The Evolution of the Atlantic Margin of Iberia as Recorded in the Lusitanian Basin (Portugal)*

Rui Pena dos Reis[1], Nuno Pimentel[2], and António Garcia[3]

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[1]Earth Sciences, University of Coimbra, Coimbra, Portugal (Penareis@DCT.UC.PT)
[2]Geology, University of Lisbon, Lisbon, Portugal
[3]Federal University of Sergipe, Aracaju, Brazil

Abstract

The Lusitanian Basin (LB) is located at the western façade of Europe, facing the Atlantic Ocean but close to the Mediterranean Sea. It is a peri-Atlantic basin originated in a Tethyan realm, sharing with both oceans, some of its controls and tectono-sedimentary features. This work aims to present a stratigraphic chart of the LB with the major events of its evolution. The lithostratigraphy of the LB is based on published works, with revisions and formalization for some intervals. A unified chart is presented, integrating those data with recent studies developed within the scope of Project Atlantis (supported by PETROBRAS and developed by Brazilian and Portuguese universities - UFS/UC/UL).

Besides lithostratigraphy, other aspects of the LB, are presented. The evolution of the basin present three 1st order geodynamic rifting cycles, separated by large-scale regional unconformities. Fourteen second order T-R sequences are established, controlled by sea level changes and tectonic phases. Magmatic and diapiric events underline critical moments, namely in relation with geodynamic changes and the main extensional or compressional episodes. The following regional geodynamic framework and evolution results from the analysis of the sedimentary infilling:

- a Late Triassic to Late Jurassic rifting, dictated mainly by the Pangea break-up and Tethyan influence in western European plate; two phases may be defined, the first one (Upper Triassic) mainly continental with an evaporitic event, the second one (Lower and Middle Jurassic) deep ramp to carbonate shelf, both marked at its bases by magmatic intrusions;

- a Upper Jurassic to Lower Cretaceous rifting, driven by the alignment of the basin with the Central Atlantic opening; the basin has been re-oriented and new depocenters developed; intense subsidence triggered diapiric geometries;

- Lower to Upper Cretaceous drift, initiated by the North Atlantic Ocean spreading, begun and ended with magmatism; the break-up unconformity is diachronous, jumping in three steps towards North; diapirism has been intensified and reached extrusion;

- Upper Cretaceous and Cenozoic inversion of the basin with uplift and erosion, resulting from the collision between the Iberian and African plates.

Petroleum system elements, identifiable and active in the LB, may also be integrated in this framework. Source-rocks, reservoirs, maturation and traps, show interesting relations with the stages of the basin's Mesozoic and Cenozoic evolution.

Selected Reference

Ziegler, P.A., 1988. Evolution of the Arctic North Atlantic and the Western Tethys: American Association of Petroleum Geologists Memoir 43, 197 p.

The evolution of the Atlantic Margin of Iberia, as recorded in the Lusitanian Basin (Portugal)

Rui PENA dos REIS
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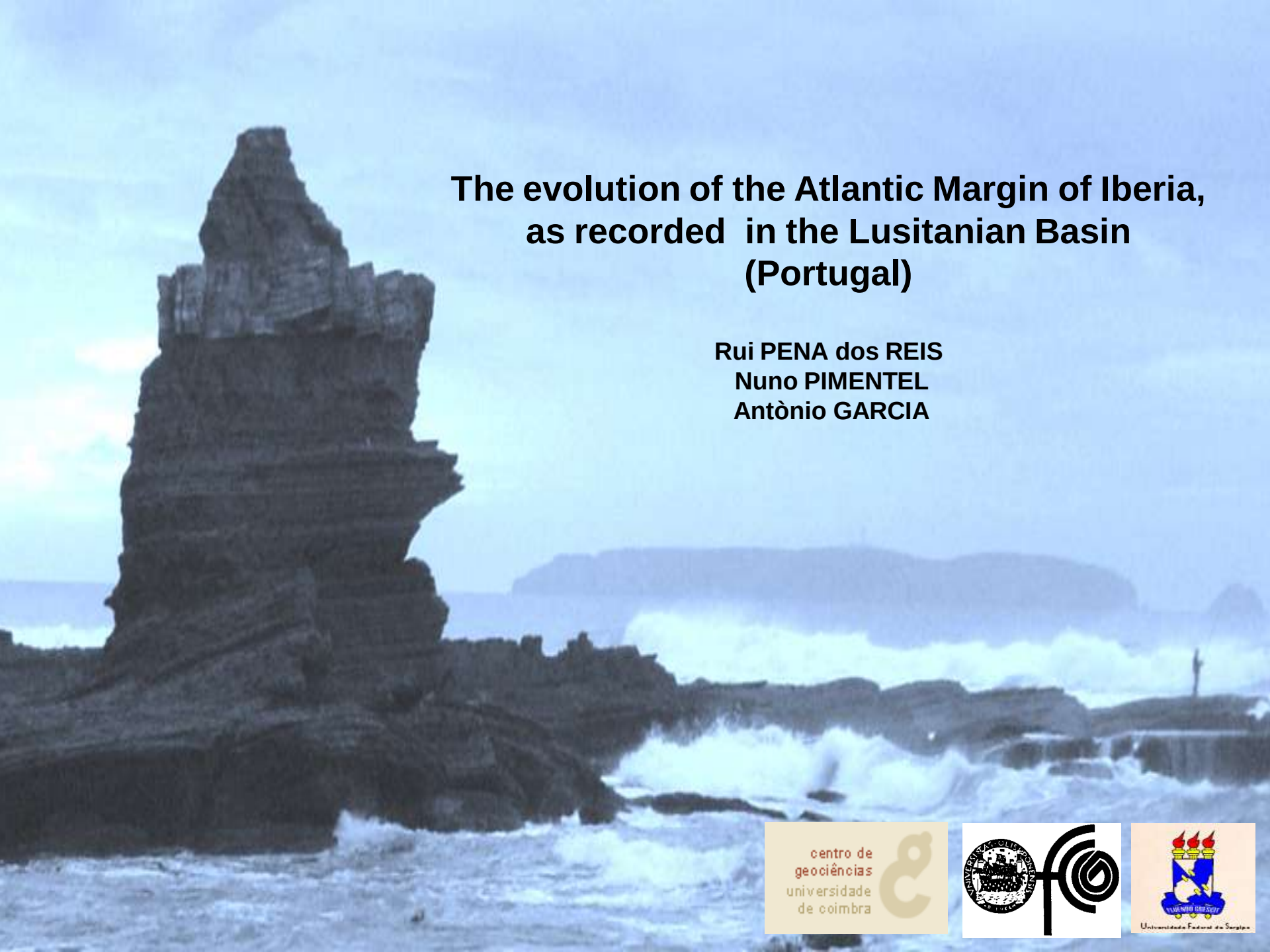
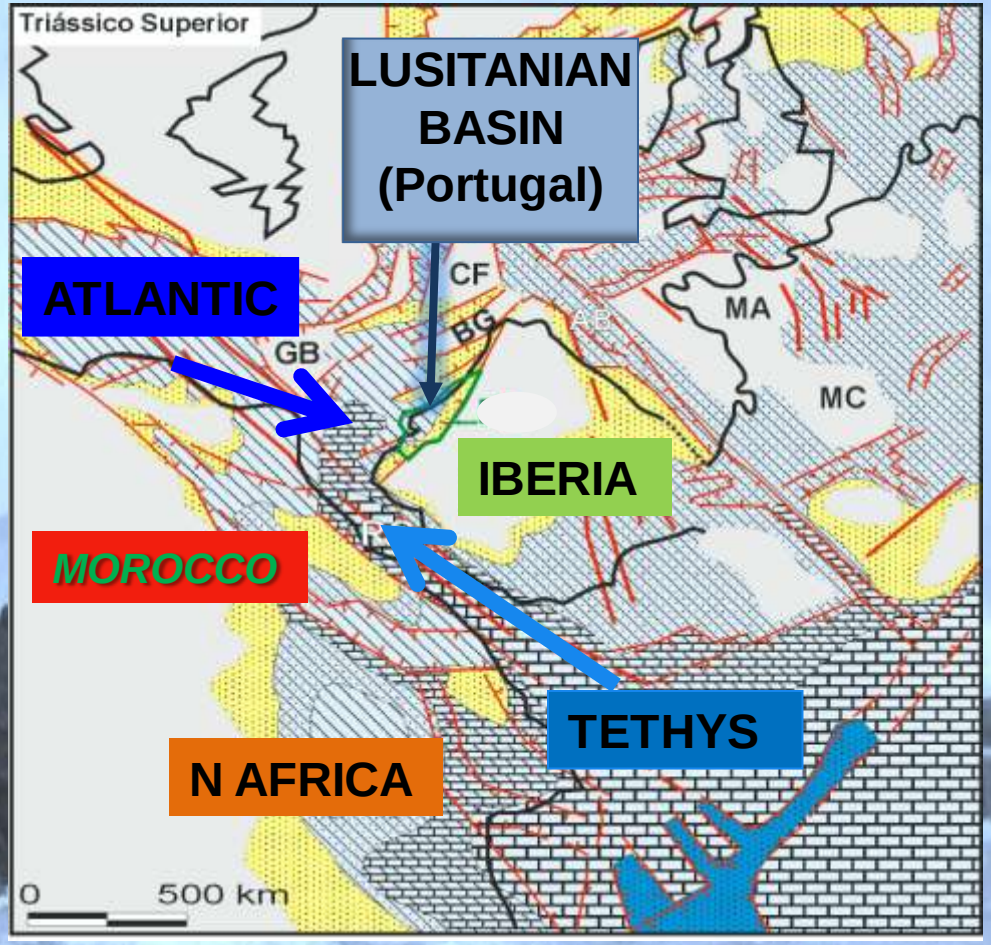
Antònio GARCIA



