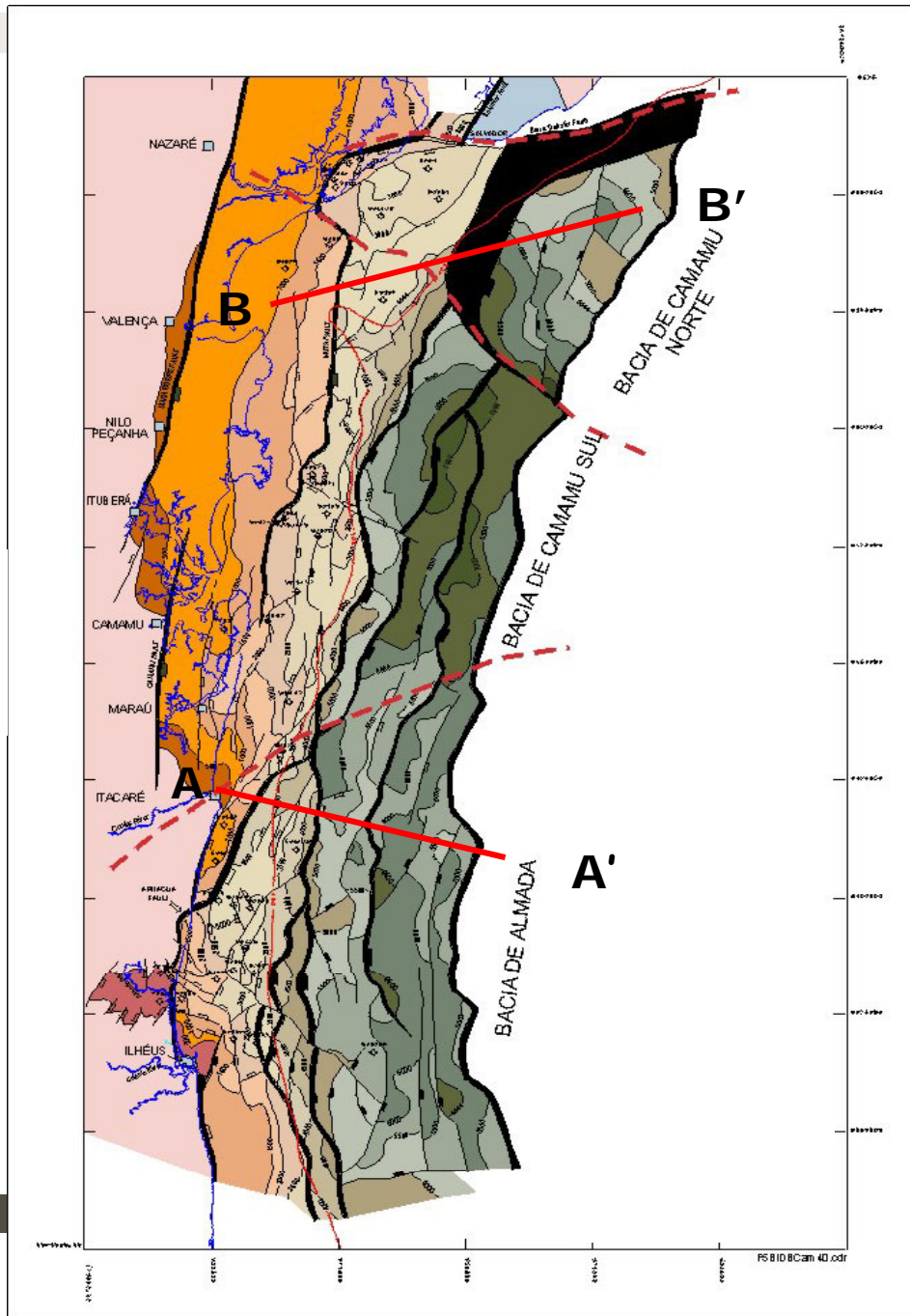
Camamu Basin – Hydrocarbon Source Rocks

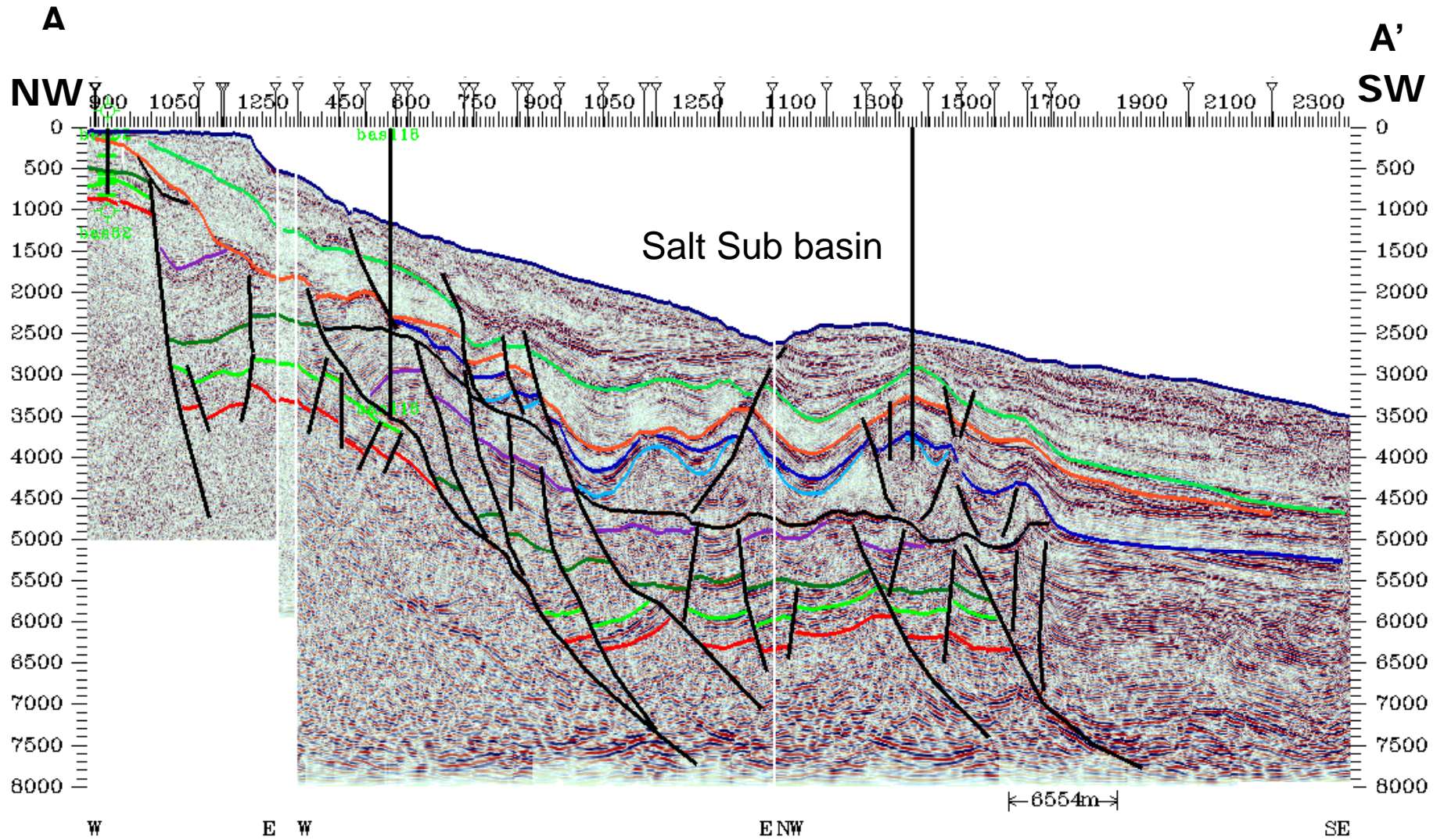


