SW Iberian and NW Moroccan Onshore Basins - Mesozoic Evolution and Geodynamic Framework*

N. Pimentel[1] and R. Pena dos Reis[2]

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[1]Centro de Geologia, Universidade de Lisboa, 1749-016 Lisboa, Portugal (Pimentel@fc.ul.pt)
[2]Centro de Geociências, Universidade de Coimbra, 3049-272 Coimbra, Portugal (Penareis@dct.uc.pt)

Abstract

The upper Triassic - lower Cretaceous infill of the west Iberian and northwest Moroccan on-shore basins presents a strong signature of both the Central Atlantic and the Alpine Tethys Mesozoic evolution. This fact can be better understood by comparing the Lusitanian Basin (Central Portugal, N of Lisbon) with other nearby basins to the south, such as the Portuguese Alentejo (50 km S) and Algarve Basins (200 km S), and the Moroccan Atlas (700 km SE) and Agadir Basins (800 km S). A late Triassic rifting episode is recorded in every basin in relation to the Atlasic and west Morocco penetrating branches of the Alpine Tethys and the continental fragmentation between the Grand Banks and Iberia. In early Jurassic times, a major marine invasion occurred in all the increasingly subsiding areas, formerly with intra-continental to evaporitic environments. East of the Atlasic areas, the Tethyan influence is intense and opened to deep marine conditions. The same facies are recorded in the Lusitanian Basin, probably opened to a boreal Tethys branch, but not in the southern Iberian basins, neither on the West Moroccan basins. From the Toarcian on, a strong uplift occurred in Atlasic areas, and a separation of an Atlantic oceanic domain has been established in Morocco. This event is also recorded, at a decreasing scale northwards, in the Algarve, the Alentejo and the Lusitanian basins, with minor unconformities, instability signatures and subsidence attenuation. The middle to late Jurassic boundary is a critical moment in all these basins. Important changes in sedimentary environments, depositional hiatus, uplift and even angular unconformities, followed by increased subsidence, underline this critical moment, related to the alignment between the Iberia – North America crustal separation and the ongoing Central Atlantic drifting more to the South. Lower Cretaceous evolution is controlled mainly by the North Atlantic opening and passive margins being gradually installed northwards. Coeval facies changes, siliciclastic inputs and unconformities, may be identified in the sedimentary record of all the basins, related with successive rift-segments and break-ups. The analysis and correlation of all these basins allows a better understanding of the Mesozoic evolution of both the Alpine Tethys and the Central-North Atlantic, by identifying contemporaneous but distinct signatures in the sedimentary record of the nearby outcropping basins.

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SW IBERIAN AND NW MOROCCAN ONSHORE BASINS

- *MESOZOIC EVOLUTION AND GEODYNAMIC FRAMEWORK*

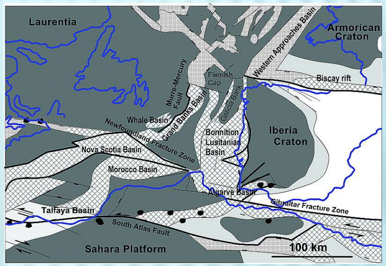
N. Pimentel [1,3] & R. Pena dos Reis [2,3]

1: Centro de Geologia, Universidade de Lisboa, (Pimentel@fc.ul.pt)
2: Centro de Geociências, Univ. de Coimbra, (Penareis@dct.uc.pt)
3: Margins Exploration Group

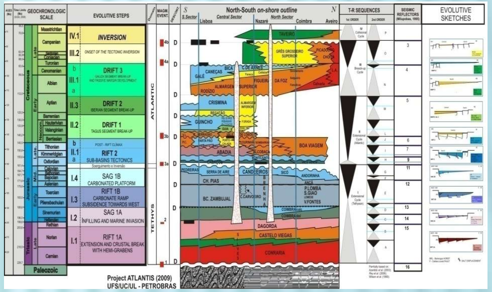
Algarve Basin, SW Portugal

Presentation Outline

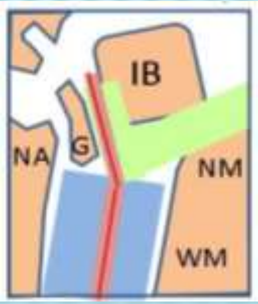
I. **GEODYNAMIC FRAMEWORK** of the Iberian-Moroccan Mesozoic Basins.