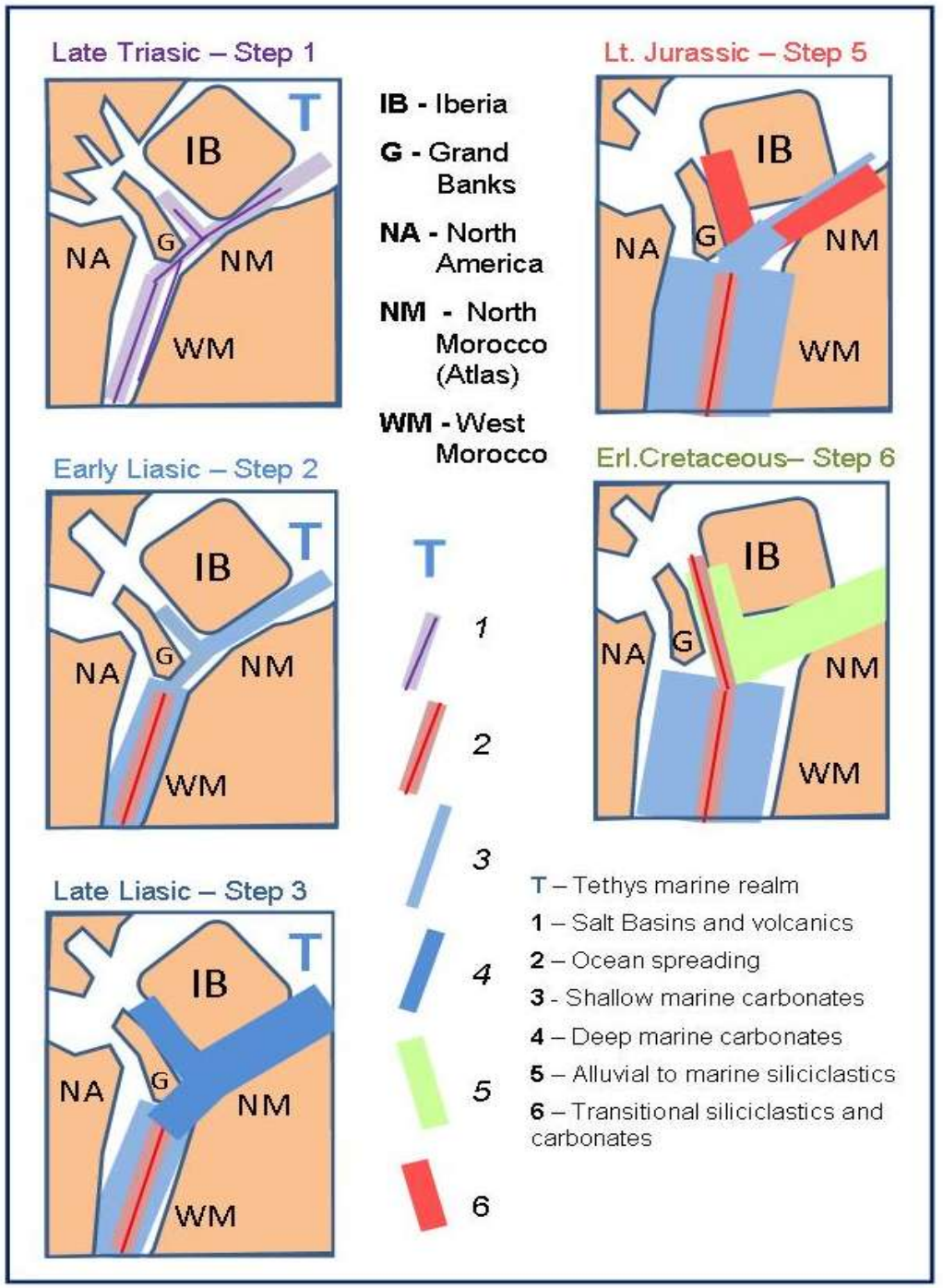
The Lusitanian Basin (LB) is located at the western façade of Europe, facing the Atlantic Ocean and North America, but close to Morrocco and the Mediterranean Sea (the former Tethys).