Camamu Basin

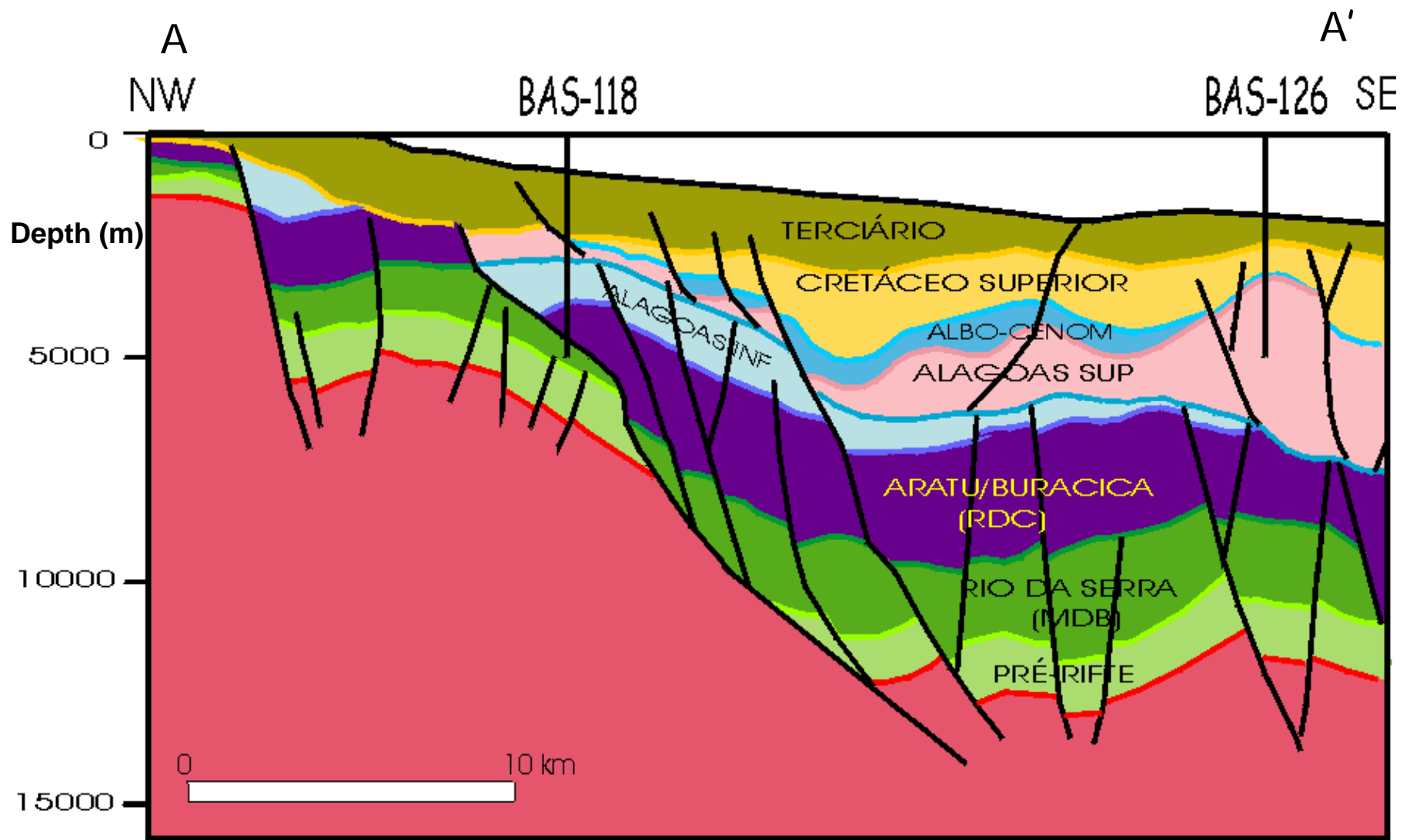
Top Basement
Depth Structure
Map

Alamada Basin

