JURASSIC CARBONATE PLATFORMS ALONG THE AGADIR-ESSAOUIRA BASIN

AN OUTCROP ANALOGUE FOR CENTRAL ATLANTIC MARGIN CARBONATE SYSTEMS

A. Duval-Arnould ; S. Schroeder ; J. Redfern ; L. Bulot

AIMS OF THE STUDY

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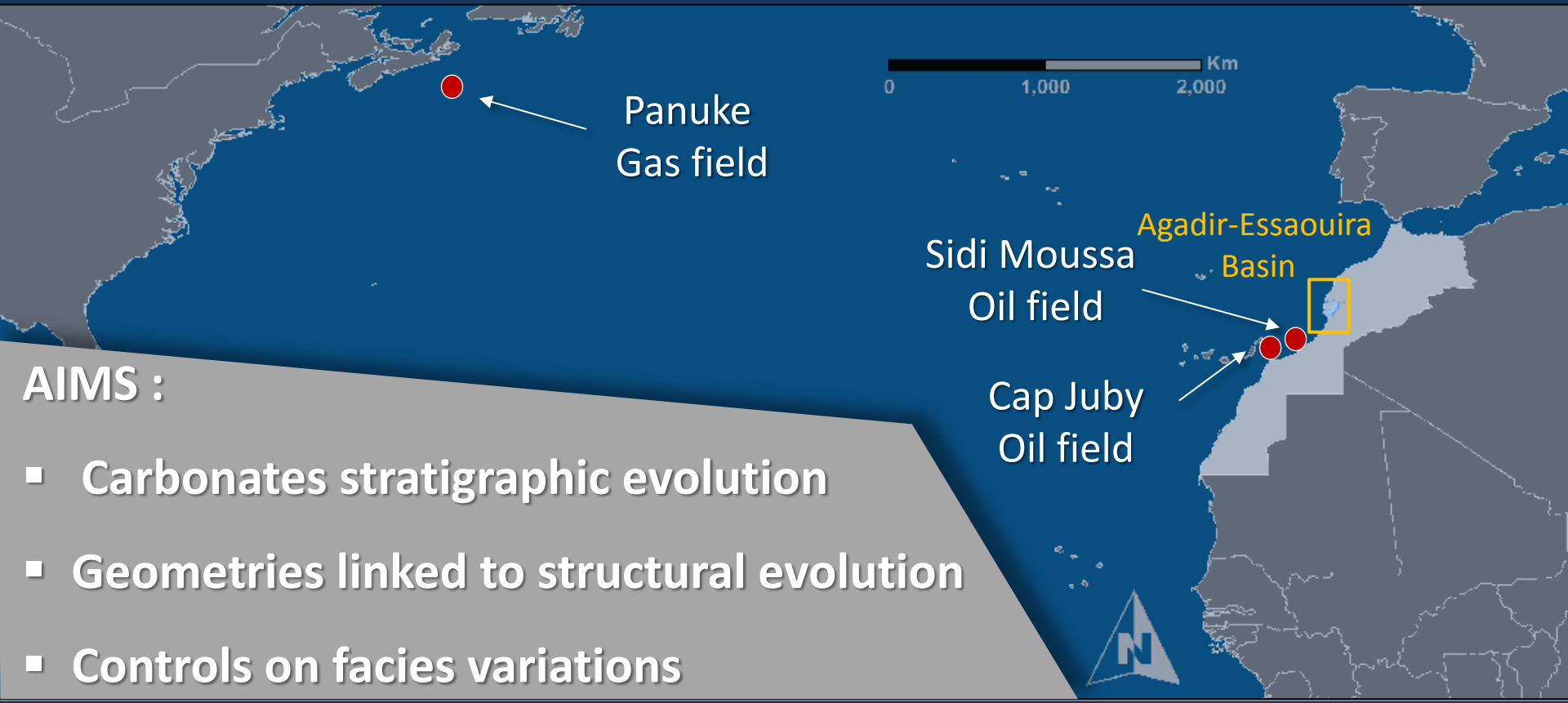
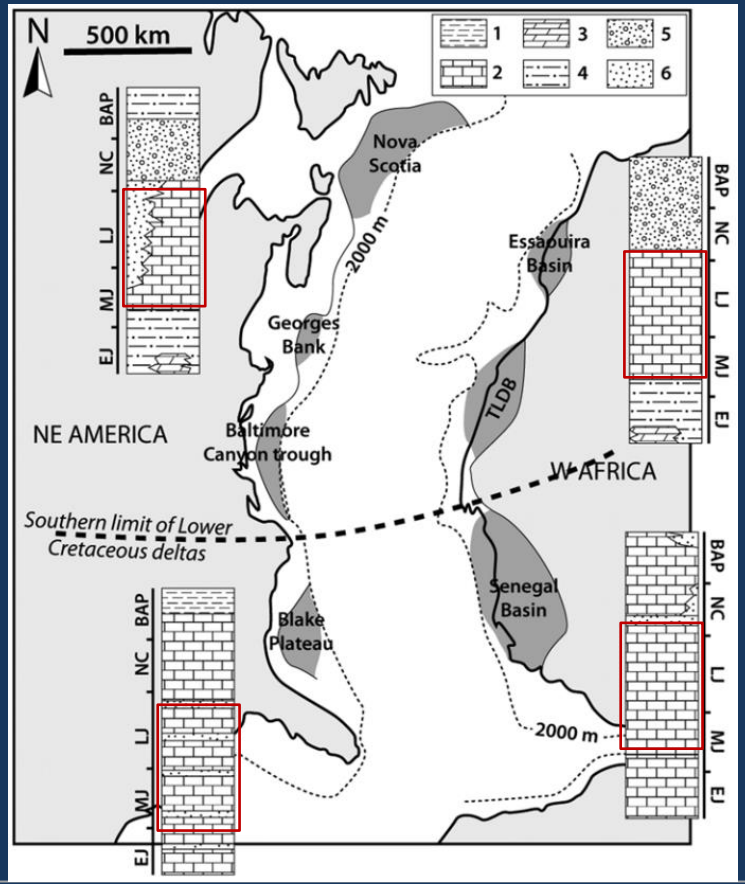


AIMS :

- **Carbonates stratigraphic evolution**
- **Geometries linked to structural evolution**
- **Controls on facies variations**

CENTRAL ATLANTIC BASINS



Comparison of Middle Jurassic– Aptian stratigraphical record of Central Atlantic Ocean conjugate passive margins.