GEODYNAMIC FRAMEWORK OF IBERIA IN UPPER TRIASIC

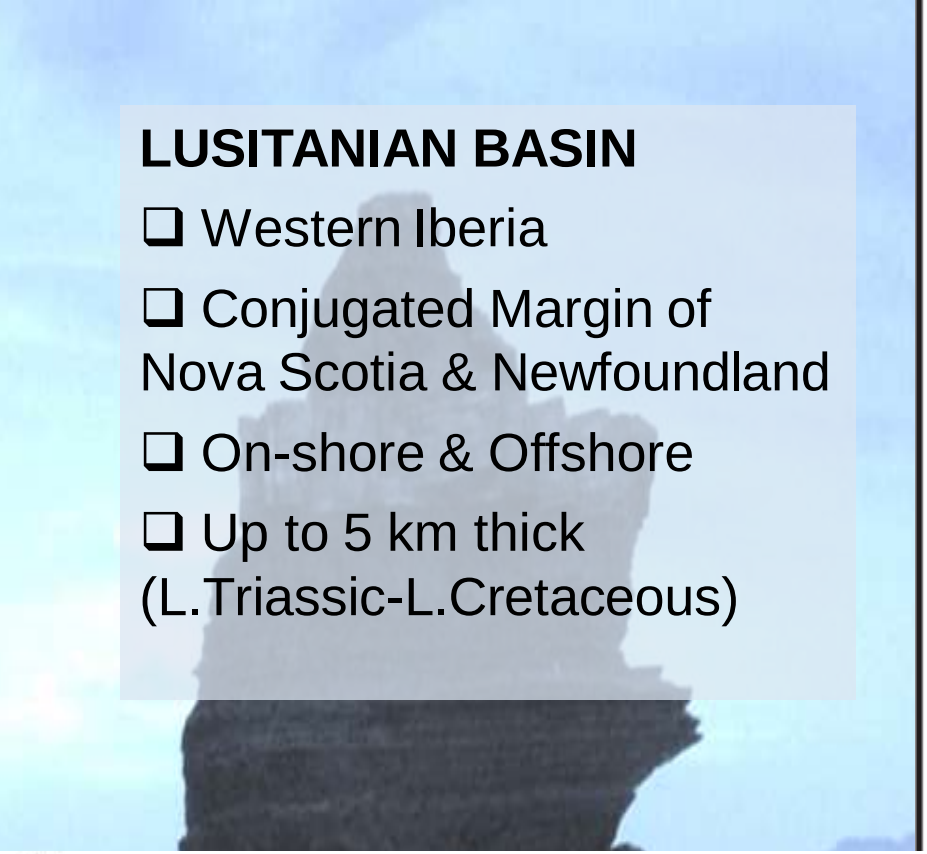
Modif. Ziegler, 1988

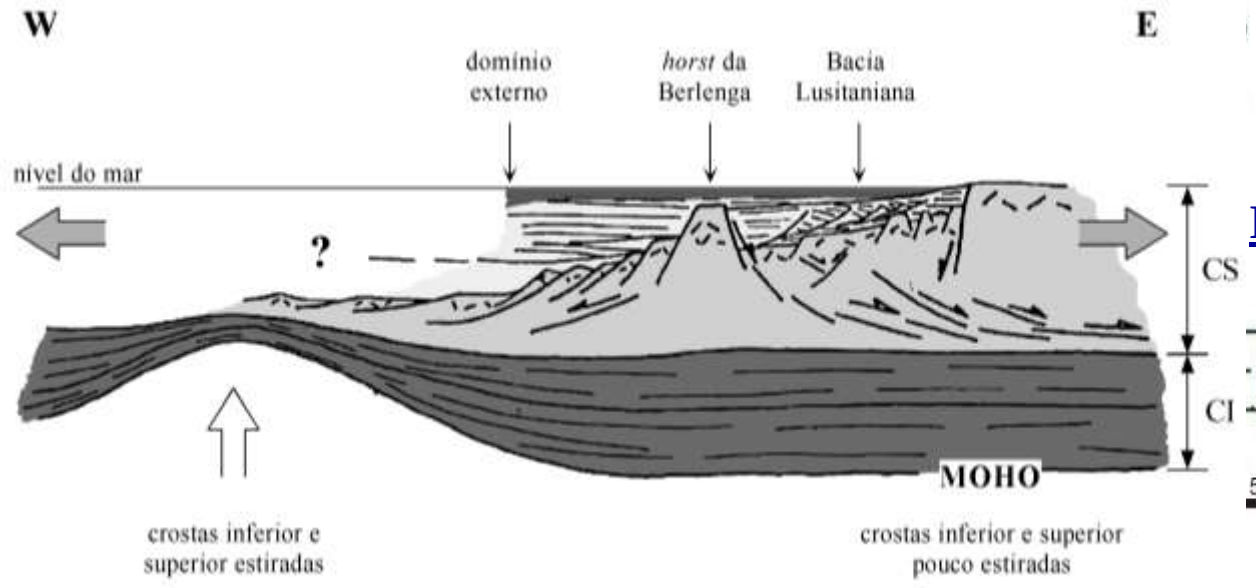
The geodynamic evolution of the Lusitanian Basin received from the Tethys and the Atlantic its controls and tecto-sedimentary influences.

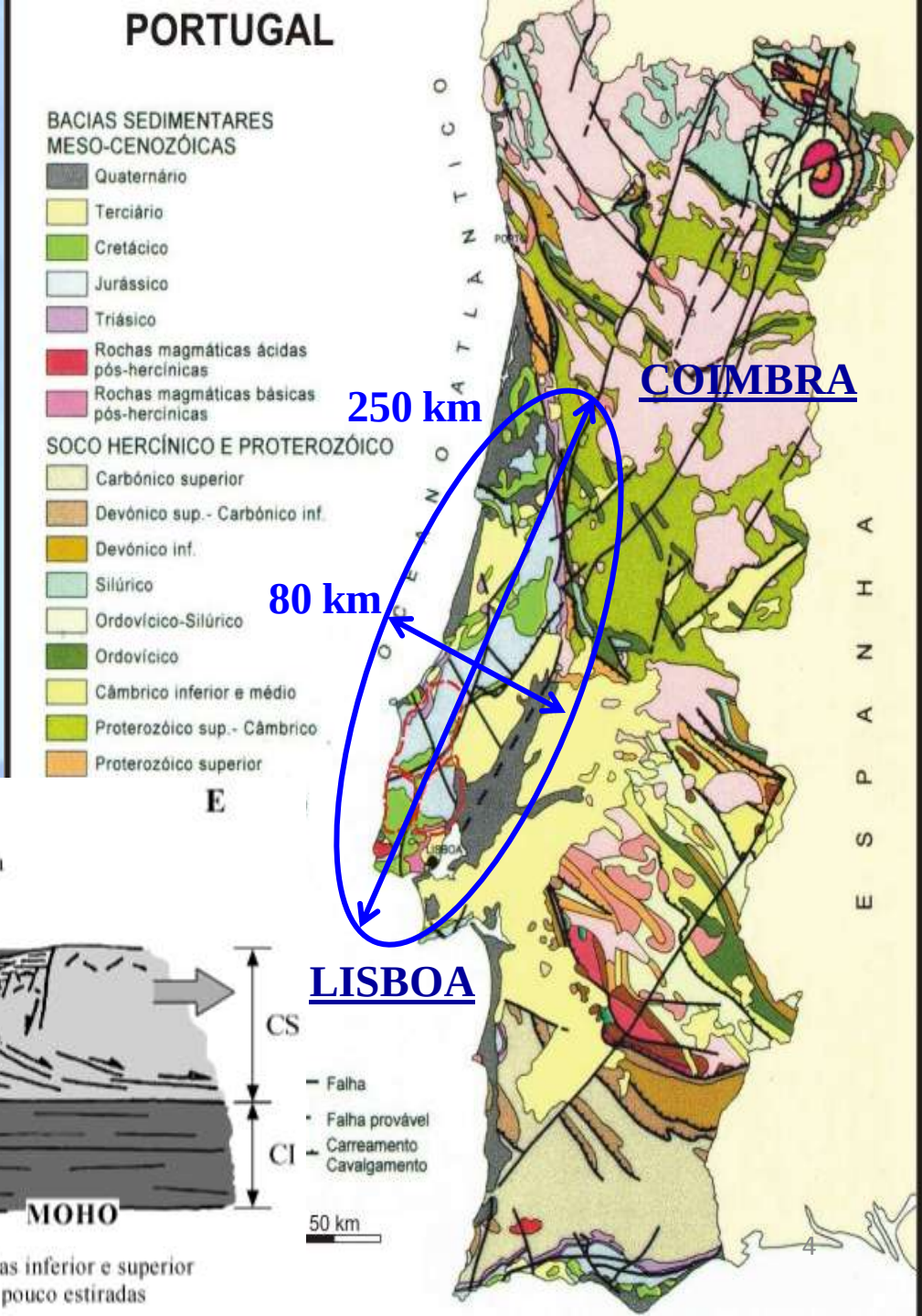


LUSITANIAN BASIN

- ❑ Western Iberia
- ❑ Conjugated Margin of Nova Scotia & Newfoundland
- ❑ On-shore & Offshore
- ❑ Up to 5 km thick (L.Triassic-L.Cretaceous)