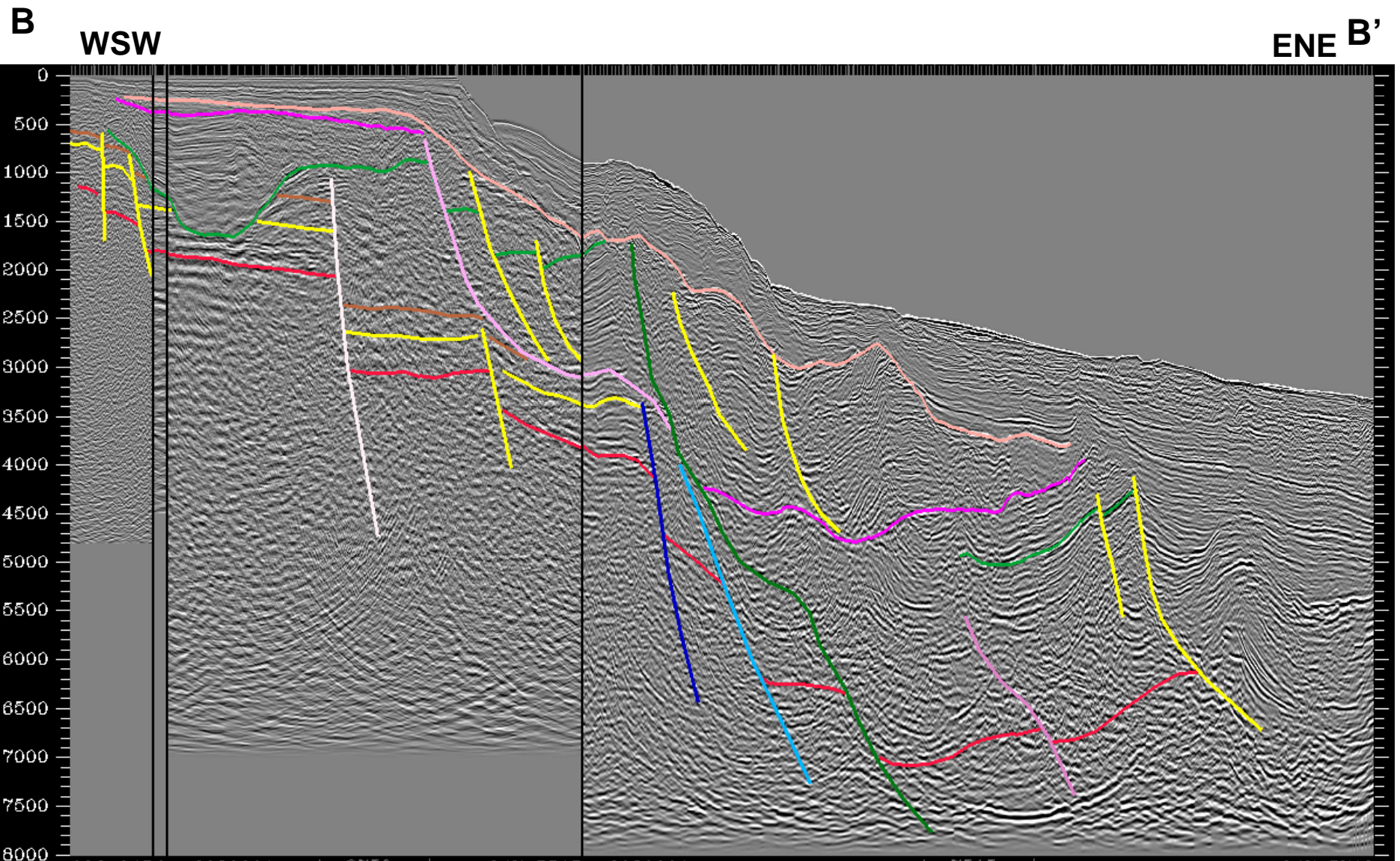




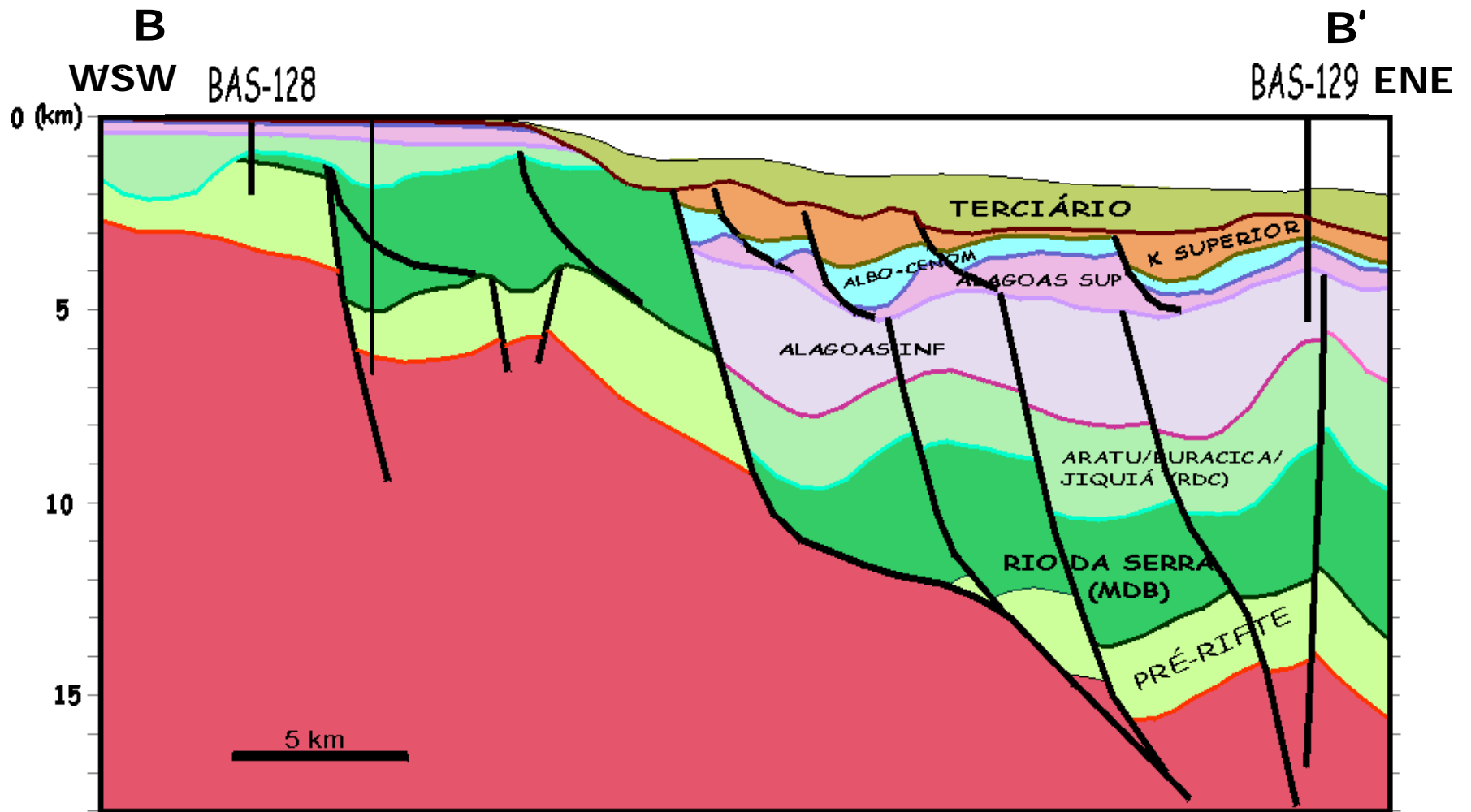
Almada Basin - Seismic Section A – A'