Leprêtre et al, 2017

Middle to Upper Jurassic:

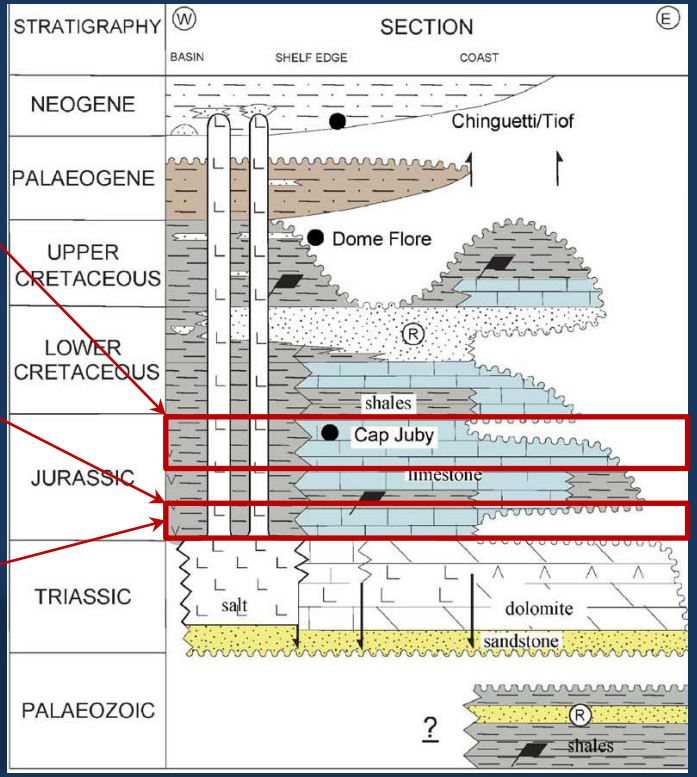
- Marine transgression
- Stable carbonate Platform
- Carbonate deposition interrupted by siliciclastic deposits

CENTRAL ATLANTIC BASINS

Reservoir Potential
Middle to
Upper Jurassic?

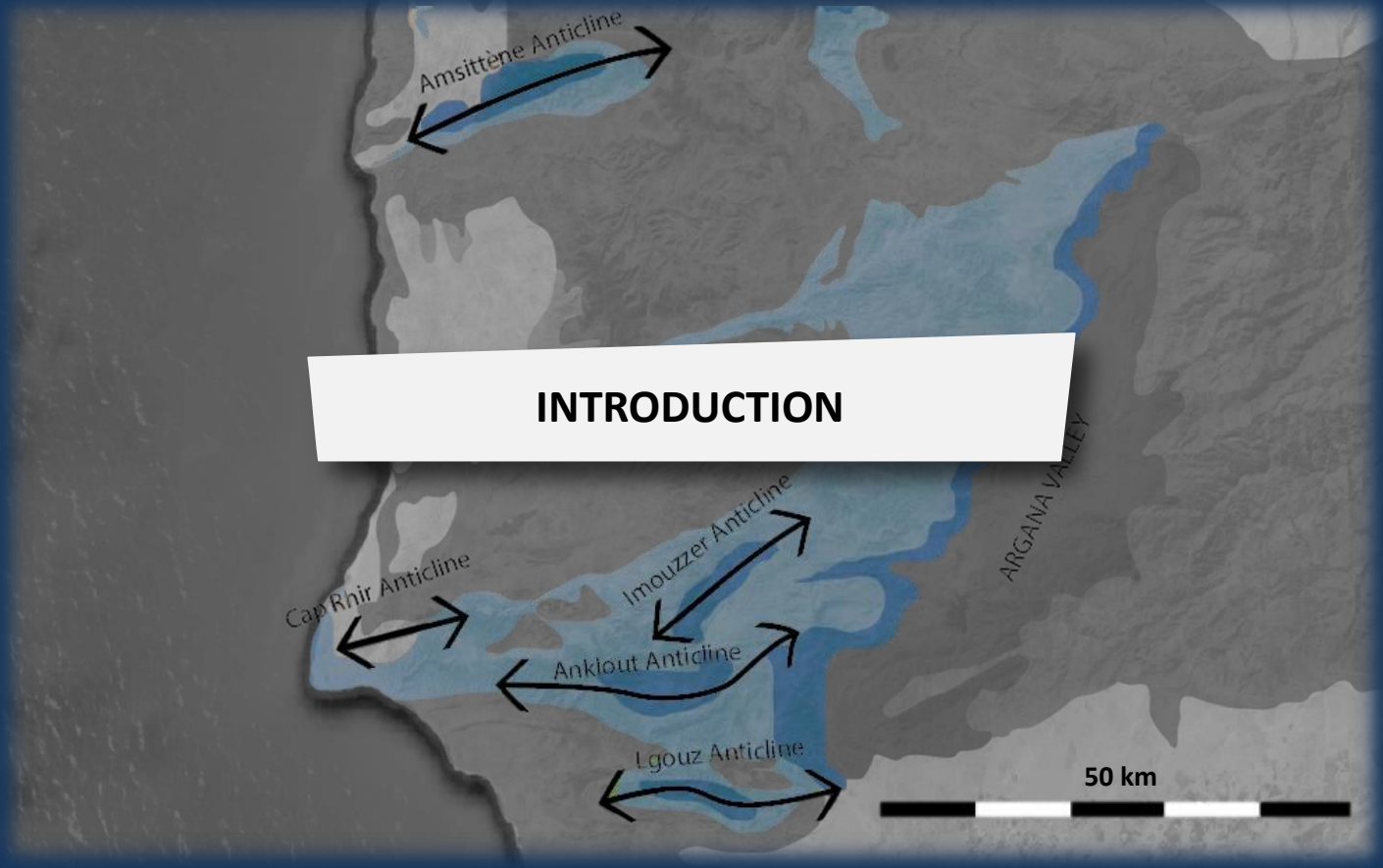
Reservoir Potential
Lower Jurassic

Potential Source rock
Lower Jurassic



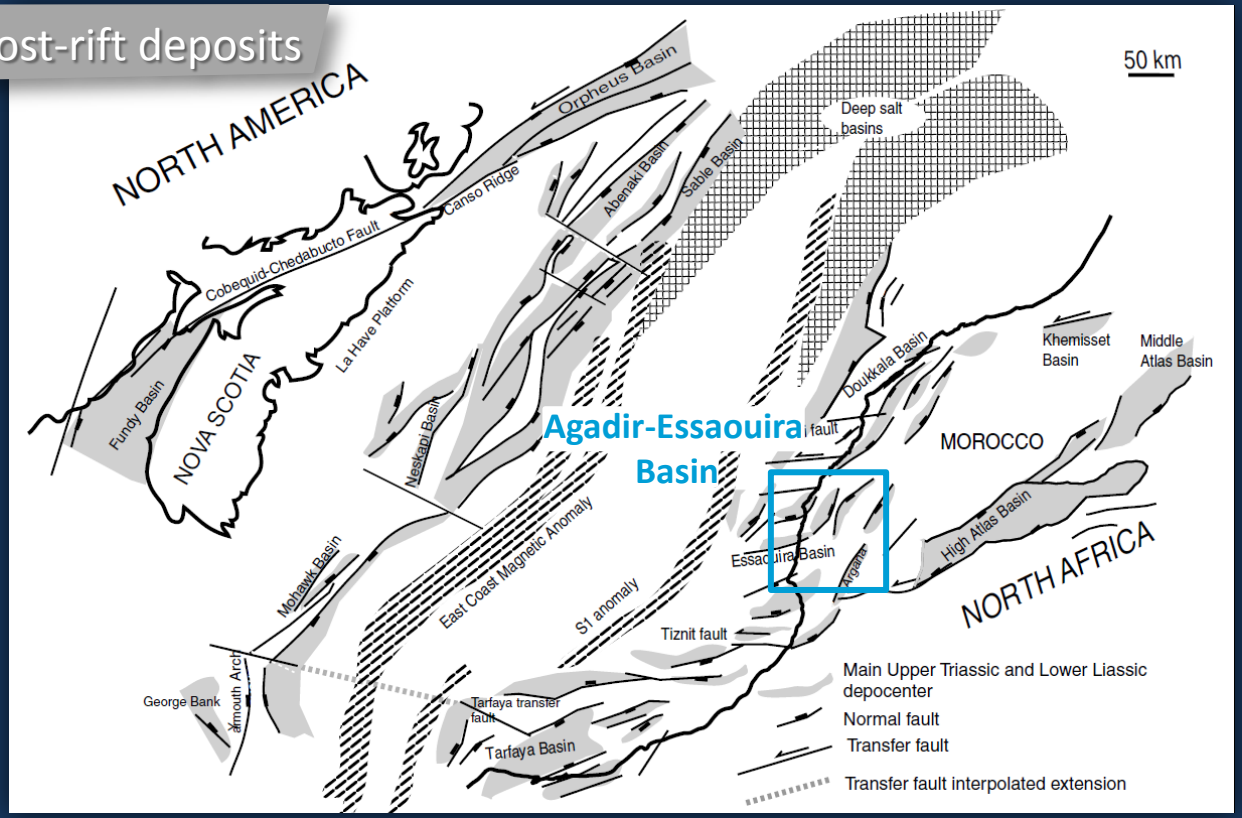
Stratigraphic and tectonic features which are present along most of the **NW African margin**.