II. **BASIN'S OVERVIEW** Sedimentary infill & geodynamic steps



III. **REGIONAL TECTONO-SEDIMENTARY APPROACH**



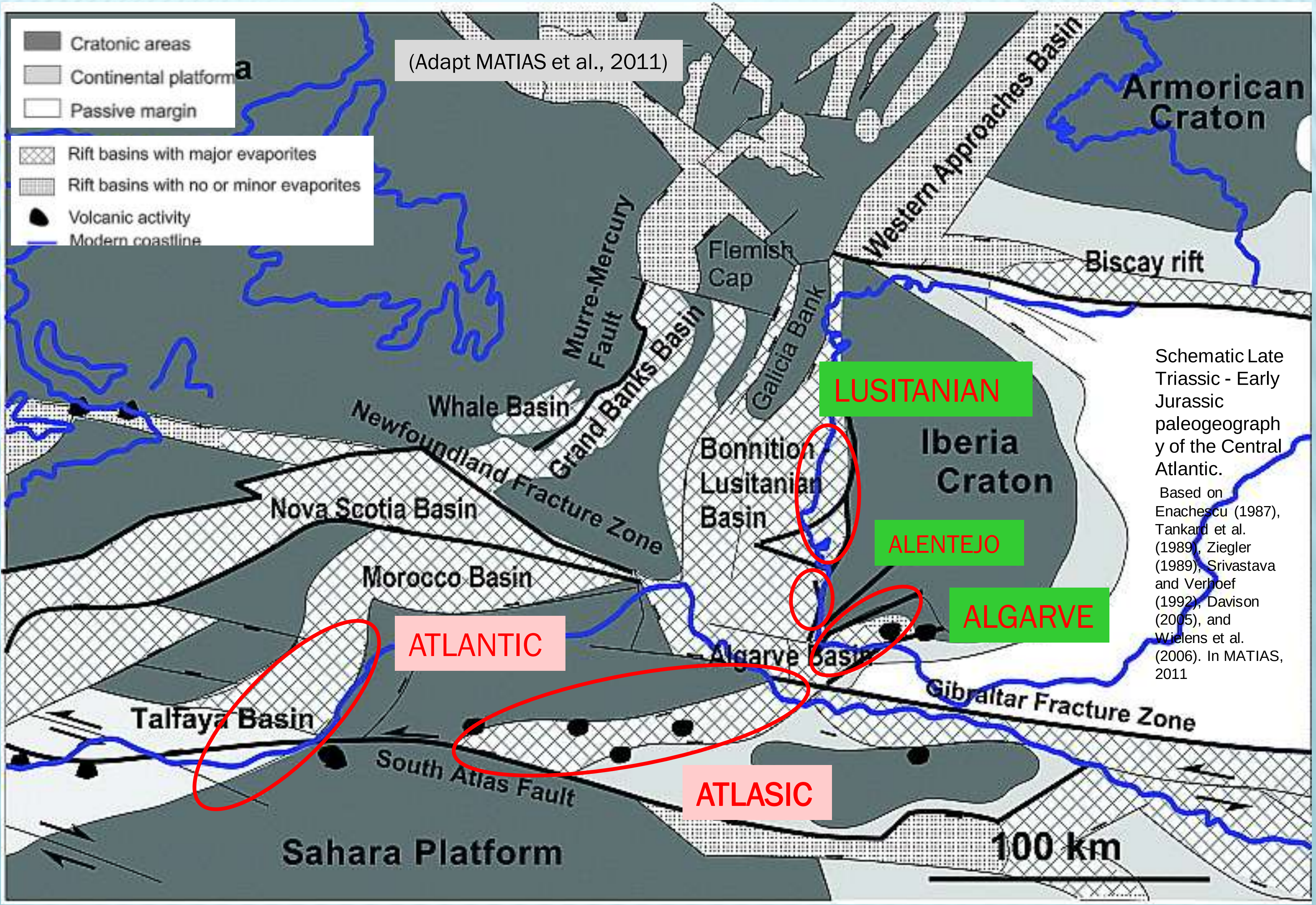
IV. **CONCLUSIONS**

SW IBERIAN and
NW MOROCCAN BASINS
ARE NEARBY MESOZOIC
BASINS RELATED WITH

- TETHYS CLOSURE
- Central & North
  ATLANTIC OPENING
- ALPINE COLLISION

GEODYNAMIC FRAMEWORK

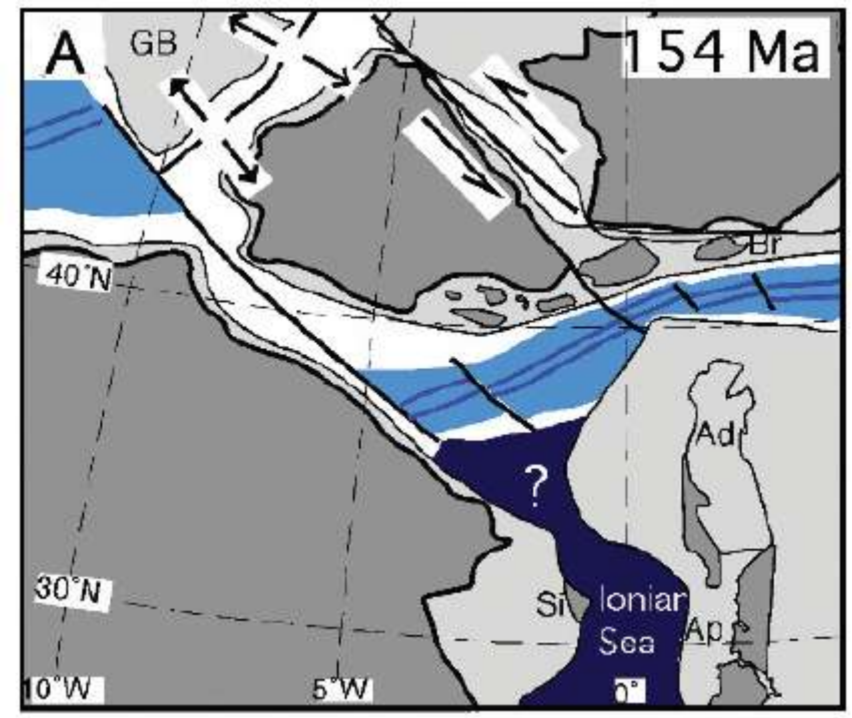