Regional Geologic Cross Section – Almada Basin



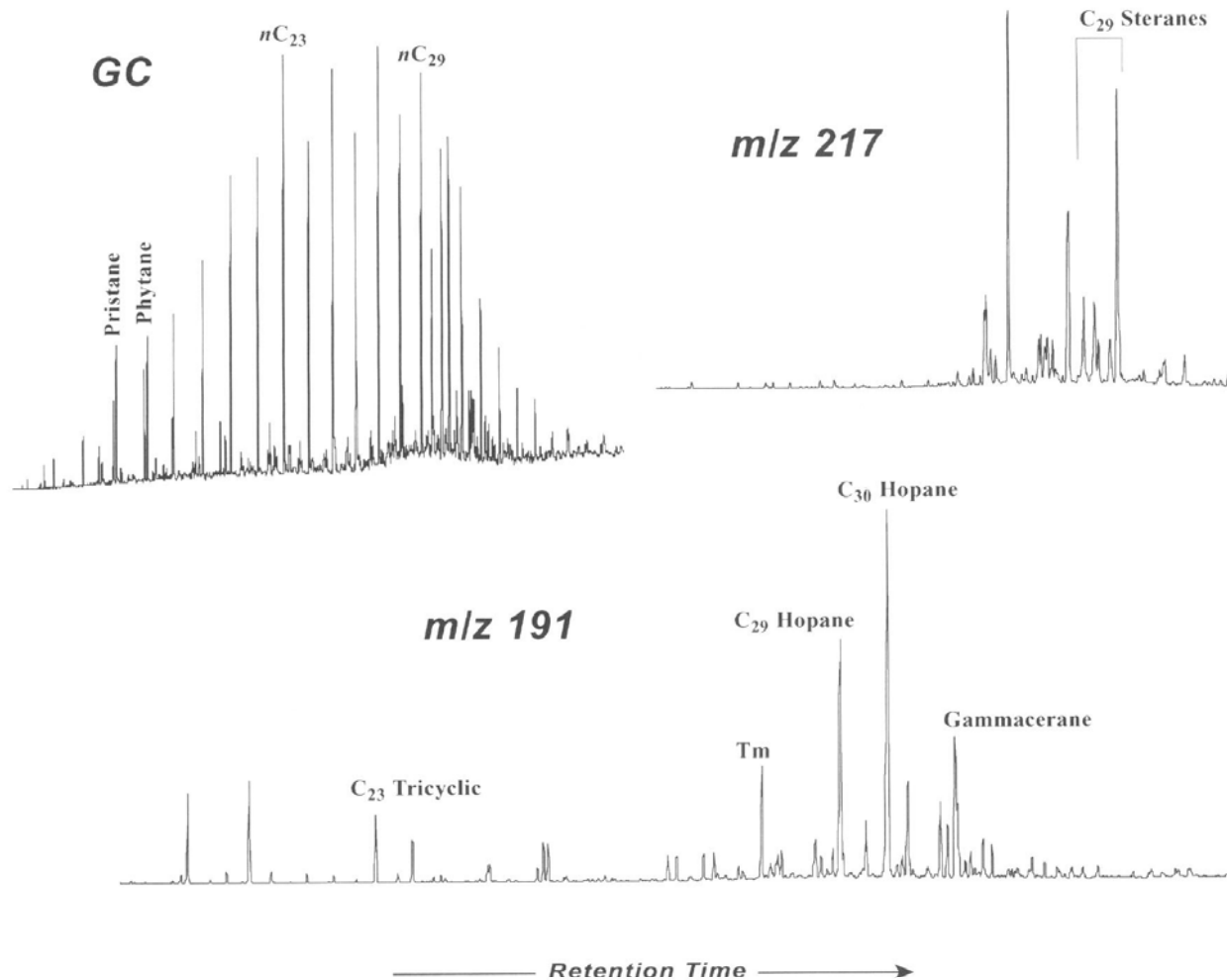
Camamu Basin – Seismic Section B – B'



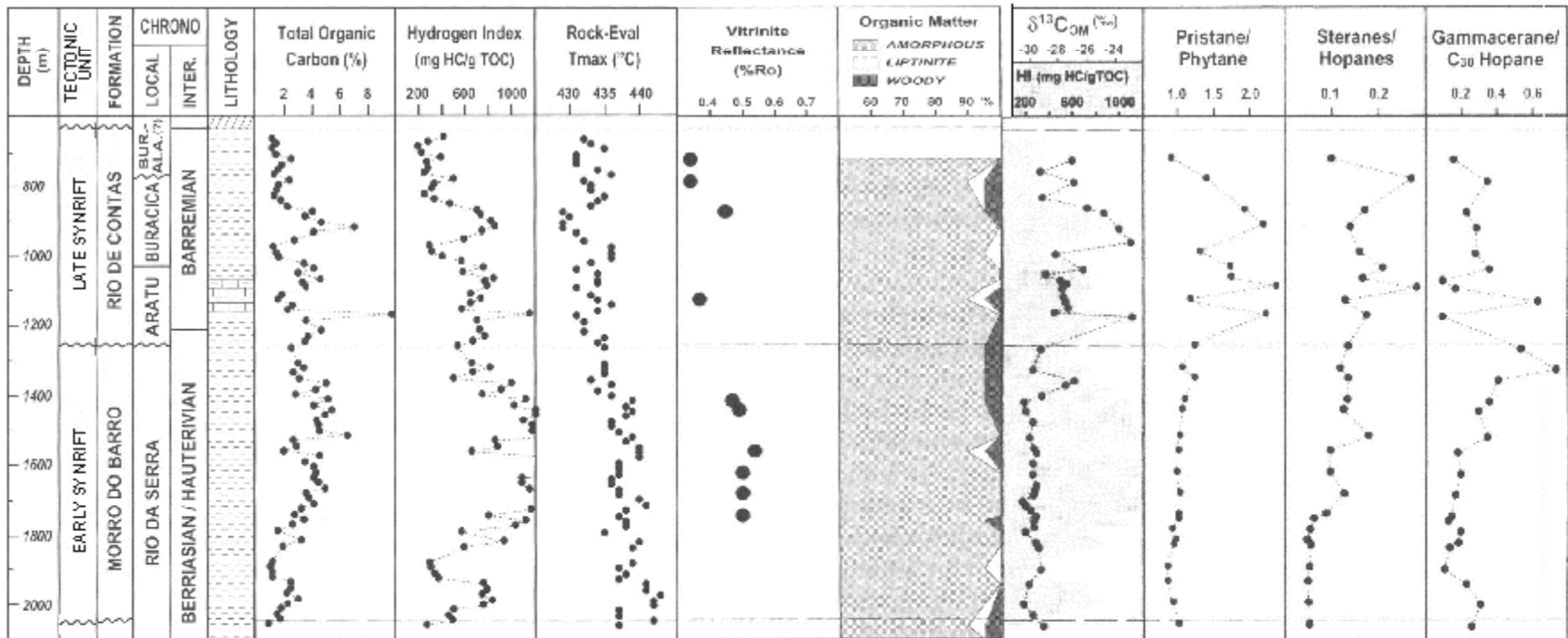
Regional Geologic Cross Section – Camamu Basin **StatoilHydro**