Davidson, 2005


Amsittène Anticline
INTRODUCTION
ARGANA VALLEY
Imouzzer Anticline
Cap Rhir Anticline
Anklout Anticline
Lgouz Anticline
50 km

PRESENTATION

Jurassic: first post-rift deposits

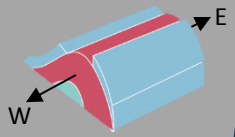


Structural framework of the Central Atlantic intracontinental Triassic–Liassic rift. *Le Roy and Piqué, 2001*

AGADIR-ESSAOUIRA BASIN

OUTCROPS

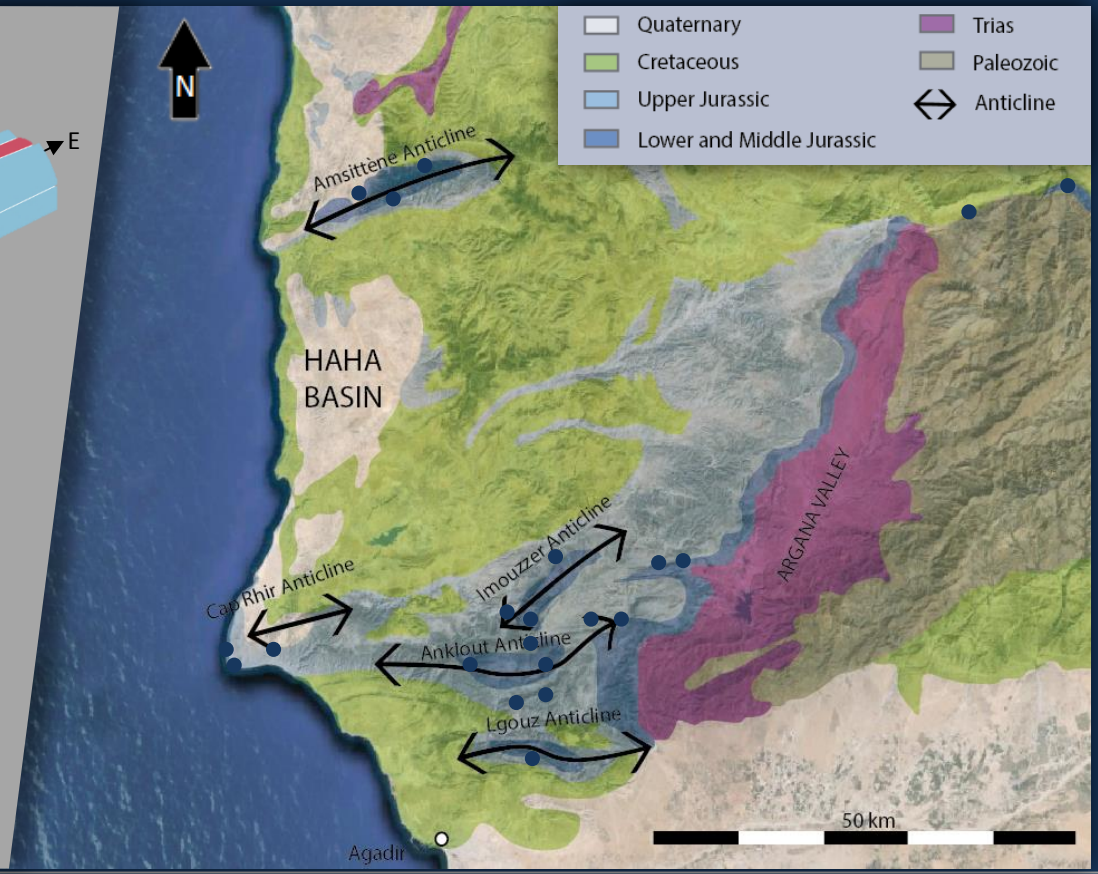
East-West Anticlines



- Access to complete succession
- Controls on carbonate deposition (?)