THE BASIN'S INITIAL CONFIGURATION
- INDEPENDENT ARMS OF A BREAKING PANGEA



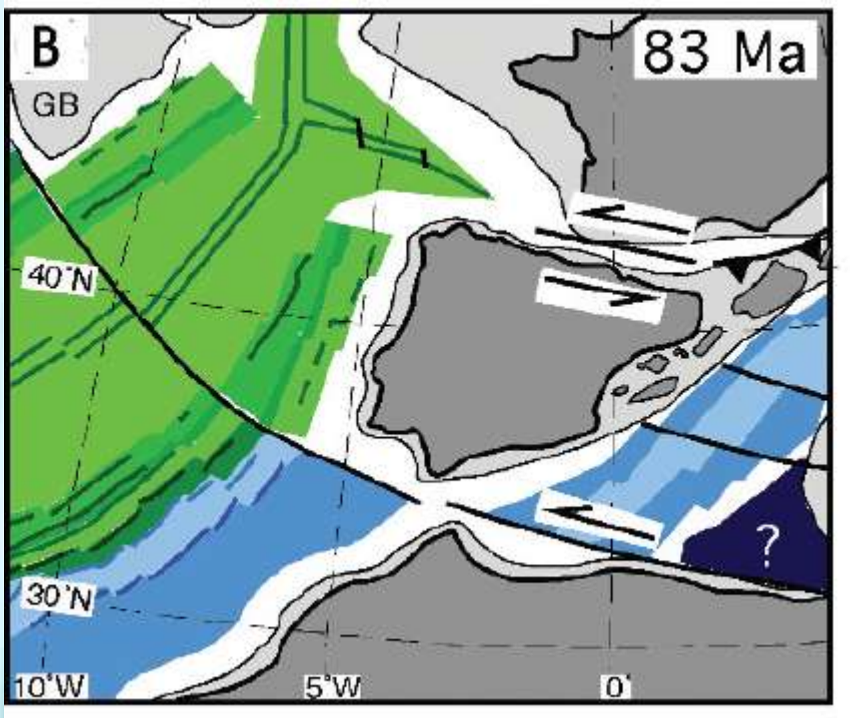
Schematic Late Triassic - Early Jurassic paleogeography of the Central Atlantic.

Based on Enachescu (1987), Tankard et al. (1989), Ziegler (1989), Srivastava and Verhoef (1992), Davison (2005), and Wielens et al. (2006). In MATIAS, 2011