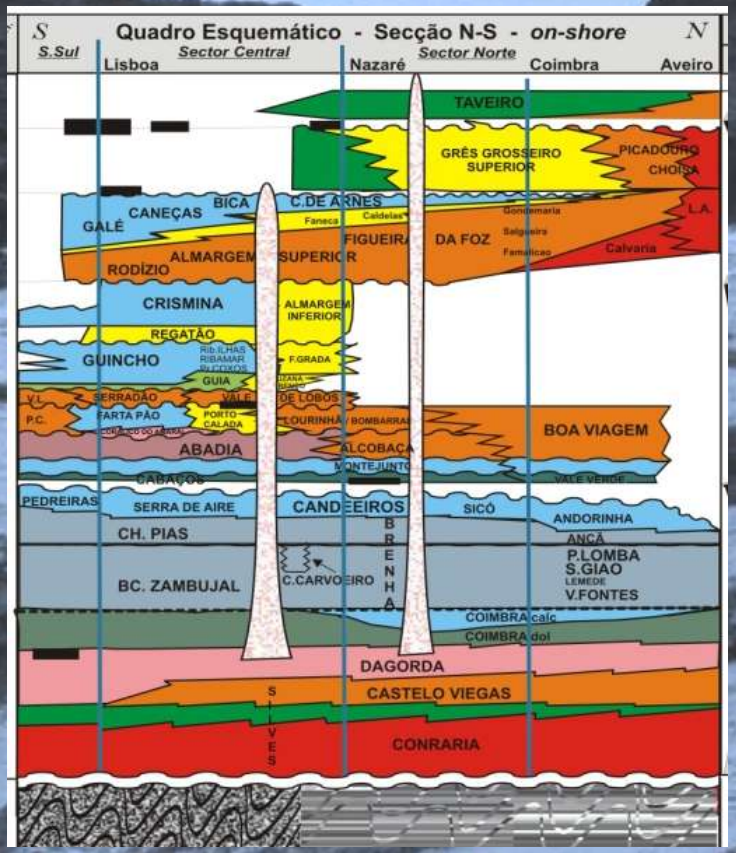






This work presents a new stratigraphic chart of the LB, focusing on the main steps and events of its evolution, since the Late Triasic crustal stretching untill the Late Creatceous inversion.

Published data have been integrated with recent studies developed within the scope of Project Atlantis (PETROBRAS - UFS/UC/UL).



NEW LITHOSTRATIGRAPHIC AND EVENT CHART

Geochronology

Main Evolution Steps

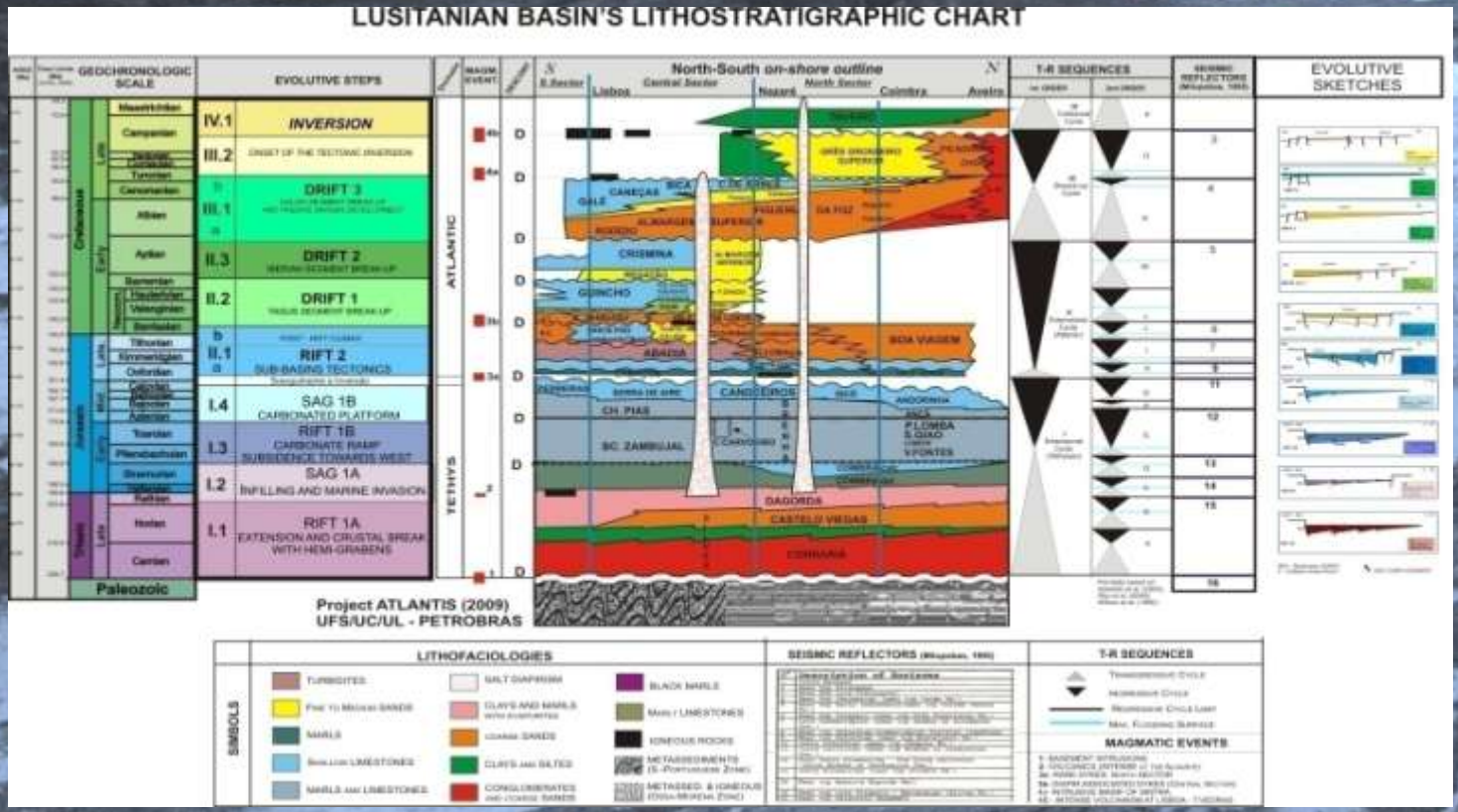
Magmatism & Unconform.

LITHOSTRATIGRAPHY

1st & 2nd Order T-R Seq.