Argana Valley

- More proximal deposits
- Lower part of the succession



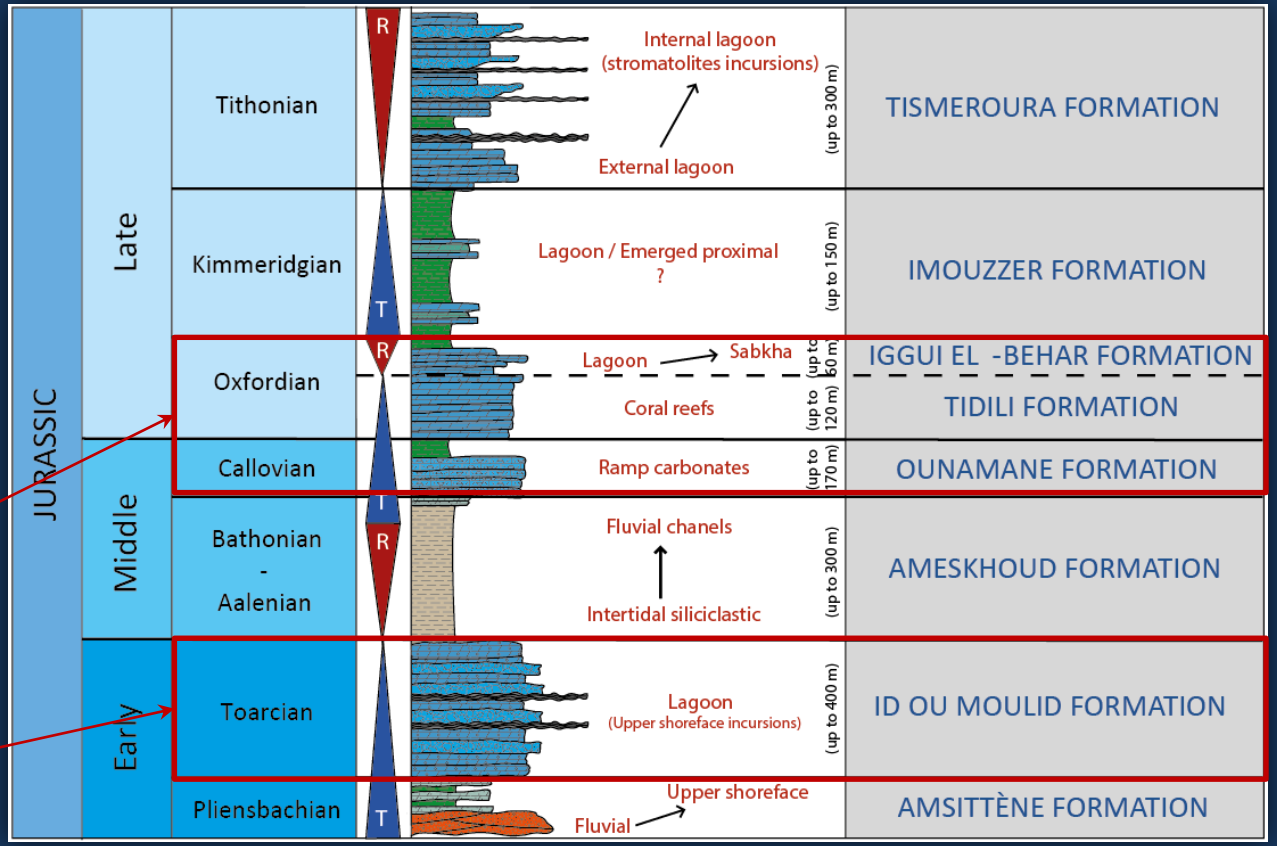
STRATIGRAPHIC EVOLUTION

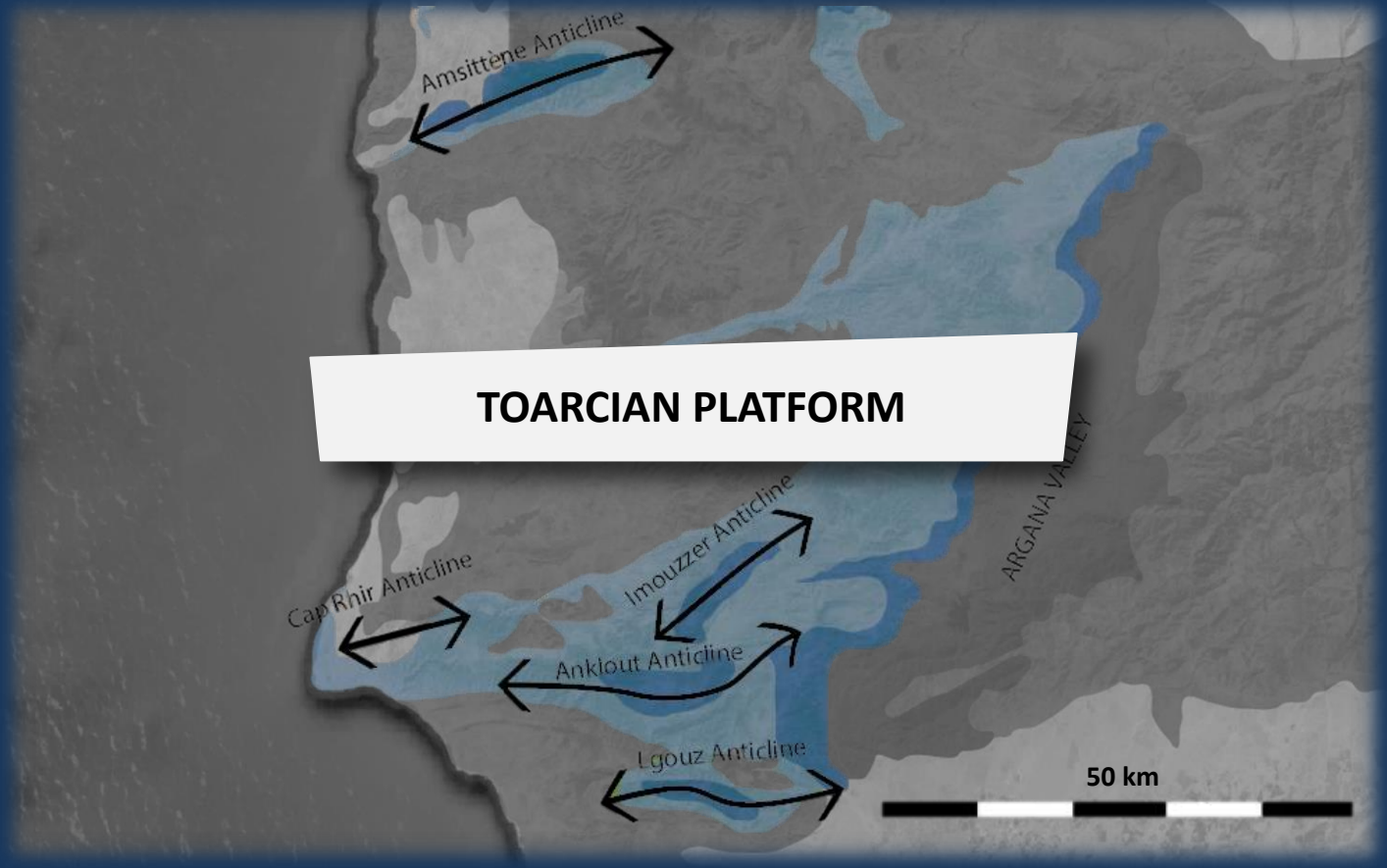
EAB Stratigraphic evolution during the Jurassic

- Mixed system
- Three times with carbonate platform development

Middle to Upper Jurassic:
RAMP CARBONATES AND CORAL REEFS

Lower Jurassic
LAGOONAL DEPOSITS




Amsittène Anticline
TOARCIAN PLATFORM
ARGANA VALLEY
Imouzzer Anticline
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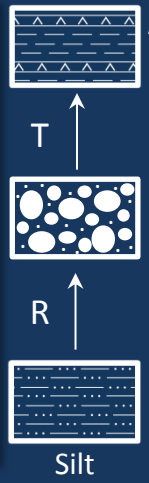
50 km