Rosenbaum et al., 2002



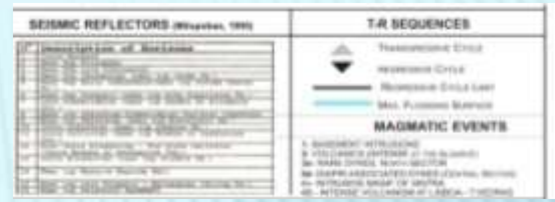
LATE JURASSIC –
TOWARDS AXIAL ATLANTIC BASINS
vs. ABANDONED TETHYAN BASINS

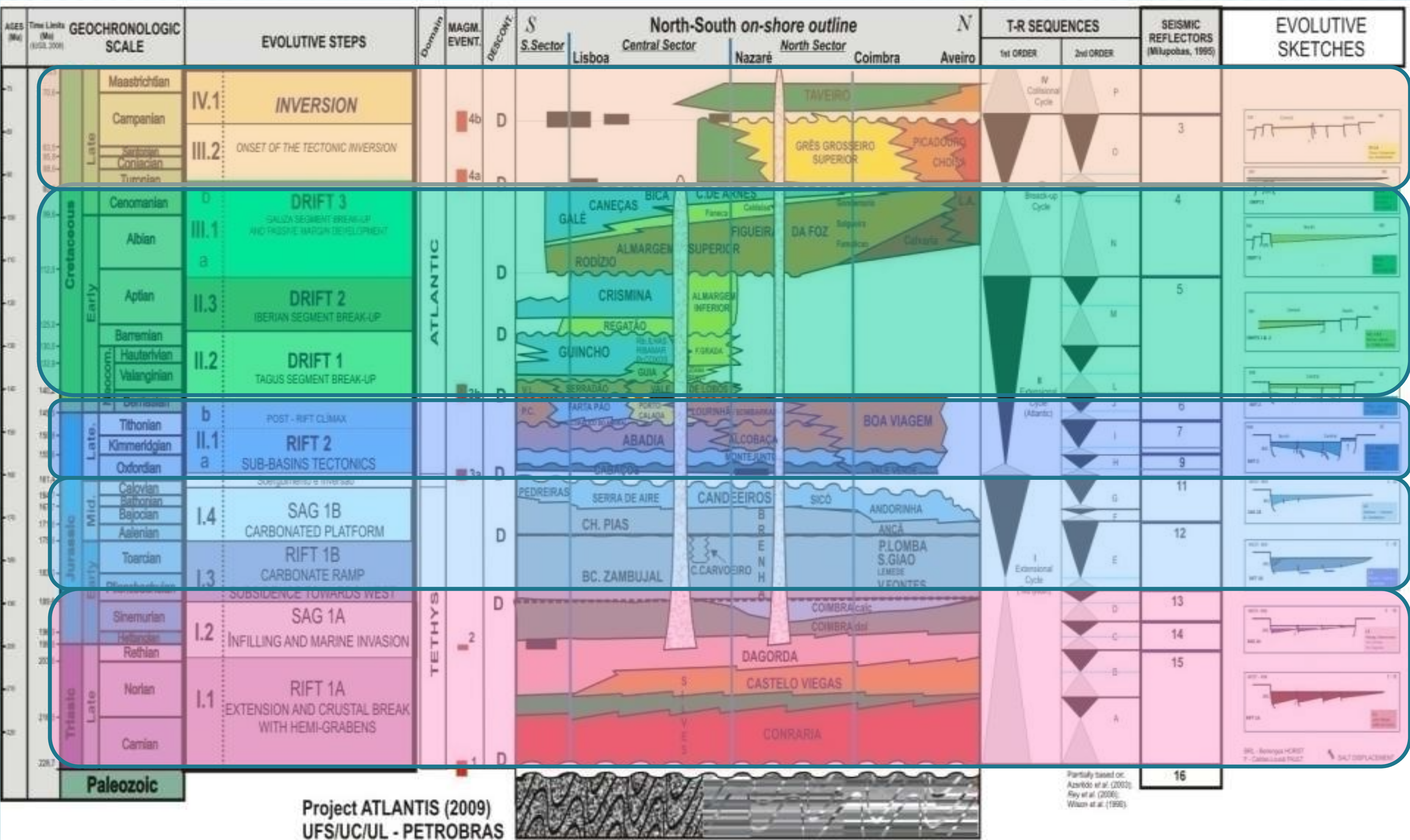


CRETACEOUS –
TOWARDS ATLANTIC PASSIVE
MARGINS

LUSITANIAN BASIN

Western Iberia, On-shore





Cenozoic inversion (Betic)

Beginning of Inversion (Pyrenean)