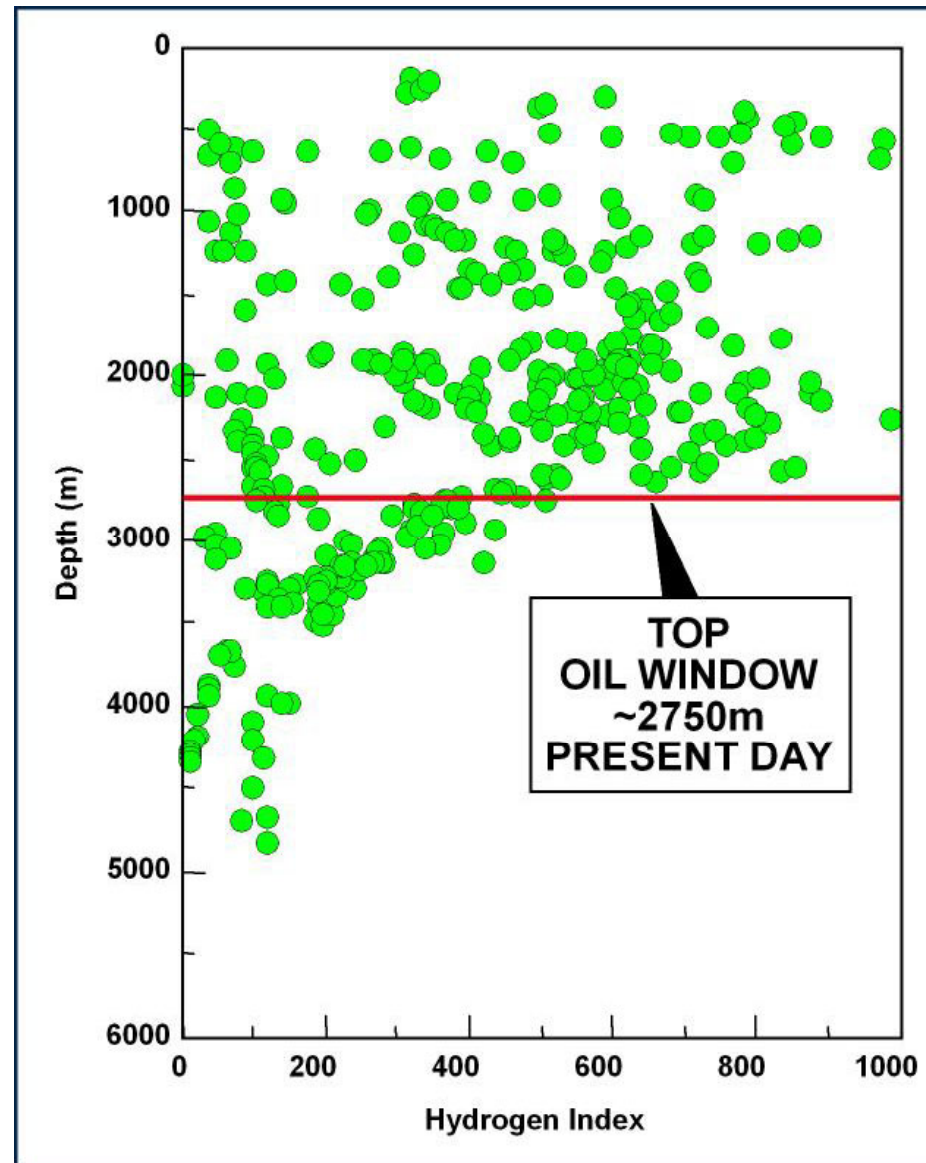
Early Syn-rift Lacustrine Source Rocks

Morro do Barro Fm., Well 1-BAS-64 1515m MD



Syn-Rift Source Rock Geochemistry: Well 1-BAS-64

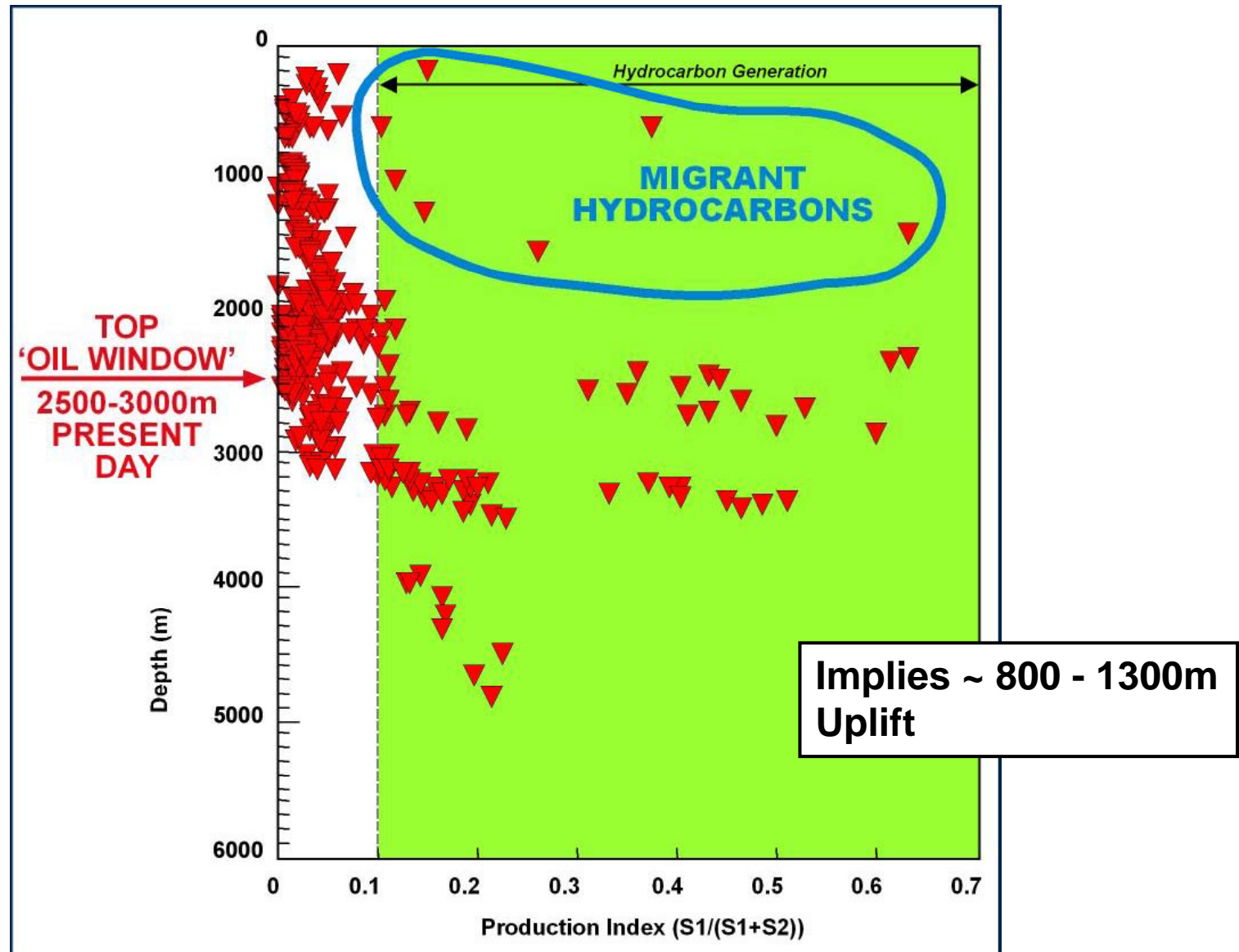




Implies ~1000m
Uplift

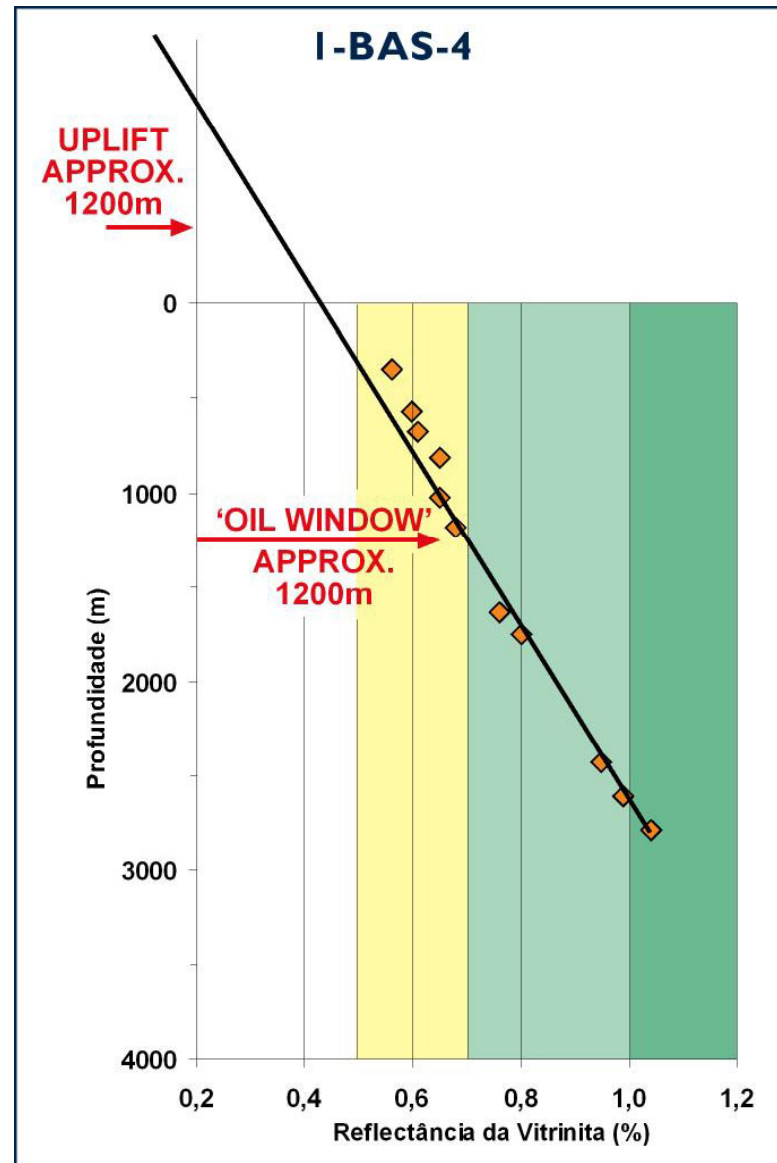
Camamu Basin – Hydrogen Index vs. Depth

StatoilHydro

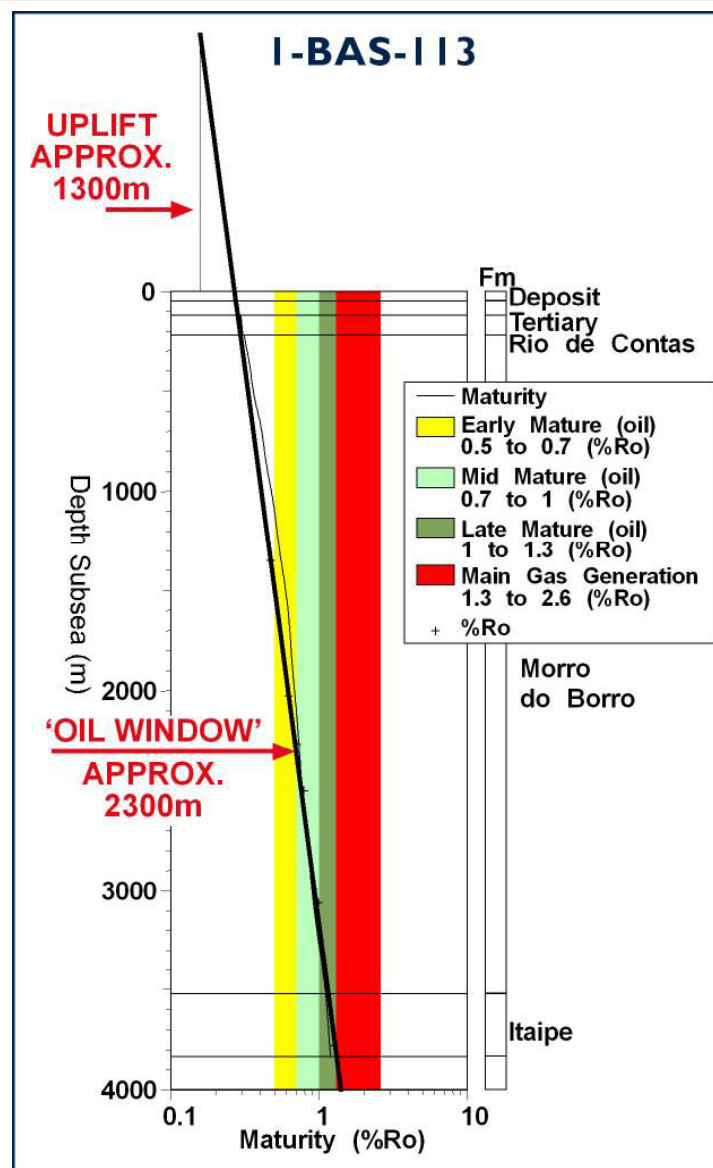


Camamu Basin – Production Index vs. Depth

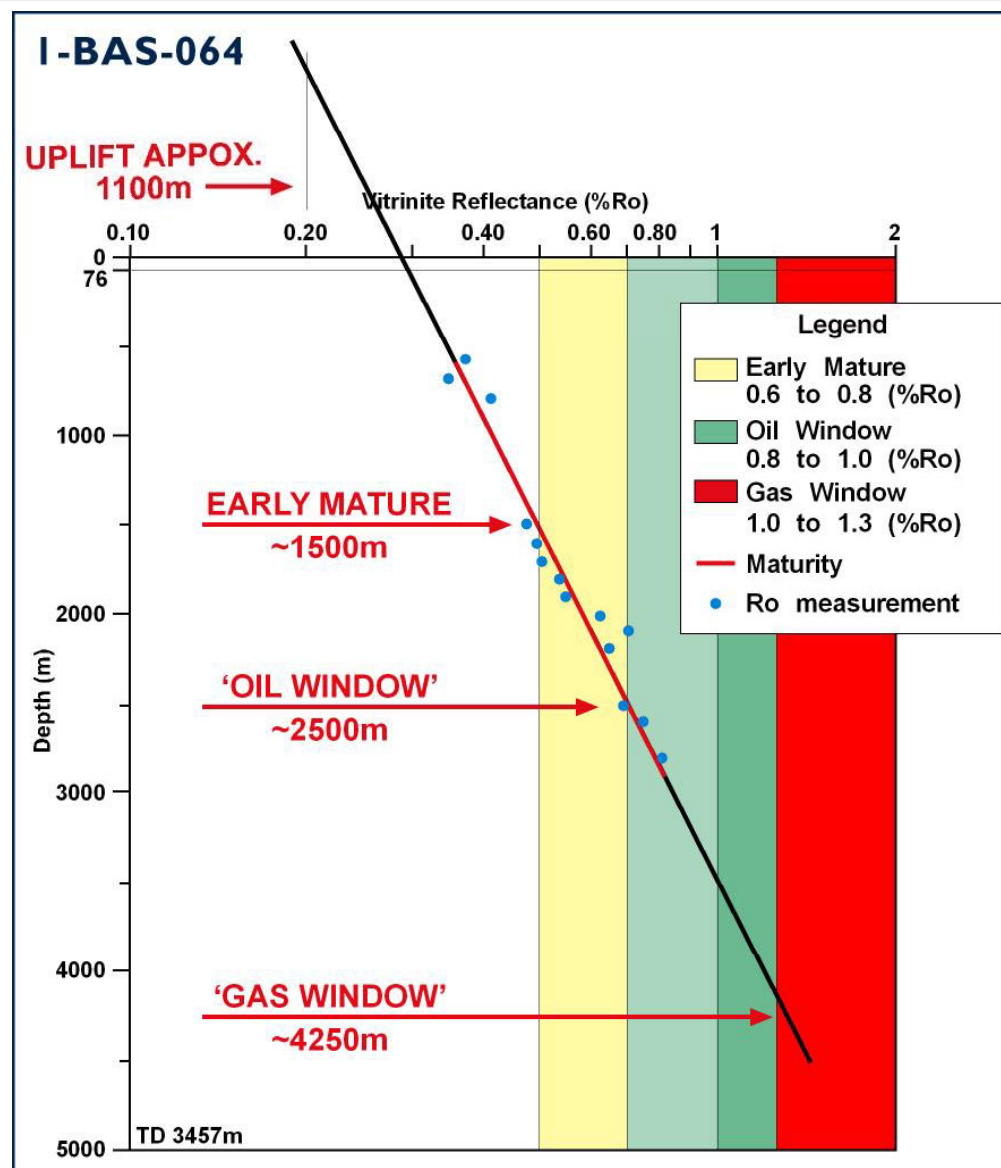
Well 1-BAS-4 Maturity vs. Depth



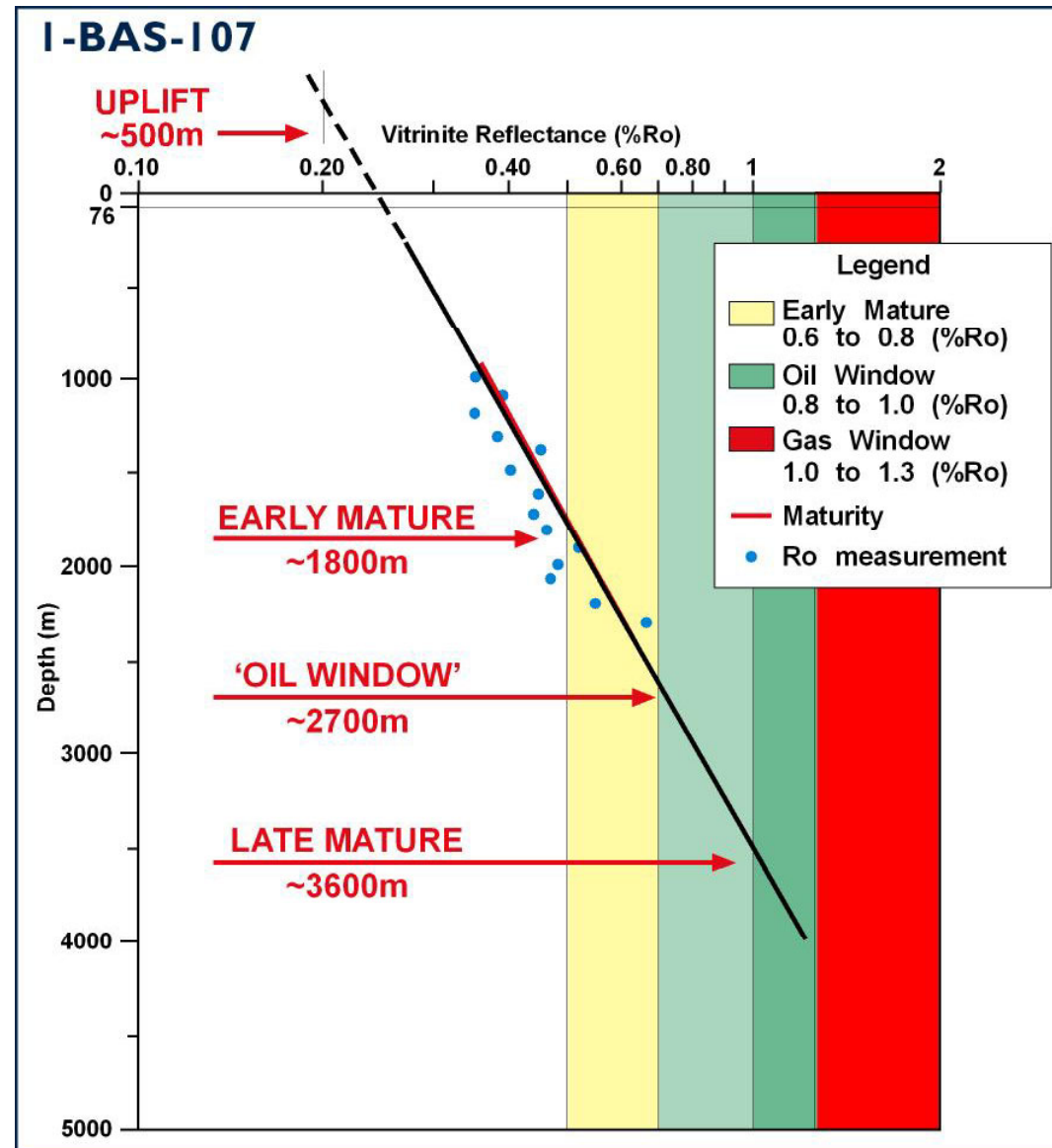