LIAS TRANSGRESSION



Alternation Clay/Evaporites

Silt

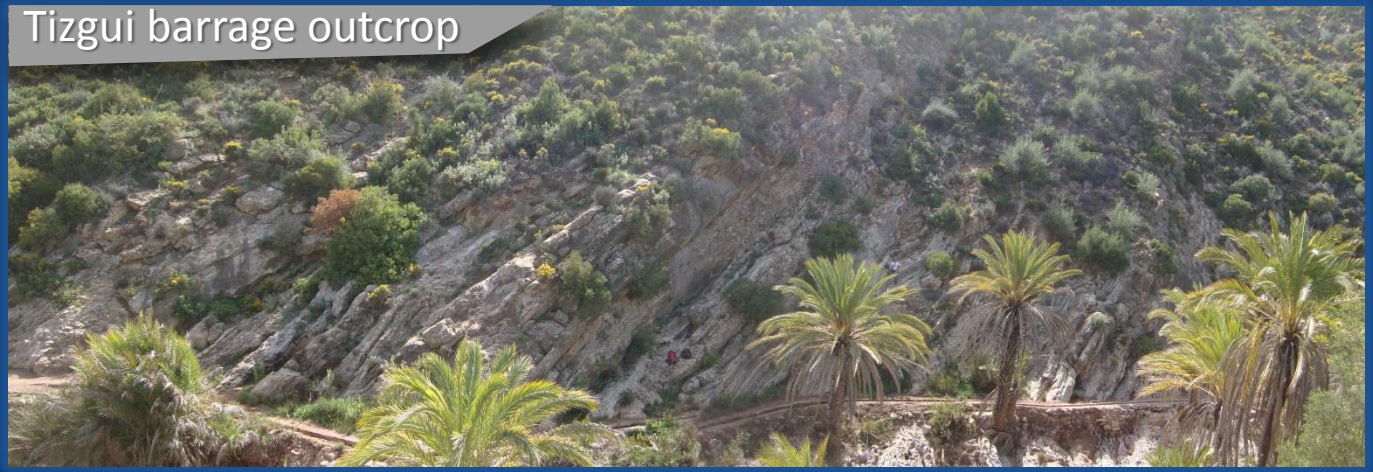
Comglomerates

Basalts

Establishment of a carbonate platform across the basin

Follows Lower Jurassic red fluvial sediments

TOARCIAN PLATFORM

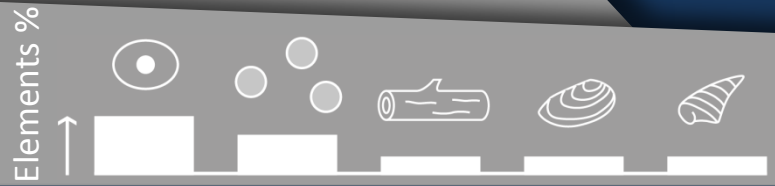


Toarcian Palaeomap

From Scotese, 2011

Sedimentary structures

PST/GST Elements



Peritidal cycles :

- Ooltic GST
- Oolitic an peloidal W/PST
- Gypsum levels
- Dissolution breccias
- Stromatolites