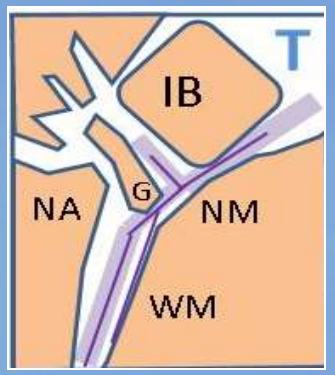
Seismic Reflectors

Cross-sections



LATE TRIASIC to EARLY JURASSIC

TETHYAN 1st RIFT AND SAG



LUSITANIAN BASIN'S LITHOSTRATIGRAPHIC CHART

GEOCHRONOLOGIC SCALE

EVOLUTIVE STEPS

IV.1 INVERSION

III.2 ONSET OF THE TECTONIC INVERSION

III.1 DRIFT 3

II.3 DRIFT 2

II.2 DRIFT 1

II.1 RIFT 2 SUB-BASINS TECTONICS

I.4 SAG 1B CARBONATED PLATFORM

I.3 RIFT 1B CARBONATE RAMP SUBSIDENCE TOWARDS WEST

I.2 SAG 1A INFILLING AND MARINE INVASION

I.1 RIFT 1A EXTENSION AND CRUSTAL BREAK WITH HEMI-GRABENS

Paleozoic

ATLANTIC

TETHYS

North-South on-shore outline

S Sector — Lisboa — Central Sector — Nazaré — North Sector — Coimbra — Aveiro — N

TAVEIRO

GRÉS GROSSEIRO SUPERIOR

CANEÇAS

BICA

C. DE AIRES

GALE

ALMARGEM SUPERIOR

FIGUEIRA

DA FOZ

RODIZIO

CRISMINA

ALMARGEM INFERIOR

PEGADAS

GUINCHO

ABADIA

BOA VIAGEM

PEDREIRAS

SERRA DE AIRE

CANDEEIROS

CH. PIAS

BC. ZAMBUJAL

C. CARVOEIRO

BRENHA

AMIA

P. LOMBA

S. GIAO

V. FONTES

COIMBRA

CONIMBRIGA

DAGORDA

CASTELO VIEGAS

CONIARIA

T-R SEQUENCES

SEISMIC REFLECTORS (Mitchum, 1995)

EVOLUTIVE SKETCHES

Project ATLANTIS (2009)
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LITHOFACIOLOGIES

SIMBOLS

TURBIDITES — SALT DIAPIRISM — BLACK MARLS

Fine to Medium SANDS — CLAYS AND MARLS WITH EVAPORITES — Marly LIMESTONES

MARLS — coarse SANDS — IGNEOUS ROCKS

SHALLOW LIMESTONES — CLAYS AND SILTES — METASEDIMENTS (S-Portuguese Zone)

MARLS AND LIMESTONES — CONGLOMERATES AND coarse SANDS — METASED. & IGNEOUS (Ossa-Morena Zone)

SEISMIC REFLECTORS (Mitchum, 1995)

Description of Reflector

T-R SEQUENCES

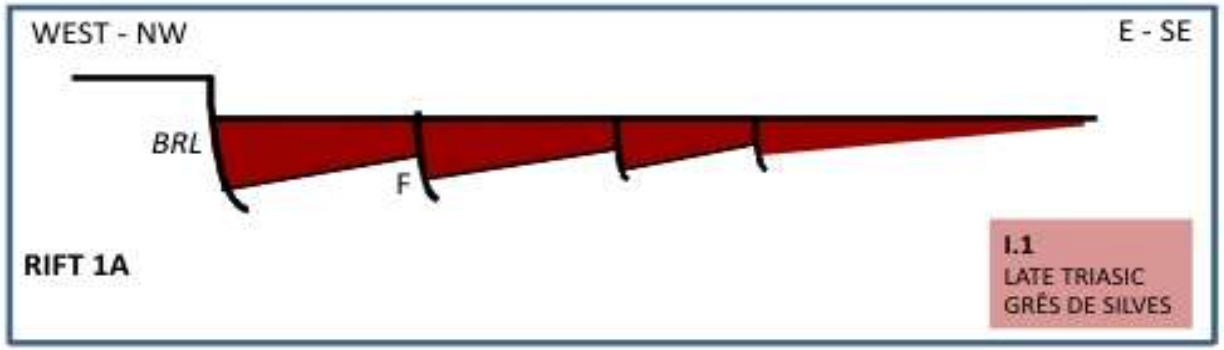
Transgressive Cycle

Regressive Cycle

Regressive Cycle Limit

Max. Flooding Surface

MAGMATIC EVENTS

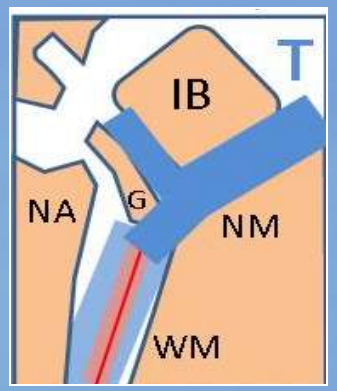


LATE TRIASIC to EARLY JURASSIC

TETHYAN FIRST RIFT AND SAG

EARLY AND MIDDLE JURASSIC

TETHYAN 2nd RIFT AND SAG



QUADRO LITOSTRATIGRÁFICO DA BACIA LUSITÂNICA

ESCALA GEOCRONOLÓGICA

INTERVALOS EVOLUTIVOS

IV.1	*INVERSÃO*	
III.2	INÍCIO DA INVERSÃO TECTÓNICA	
III.1 b	DRIFT 3	RUPTURA DO SEGMENTO GALIZA BREAK-UP E DESENVOLVIMENTO DE UMA MARGEM PASSIVA
II.3	DRIFT 2	RUPTURA DO SEGMENTO IBÉRICO
II.2	DRIFT 1	RUPTURA DO SEGMENTO TEJO
II.1 b	RIFT 2	POST - RIFT CLIMAX
II.1 a		TECTÓNICA DE SUB-BACIAS
I.4	SAG 1B	PLATAFORMA CARBONÁTICA
I.3	RIFT 1B	SUBSIDÊNCIA EM RAMPA BASCULADA PARA W
I.2	SAG 1A	COLMATAÇÃO E INVASÃO MARINHA
I.1	RIFT 1A	DISTENSÃO E RUPTURA EM SEMI-GRABENS BASCULADOS PARA W

Quadro Esquemático - Secção N-S - *on-shore*

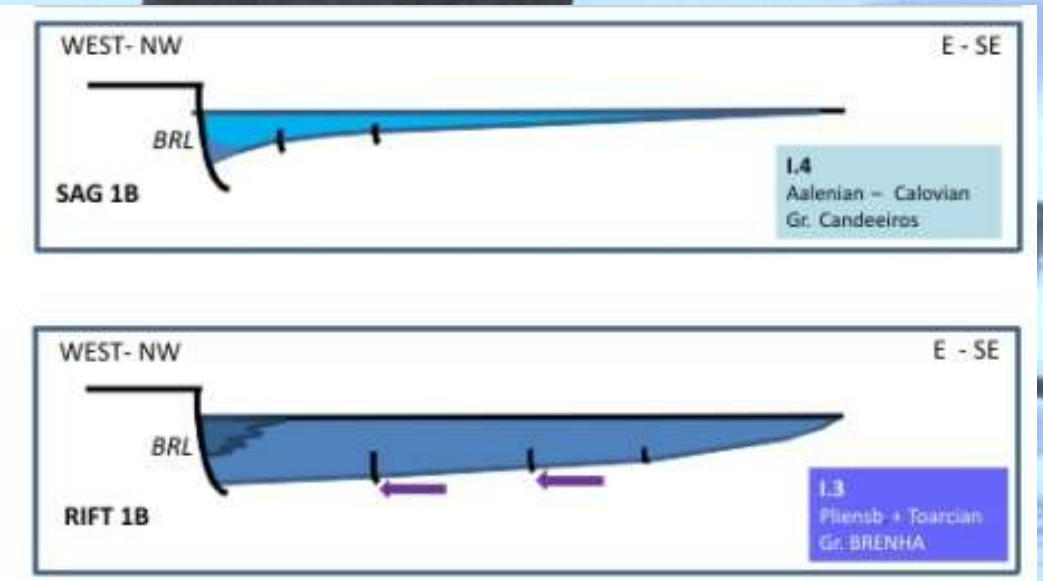
S — S.Sul — Lisboa — *Sector Central* — Nazaré — *Sector Norte* — Coimbra — Aveiro — N