Well 1-BAS-113 Maturity vs. Depth



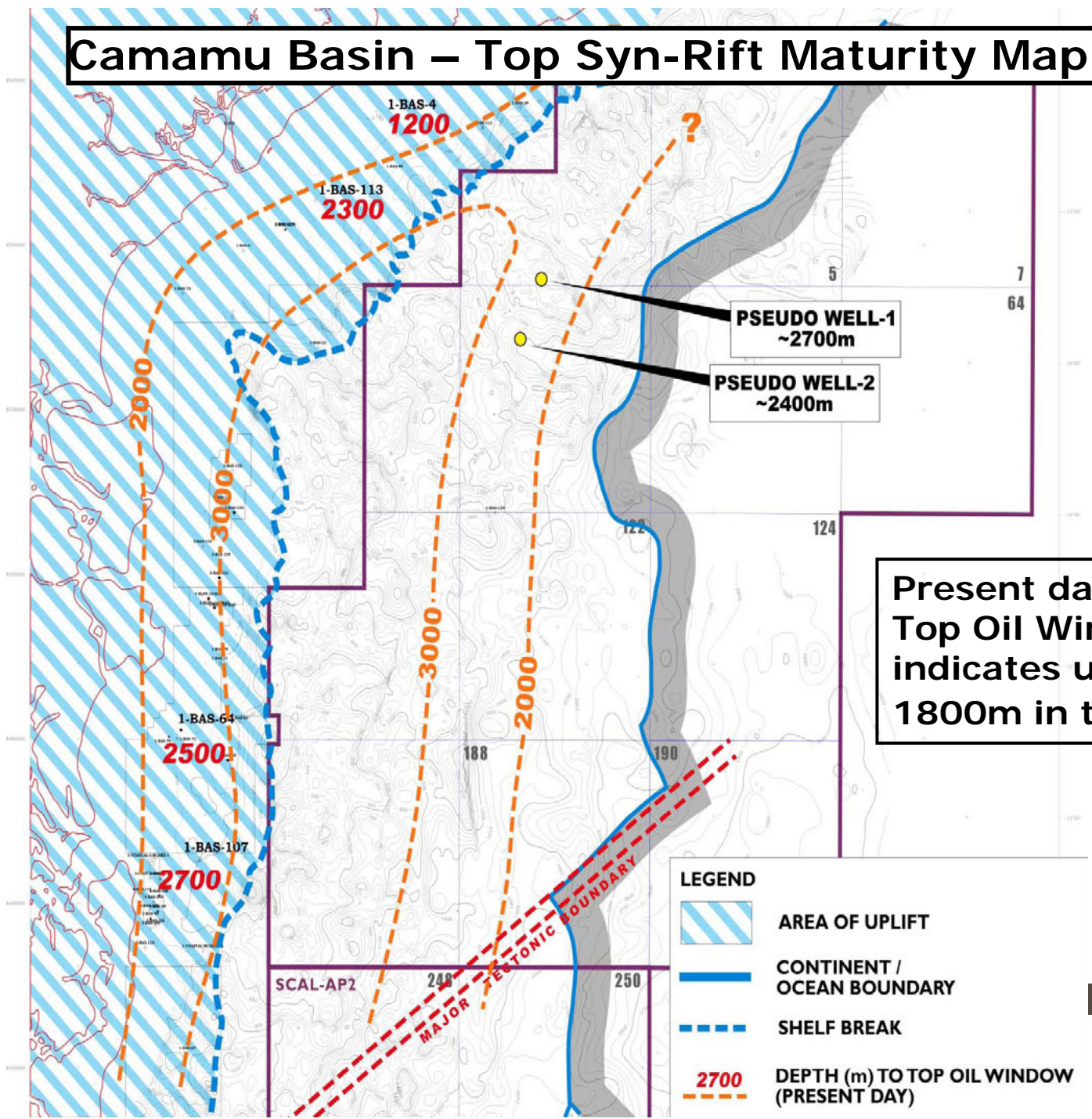
Well 1-BAS-64 Maturity vs. Depth



Well 1-BAS-107 Maturity vs. Depth



Camamu Basin – Top Syn-Rift Maturity Map



Present day depth to Top Oil Window (0.7% Ro) indicates uplift of ~800 to 1800m in the Camamu Basin

LEGEND

- AREA OF UPLIFT
- CONTINENT / OCEAN BOUNDARY
- SHELF BREAK
- 2700 DEPTH (m) TO TOP OIL WINDOW (PRESENT DAY)



Synthesis & Conclusions

- Comparison of the Camamu Basin with the Almada Basin indicates several key differences:
 - Lack of salt basin development
 - Most of the Late Cretaceous turbidite section is missing
- Indicates different basinal history both syn-rift and post-break up with considerable missing section
- Geochemical parameters eg. HI, PI, VR indicate uplift
- Uplift of approx. 500 to 1300m indicated
- Timing uncertain but probably early Tertiary?

References

Mohriak, W.U., M. Bassetto, and I.S. Vieira, 2000, Tectonic evolution of the rift basins in the northeastern Brazilian region, *in* Atlantic rifts and continental margins: Geophysical Monograph 115, p. 293-315.

Mohriak, W.U., M.R. Mello, M. Bassetto, I.S. Vieira, and E.A.M. Koutsoukos, 2000, Crustal architecture, sedimentation, and petroleum systems in the Sergipe-Alagoas Basin, northeastern Brazil, *in* Petroleum systems of South Atlantic margins: AAPG Memoir 73, p. 273-300.

Rosendahl, B.R., Mohriak, W.U., M.E. Odegard, J.P. Turner, and W.G. Dickson, 2005, West African and Brazilian conjugate margins; crustal types, architecture, and plate configurations, *in* Petroleum systems of divergent continental margin basins: Gulf Coast Section SEPM Research Conference 25, p. 13-14.