ID OU MOULID FORMATION

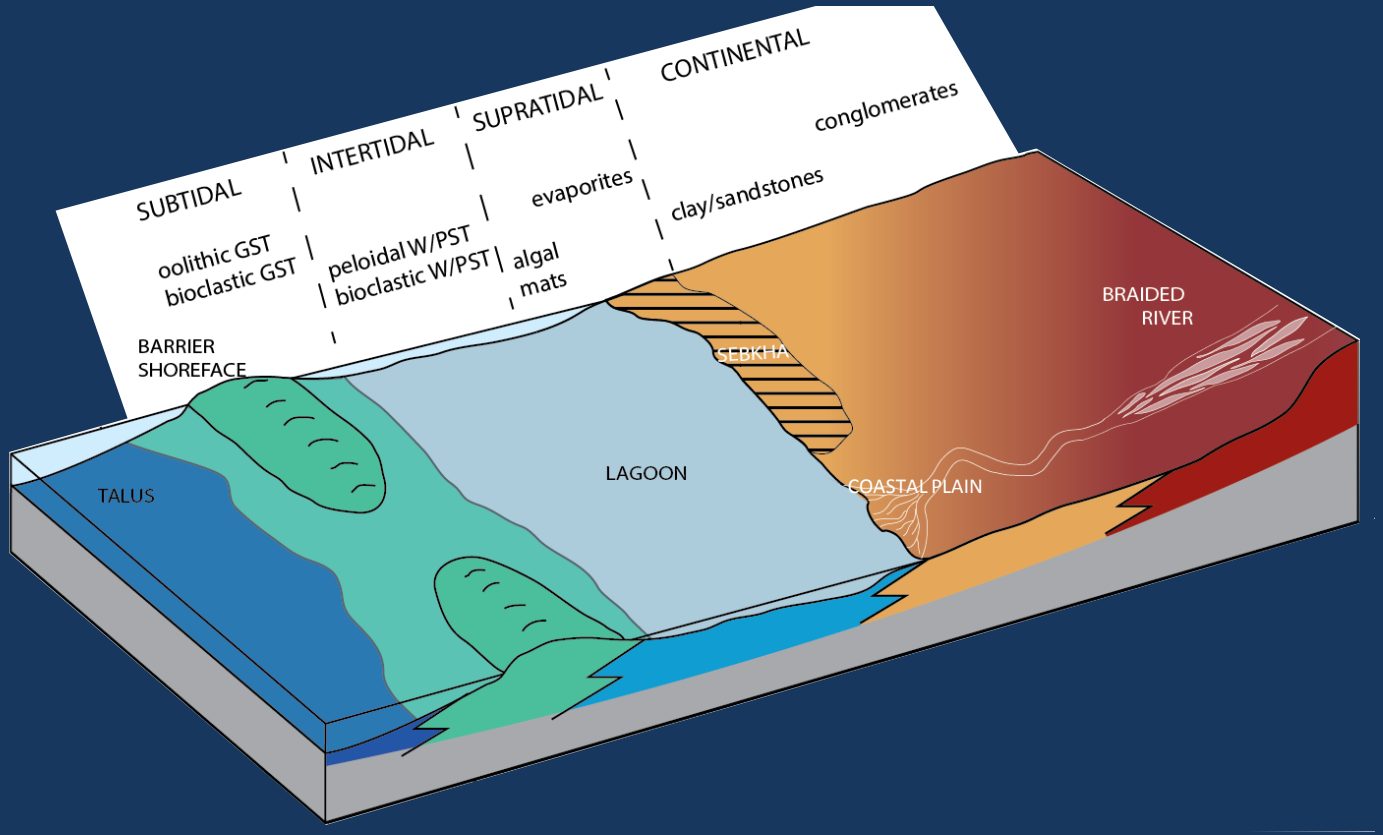
SUPRATIDAL

INTERTIDAL

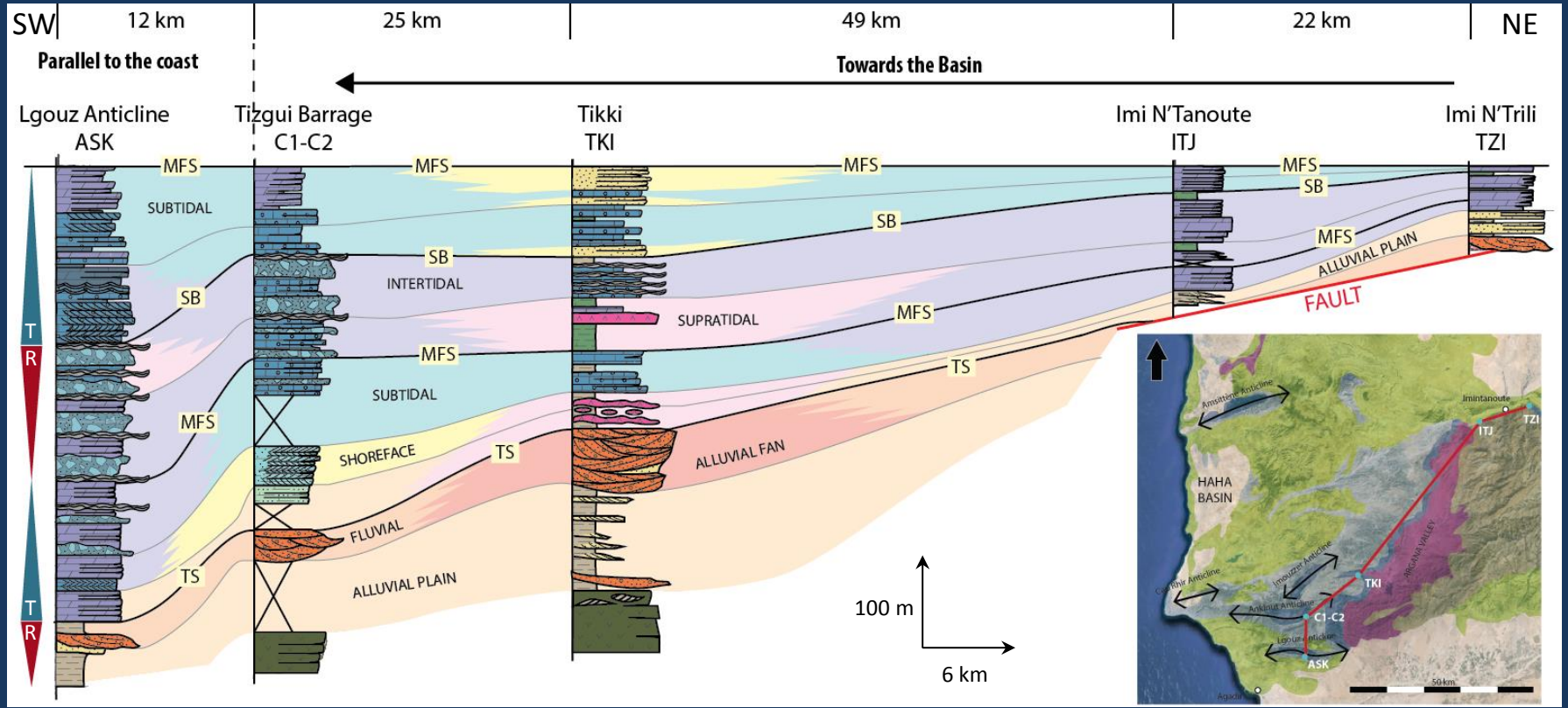
SUBTIDAL

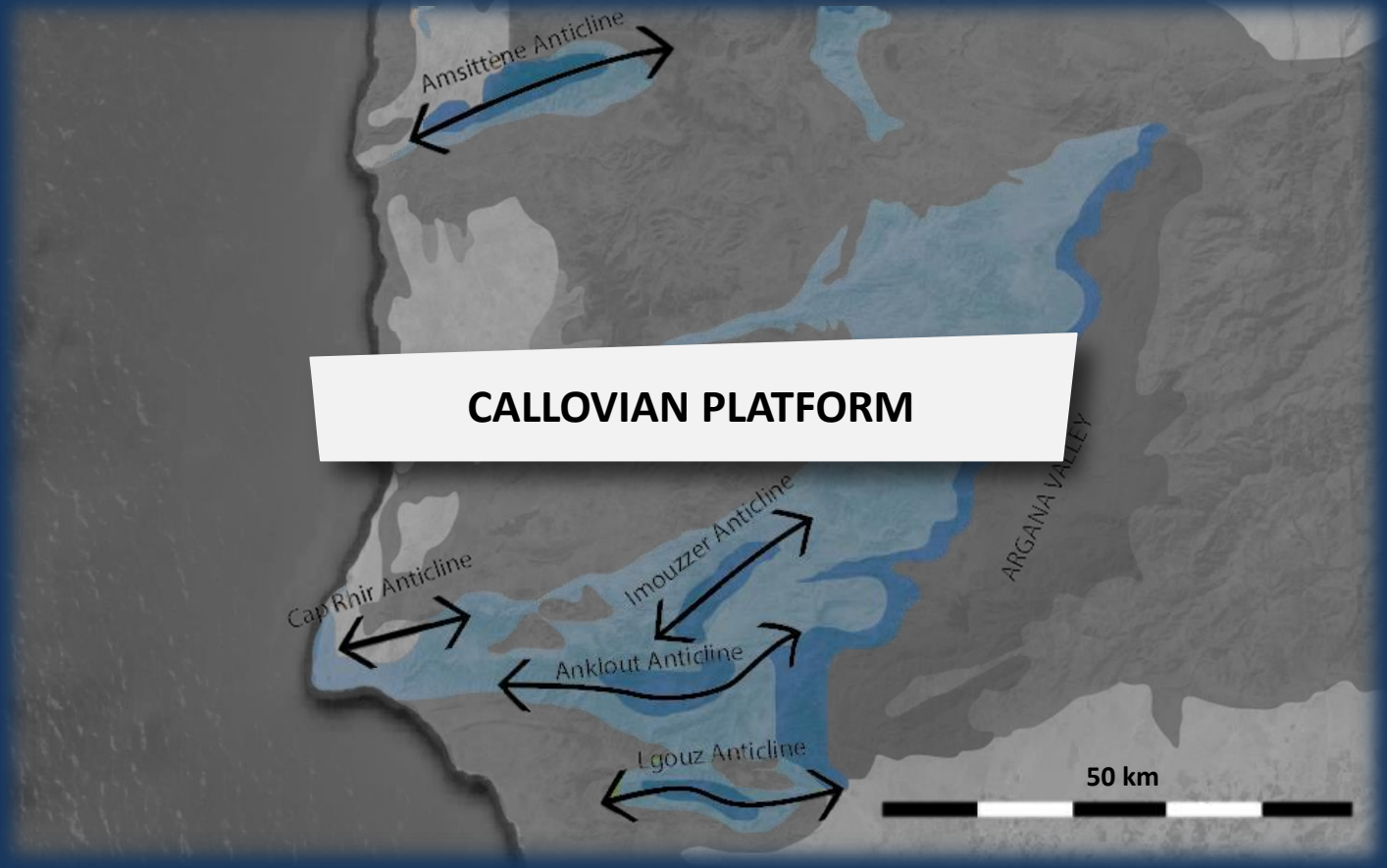
Peritidal cycles – Id Ou Moulid Fm

DEPOSITIONAL ENVIRONMENT MODEL



LIAS CORRELATIONS




Amsittène Anticline
CALLOVIAN PLATFORM
ARGANA VALLEY
Imouzzer Anticline
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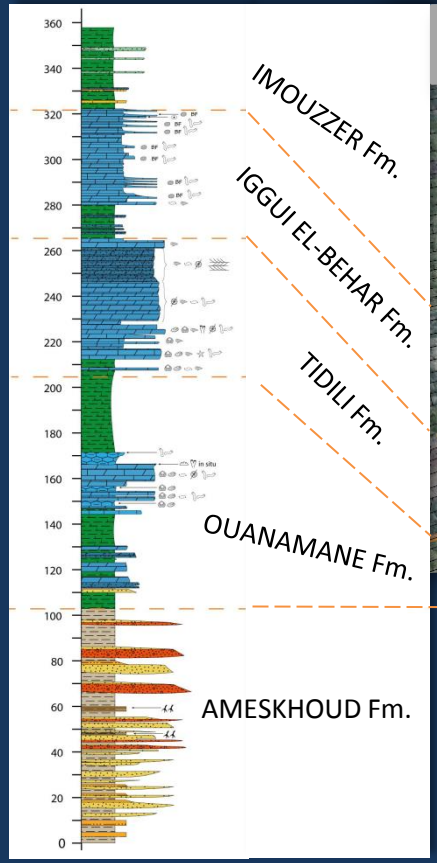
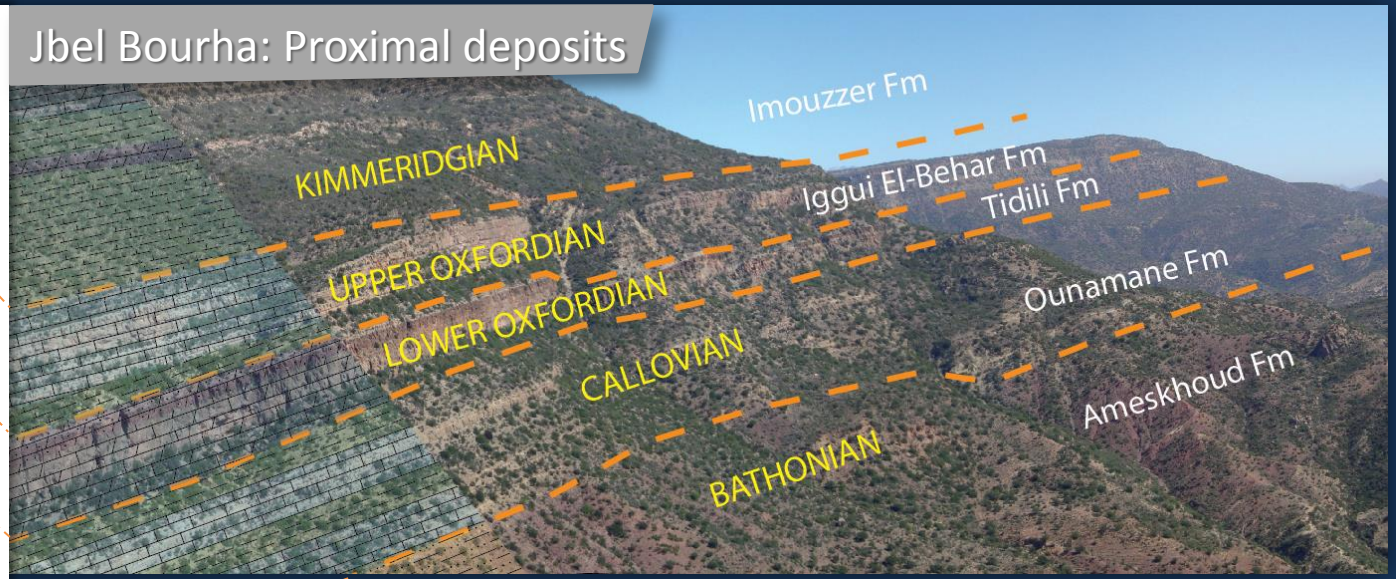
Anklout Anticline
Lgouz Anticline
50 km

STRATIGRAPHIC OVERVIEW

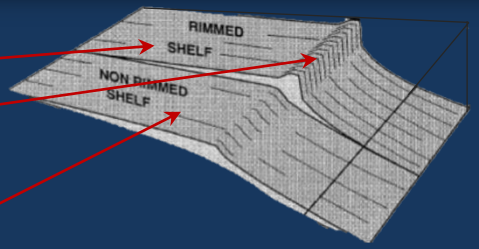




Iggui-El Behar Fm: **LAGOON**

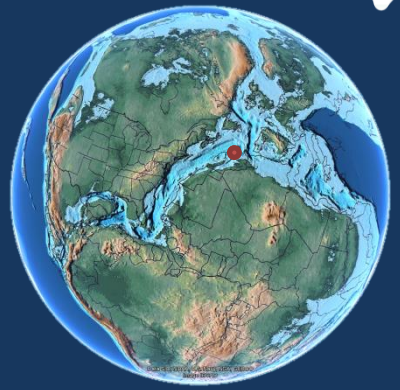
Tidili Fm: **CORAL REEFS**

Ouanamane Fm: **OPEN PLATFORM**