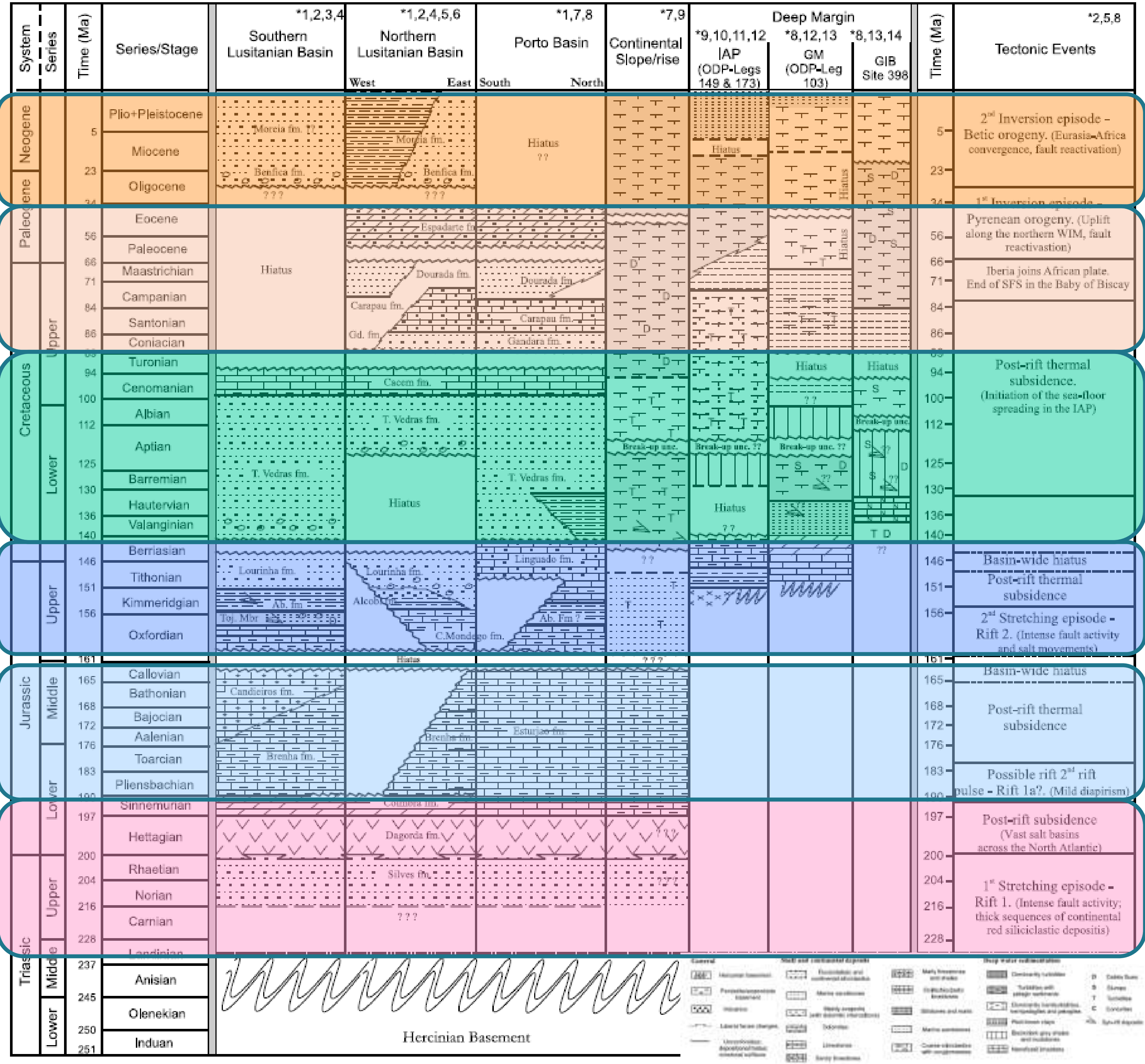
Post-Rift thermal subsidence

Basin-wide hiatus

Atlantic Rifting and Post-rift subsidence

Post-rift subsidence

Intra- continental Rifting



In T.Cunha, 2009

ALGARVE BASIN
Southern Iberia

Westwards thrusting of allochtonous units (Betic-Rif)

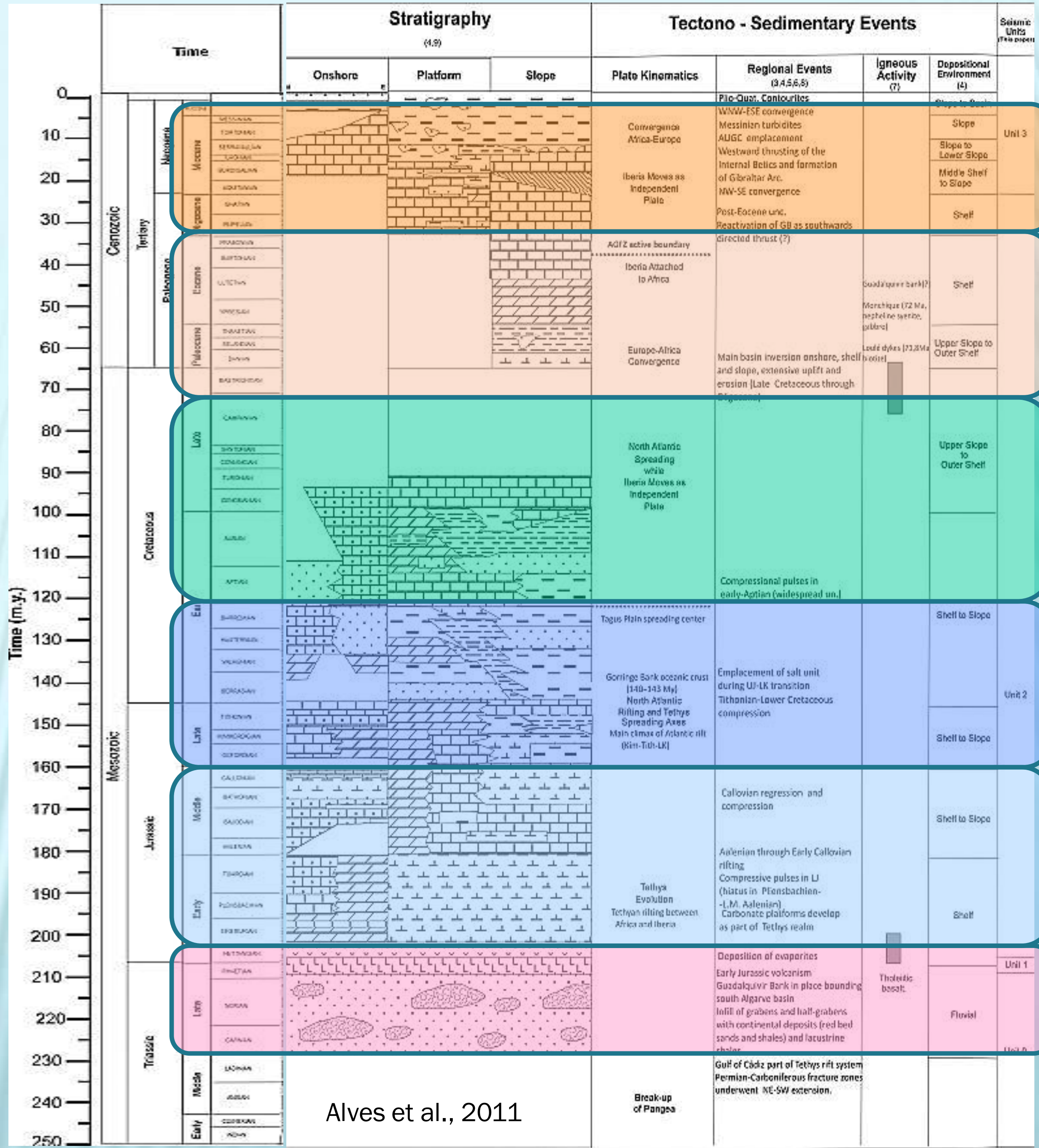
Eur-Afr convergence, basin's inversion & up-lift