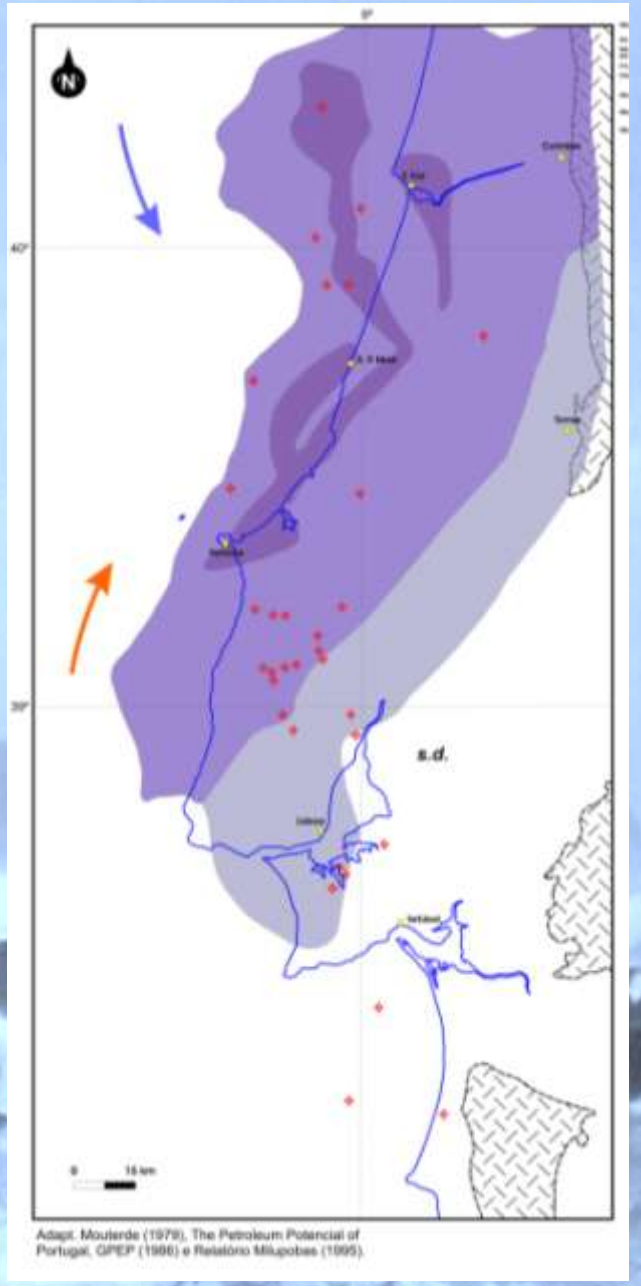
SEQUÊNCIAS T-R

REFLECTORES SÍSMICOS

Projecto ATLANTIS (2009)
UFS/UC/UL - PETROBRAS

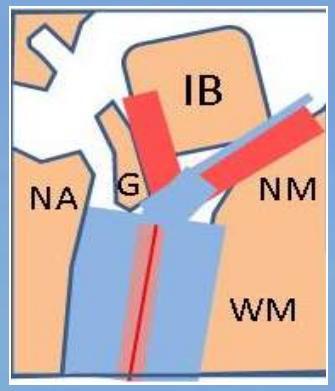
EARLY AND MIDDLE JURASSIC TETHYAN 2nd RIFT AND SAG





UPPER JURASSIC

ATLANTIC 1st RIFTING



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III.1 DRIFT 3 — RUPTURA DO SEGMENTO GALIZA BREAK-UP E DESENVOLVIMENTO DE UMA MARGEM PASSIVA

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II.2 DRIFT 1 — RUPTURA DO SEGMENTO TEJO

II.1 RIFT 2 — TECTÓNICA DE SUB-BACIAS

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I.2 SAG 1A — COLMATAÇÃO E INVASÃO MARINHA

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Paleozóico

Quadro Esquemático - Secção N-S - on-shore

S Sul — Lisboa — Sector Central — Nazaré — Sector Norte — Coimbra — Aveiro — N

ATLÂNTICO

TETHIS

SEQUÊNCIAS T-R

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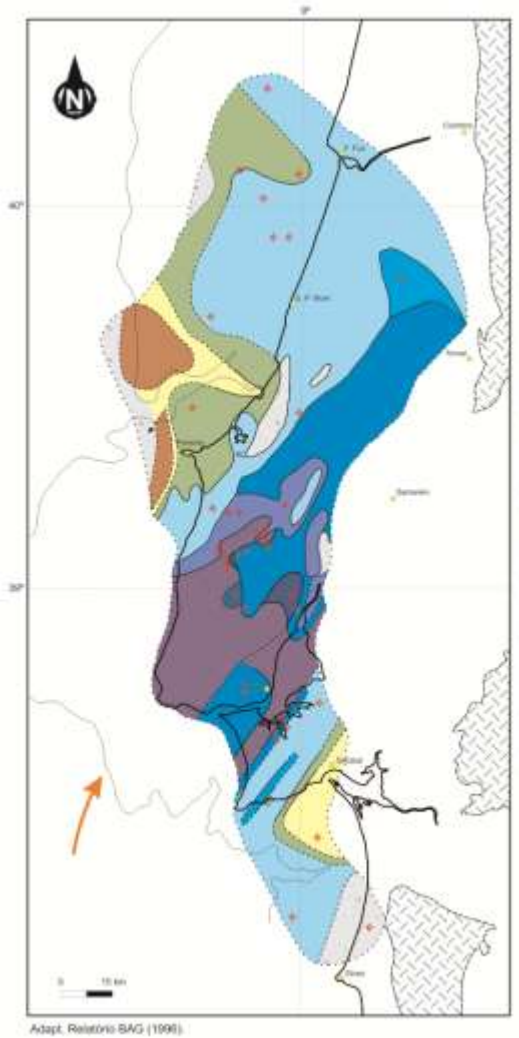
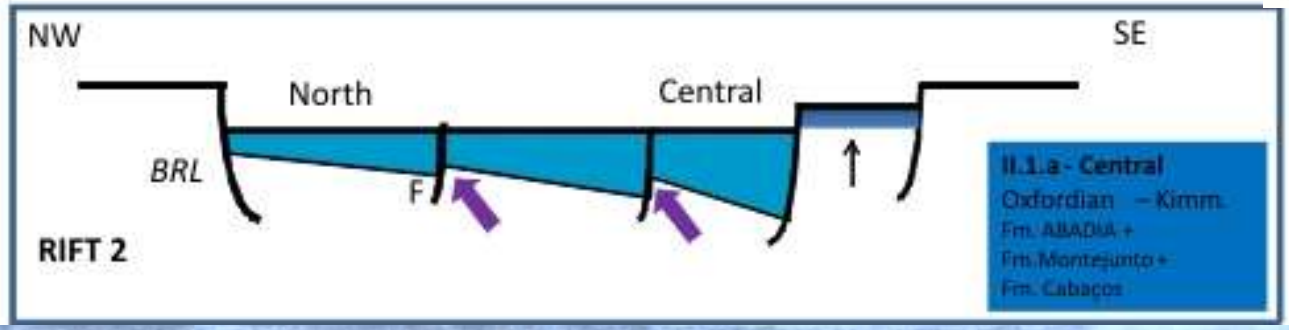
UPPER JURASSIC