Modified after Pomar, 2001

CALLOVIAN PLATFORM



Aalenian-Callovian Palaeomap

From Scotese, 2011

Open platform:

- Oolitic GST
- Brachiopod rich marls
- FST and RST
- Firm and Hard Ground
- General transgression

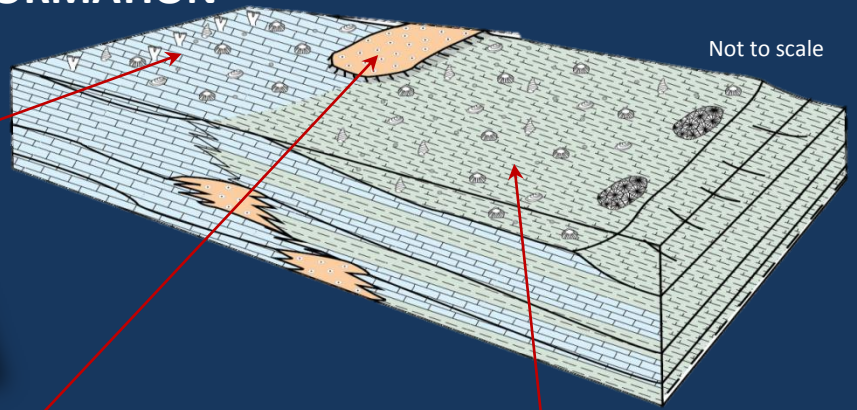
Alternation Marls / rich FST

PST/FST Elements

CALLOVIAN PLATFORM

OUANAMANE FORMATION

INNER PLATFORM



SHOALS DEPOSITS

OUTER PLATFORM

CALLOVIAN PLATFORM

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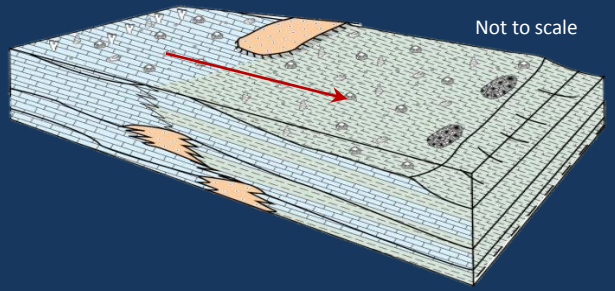


Evolution from inner to outer platform deposits

Callovian Transgression

CHRONOTRATIGRAPHY

Ammonites:

- Precise time constraints on Callovian interval
- Paleobiogeographic implications