North-Atlantic Drift & independent Iberia plate

North-Atlantic Rifting and W Tethys spreading

Tethyan marine filling between Iberia and Africa

Intra-continental grabens infill



Alves et al., 2011

ALENTEJO BASIN
Southwestern Iberia

Inversion and Up-lift

Post-Rift in SW Iberia

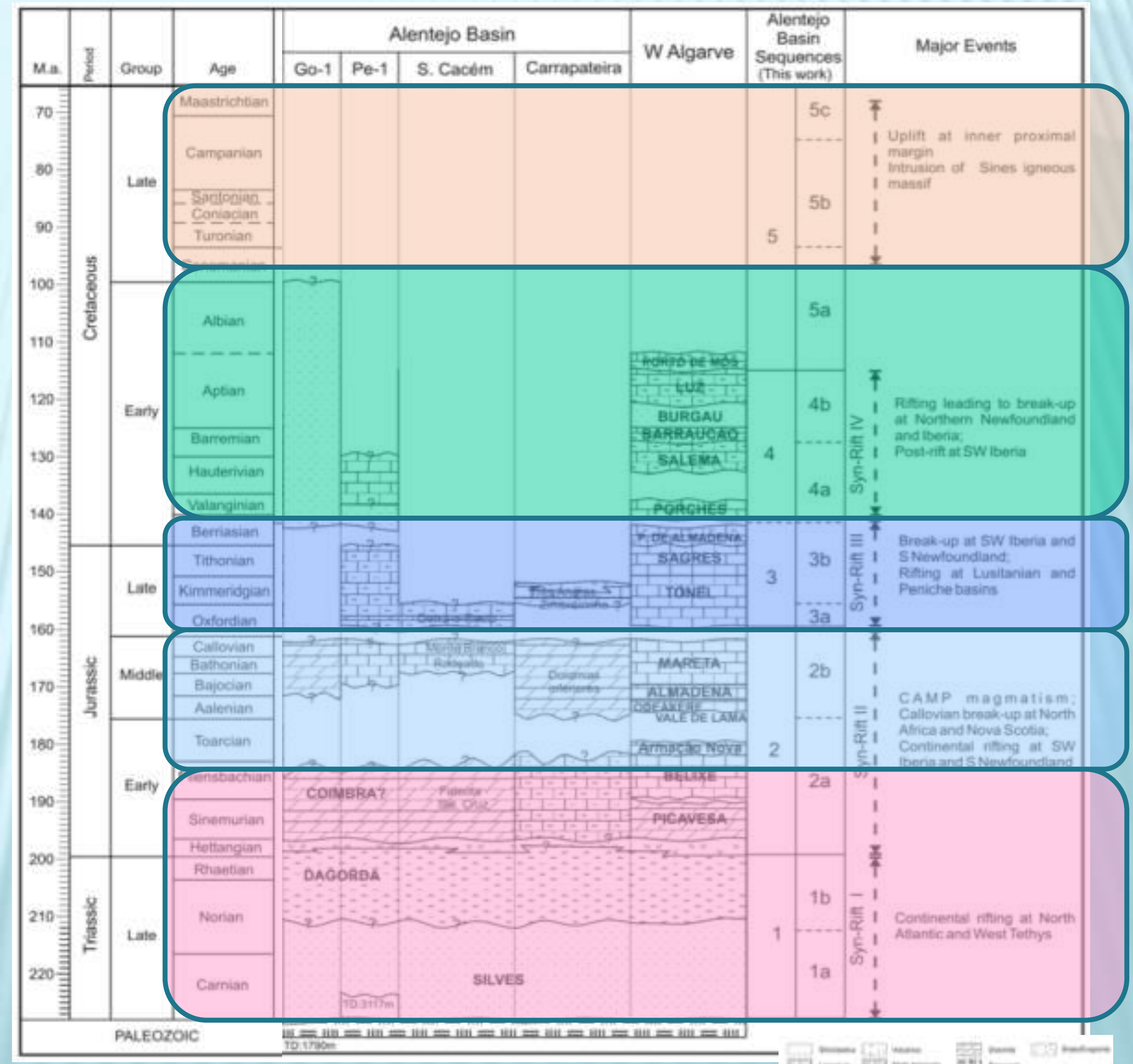
Break-up at SW Iberia and S NFL

Callovian Break-up in Morocco and N.Scotia

Continental Rifting at SW Iberia and S NFL

CAMP related Magmatism

Continental Rifting at N Atlantic and W Tethys



Pereira & Alves, 2010

ATLASIC BASINS