ATLANTIC 1st RIFTING

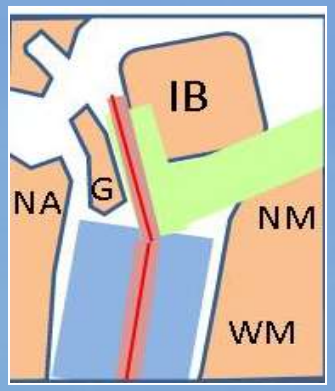


Adapt. Relatório BAG (1998)



EARLY TO LATE CRETACEOUS

ATLANTIC BREAK-UPS and DRIFT



QUADRO LITOSTRATIGRÁFICO DA BACIA LUSITÂNICA

ESCALA GEOCRONOLÓGICA

INTERVALOS EVOLUTIVOS

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III.1 a		
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II.2	DRIFT 1	RUPTURA DO SEGMENTO TEJO
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II.1 a	RIFT 2	TECTÓNICA DE SUB-BACIAS
		Soerguimento e Inversão
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SEQUÊNCIAS T-R

REFLECTORES SÍSMICOS

Projecto ATLANTIS (2009)
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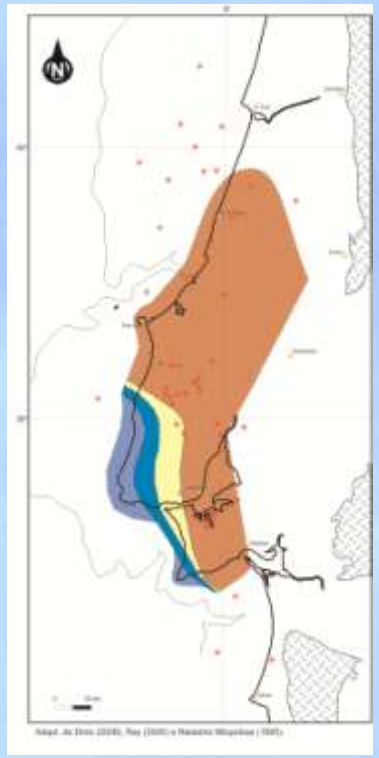
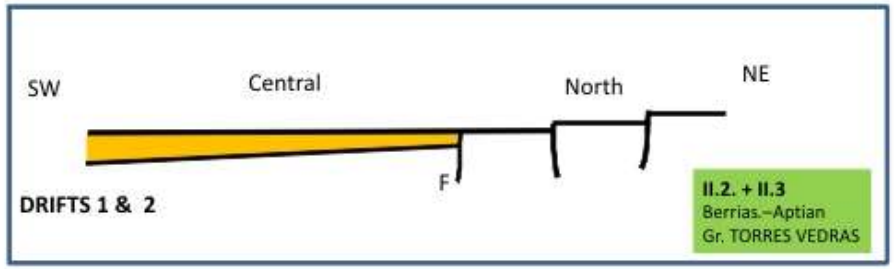
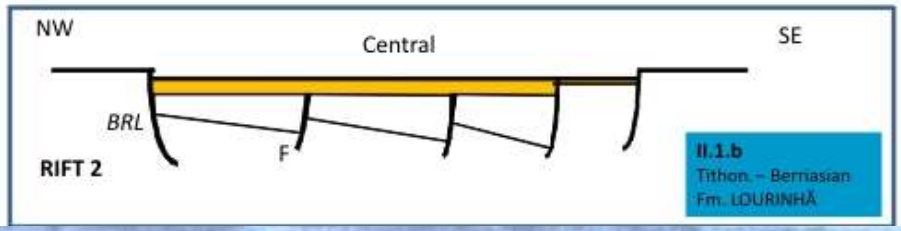
EARLY - LATE CRETACEOUS

ATLANTIC Break-ups and DRIFT

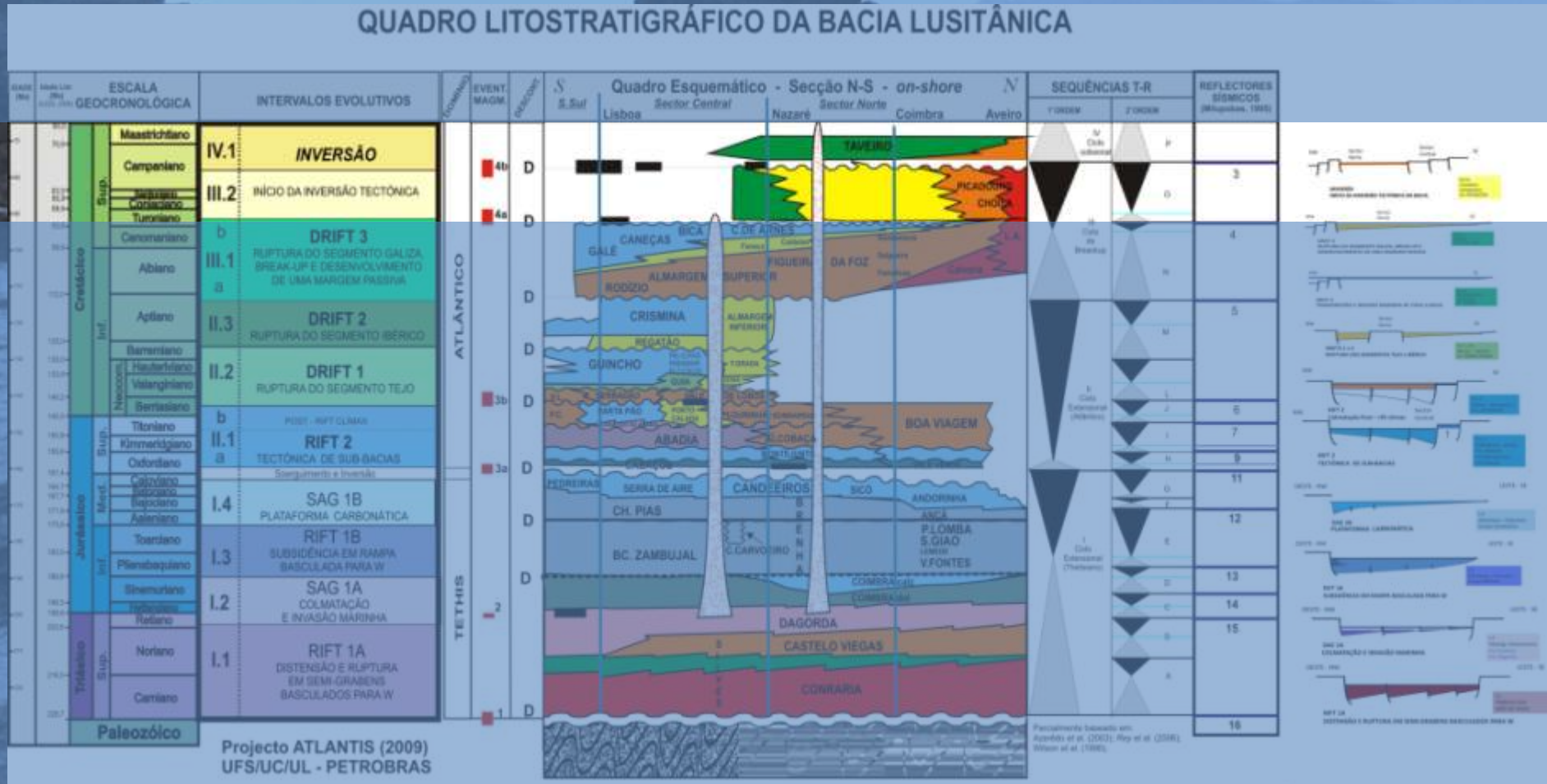






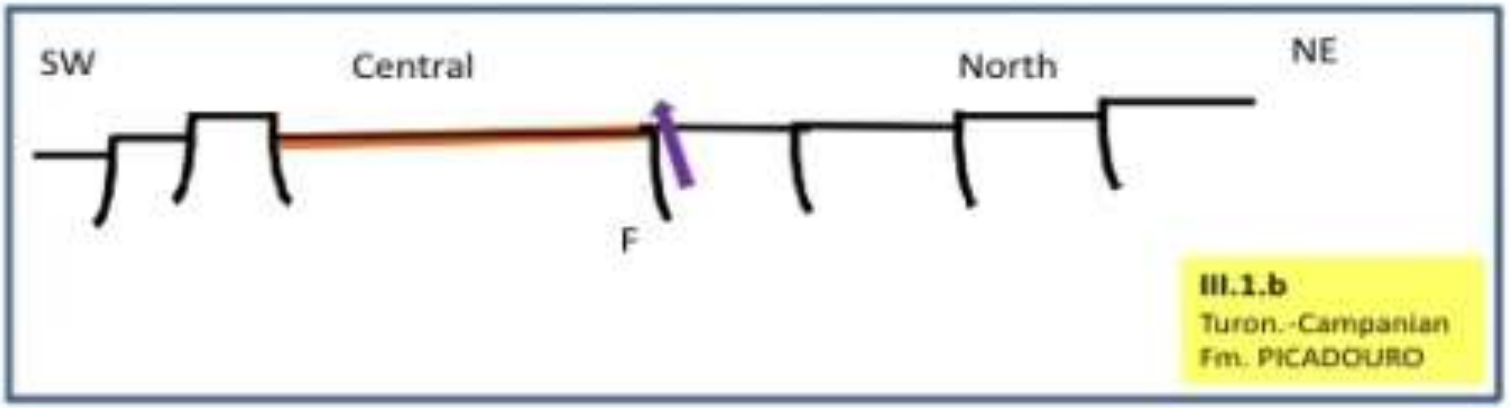
LATE CRETACEOUS

IBERIAN INVERSION



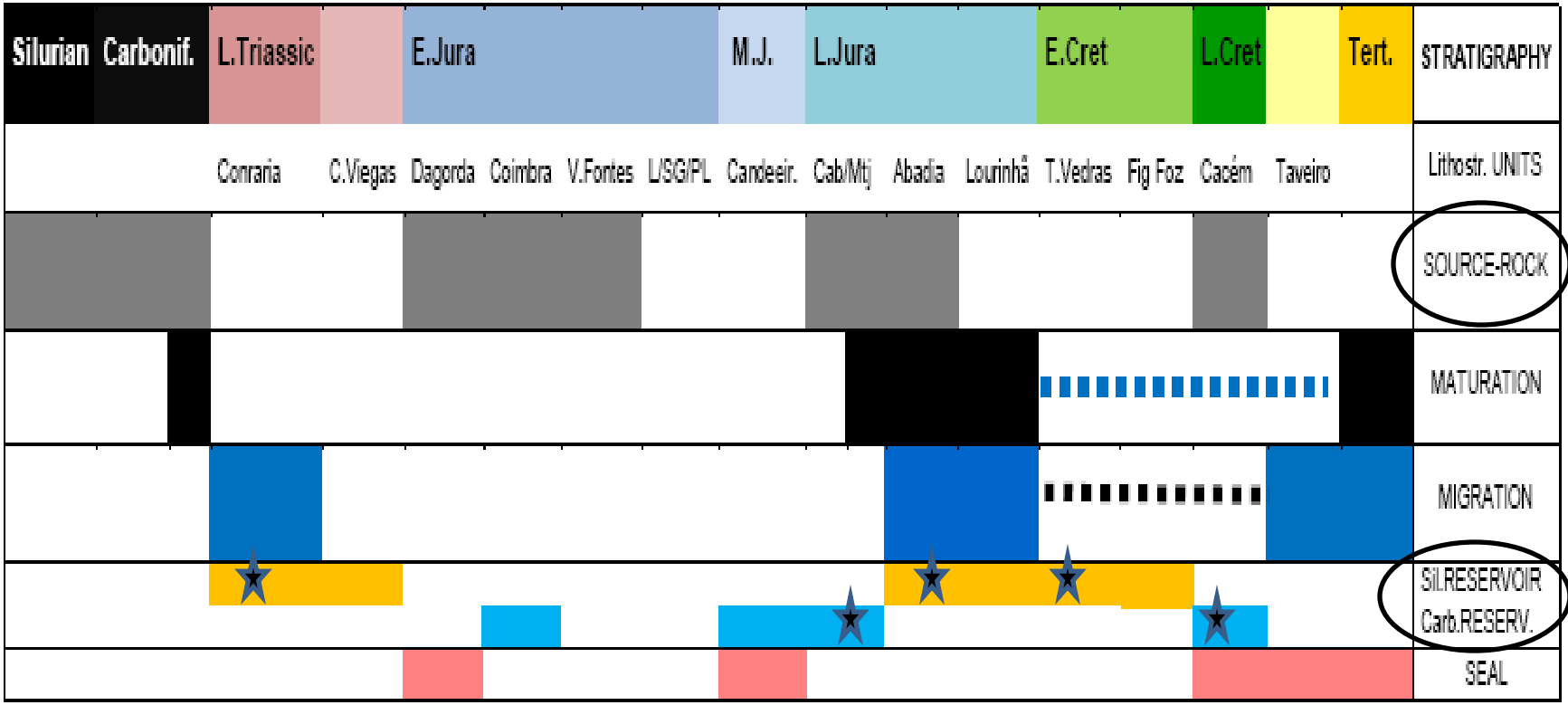
LATE CRETACEOUS AND TERTIARY

IBERIAN INVERSION



The evolution of the basin promoted the occurence of multiple Source-rocks and Reservoirs,
with good conditions for the whole Petroleum System development, including numerous outcrop and well oil-shows

SIMPLIFIED CHART OF THE PETROLEM SYSTEMS at the Lusitanian Basin (Portugal)



THIS RESEARCH HAS BEEN DEVELOPPED IN THE SCOPE OF THE "ATLANTIS PROJECT"

"Geological Evolutive Model for the Marine Riftings of the Lusitanian Basin (Portugal)"

financed by PETROBRAS

and organized by Portuguese (UC-Coimbra UL-Lisbon) and Brazilian Unversities (UFS-Sergipe).