Northern Morocco

Africa – Europe collision and compression

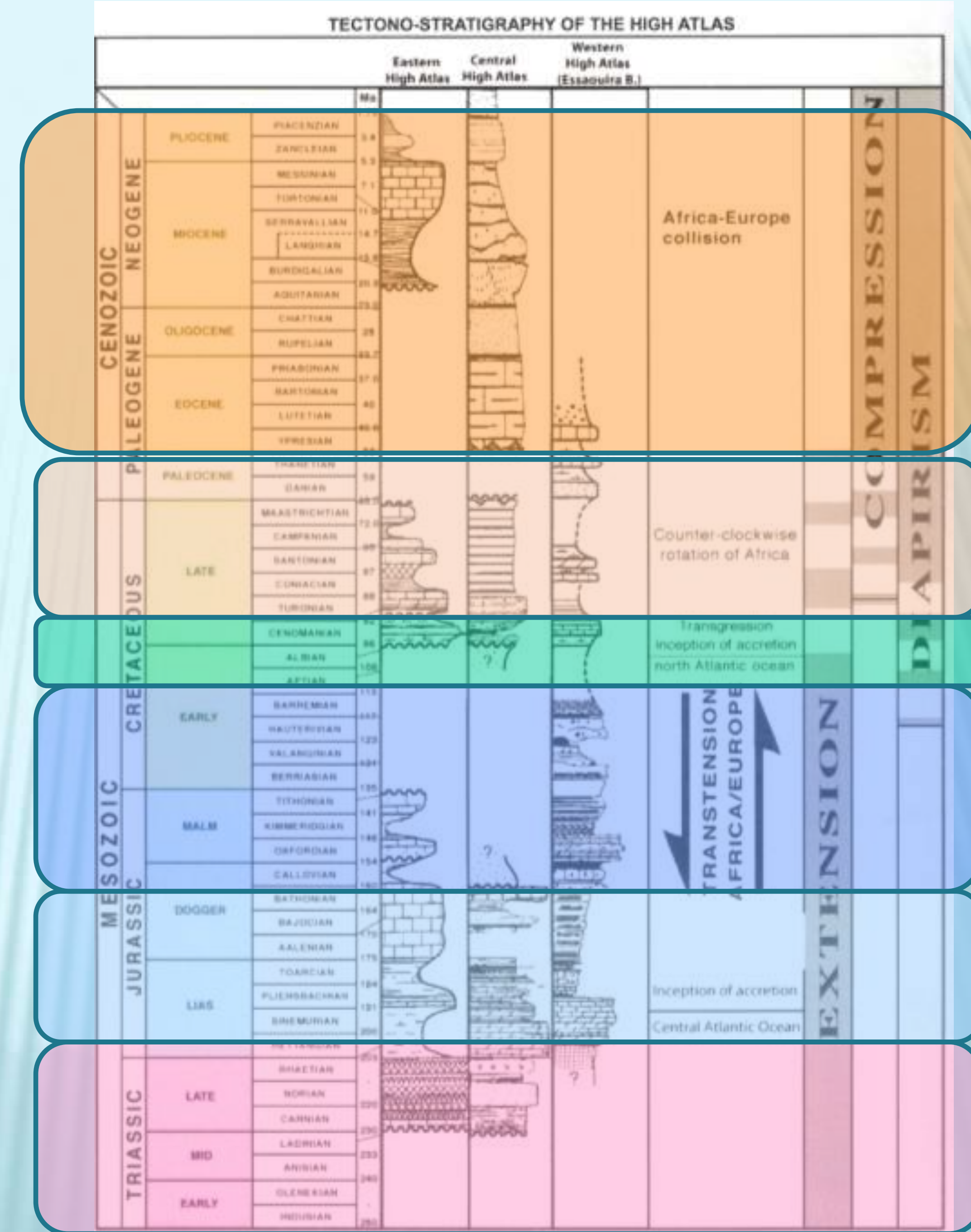
Rotation of Africa and beginning of compression

Tethyan and Atlantic marine transgression

Basin senility - compression, up-lift and terrigenous infills

Tethyan Carbonate Platform and hemipelagic basin

Intra-continental rifting with evaporites



ATLANTIC BASINS
NW Morocco

Tertiary infill and intense compressional folding

Eur-Africa collision and basin's mild inversion

Transgression; Marine platform development; Berriasian-Barremian regression.

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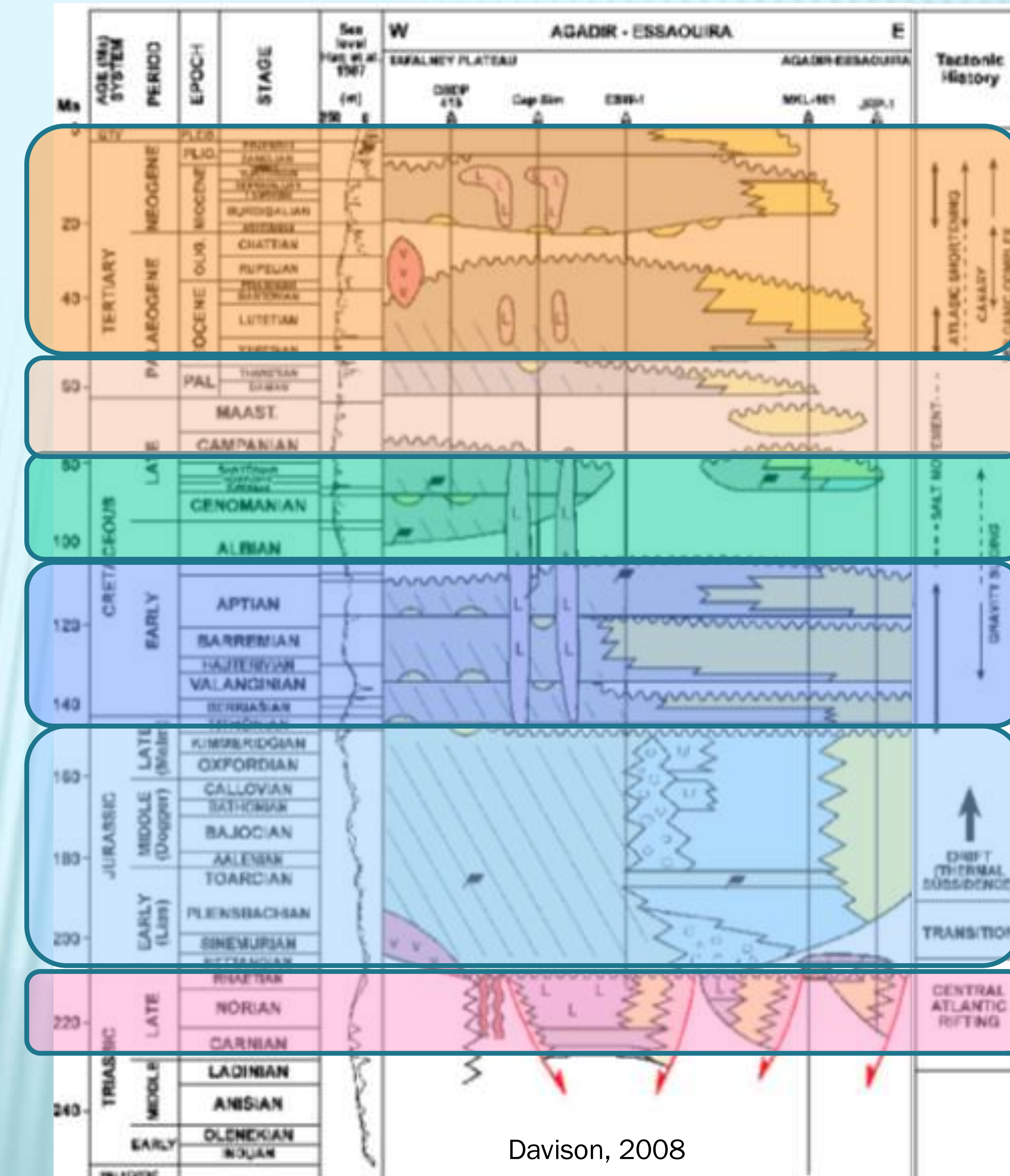
Central Atlantic spreading, and thermal subsidence

Central Atlantic Rifting

(Hafid et al., 2010)



Davison, 2008

REGIONAL TECTONO-SEDIMENTARY APPROACH

	LUSITANIAN	ALENTEJO	ATLANTIC	ALGARVE	ATLASIC
TERTIARY Late CRETACEOUS	Up-lift and **Inversion**	Up-lift and **Inversion**	Up-lift and **Inversion**	Up-lift and **Inversion**	Up-lift and **Inversion**
Late CRET. Early CRET.	Atlantic DRIFT	Atlantic DRIFT	Atlantic DRIFT	Transtension; **Atlantic** shall. Platform	Transtension; **Tethyan** shall. Platform
Early CRETAC. Late JURASSIC	**North Atlantic RIFT** Deep Marine	**North Atlantic RIFT** Deep Marine	Atlantic DRIFT	Transtension; **Atlantic** shall. Platform	Transtension; up-lift and terrig.prograd.
Mid. JURASSIC Early JURASSIC	**SAG** – Deep Marine Boreal Tethys Transgr.	**SAG** – Shallow Marine Atlantic Transgression	**SAG**: Shallow Marine Atlantic Transgression	**SAG** – Shallow Marine Tethys Transgression	**SAG**: Shallow to deep Marine Tethys Transgr.
Early JURASSIC Late TRIASSIC	Intra-continental **Rifting**	Intra-continental **Rifting**	**Central Atlantic RIFT**	Intra-continental **Rifting**	Intra-continental **Rifting**

CONCLUSIONS

All the basins share an Upper Triassic initial configuration, related to the Pangea break-up and intra-continental rifting,

followed by an Early Jurassic Sag phase with marine invasion, either from the SW (W Morocco & Alentejo), from the East (Atlas & Algarve) or from the NW (Lusitanian).

Around the Middle to **Late Jurassic** limit, Western Morocco continues as a passive margin, whereas the Alentejo and Lusitanian basins experience intense Atlantic rifting;

towards East, the Tethyan Algarve and Atlas basins decrease their subsidence and infill.

In the **Early Cretaceous,** Atlantic Break-up and Drift extend northwards, to Western Portugal and the global effects of Cenomanian transgression are felt regionally,

followed by Late Cretaceous increased inversion in all the basins and collisional up-lift throughout the Tertiary.

THIS REGIONAL GEODYNAMIC CORRELATION FRAMEWORK IS EXPECTED TO IMPROVE THE PREDICITIVE PERSPECTIVES ON THE PETROLEUM SYSTEM ELEMENTS AND REGIONAL EXPLORATION EFFORTS IN THIS AREA.