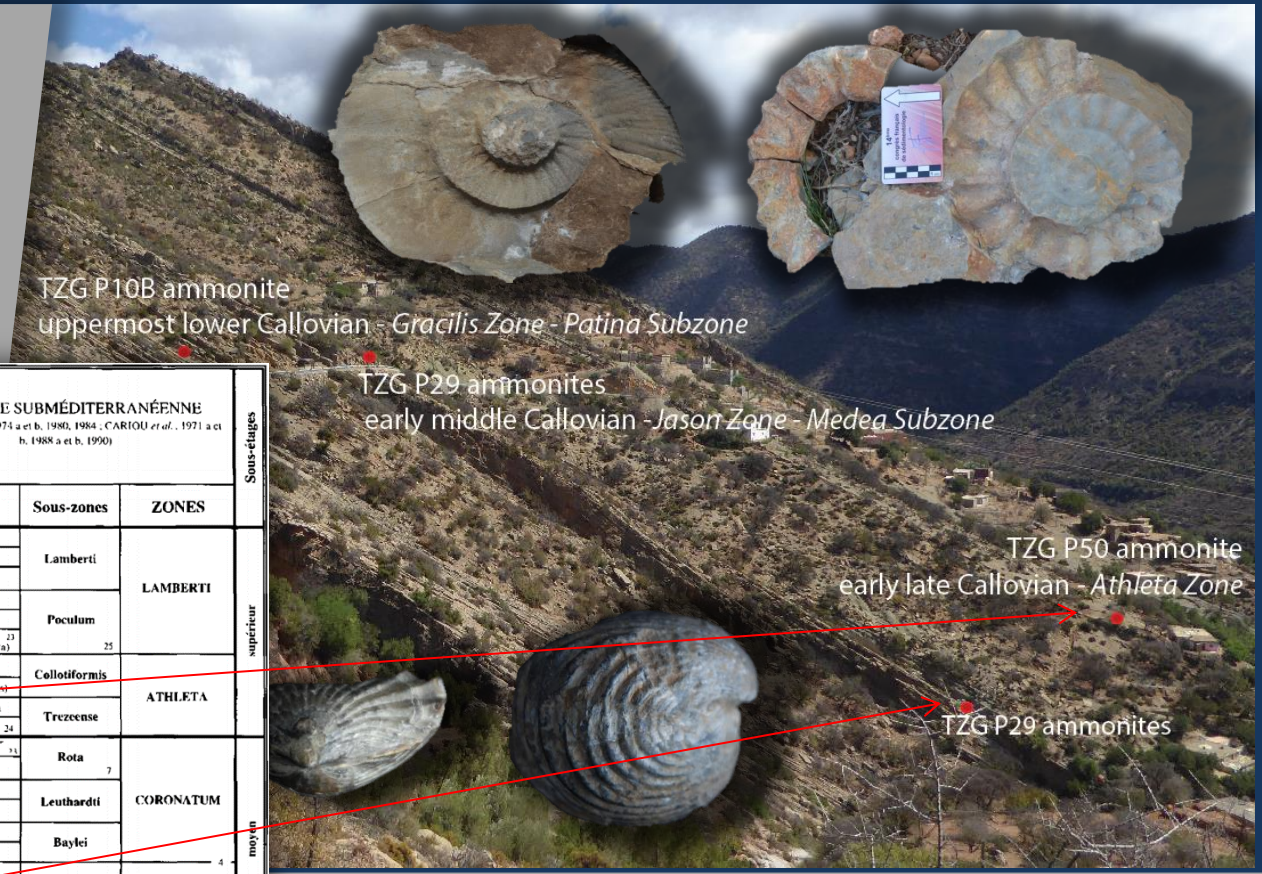
Brachiopods:

- Time correlations
- Water depth
- Palaeoenvironment

CHRONOTRATIGRAPHY

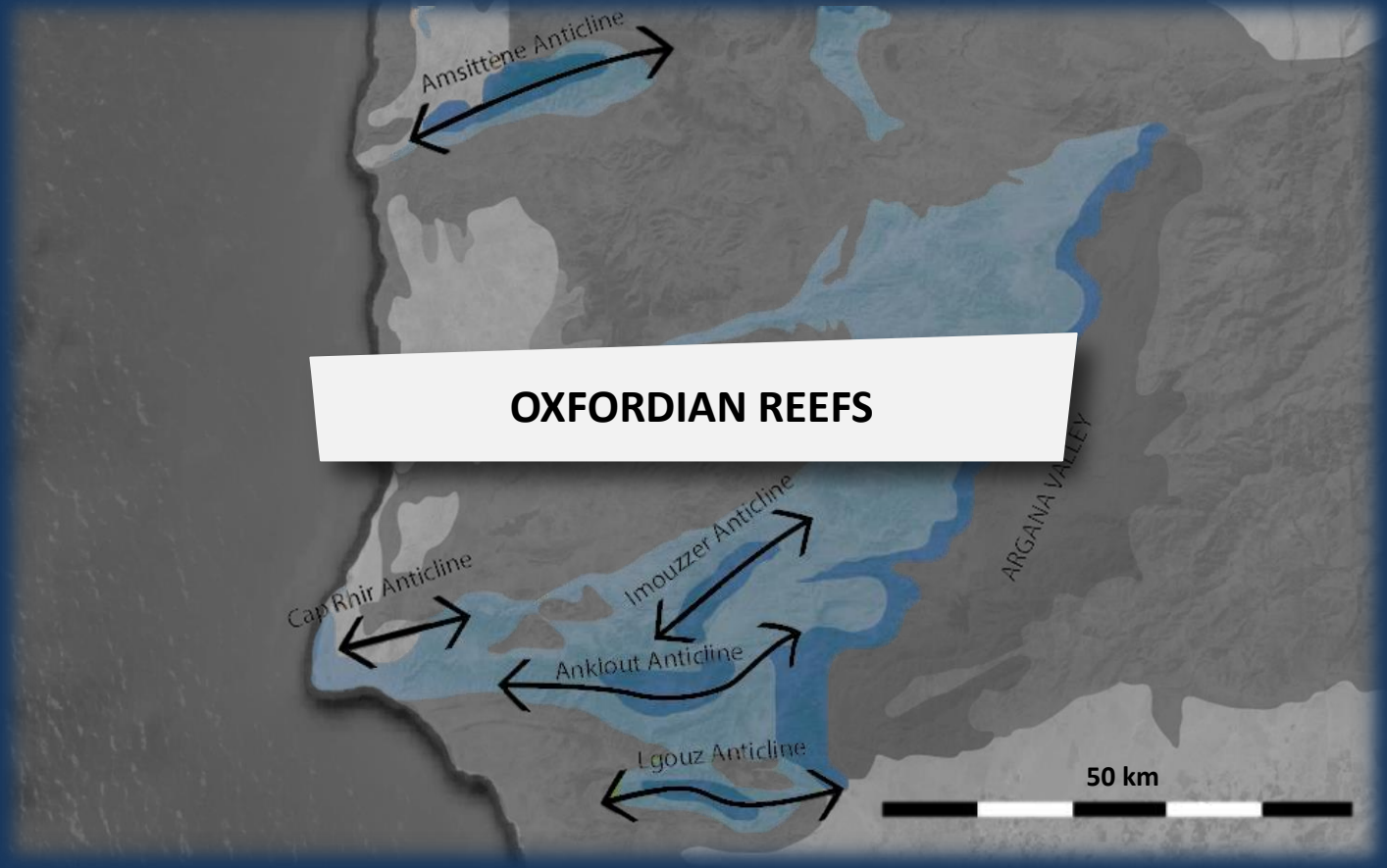
Ammonites:

- Precise time constraints on Callovian interval
- Paleobiogeographic implications



ODIN&ODIN, 1990	HARLAND *et al.*, 1990	HAQ *et al.*, 1987	Sous-étages	PROVINCE SUBBORÉALE (CALLOMON, 1955, 1964, 1984, 1985 ; CALLOMON & DIETL, 1990 ; CALLOMON & SYKES, 1980 ; CALLOMON *et al.*, 1988, 1989, 1992 ; DIETL, 1991 et inédit ; MARCHAND, 1979 ; PAGE, 1988, 1989)			PROVINCE SUBMÉDITERRANÉENNE (CARIOU, 1969, 1974 a et b, 1980, 1984 ; CARIOU *et al.*, 1971 a et b, 1988 a et b, 1990)			Sous-étages
				ZONES	Sous-zones	Horizons	Horizons	Sous-zones	ZONES	
154	157.1	152	supérieur	LAMBERTI	Lamberti	Paucicostatum Lamberti Praelamberti	Paucicostatum Lamberti Praelamberti	Lamberti	LAMBERTI	supérieur
					Henrici	Henrici Messiaeni	Athletoides Subtense Nodulosum (Angustilobata)	Poculum		
				"ATHLETA"	Spinosum	Spinosum	Collotiformis Piveteaui (Odyssea)	Collotiformis	ATHLETA	
					Proniae	Proniae	Trezeense/Athleta Leckenbyi	Trezeense		
					Phaeinum	Phaeinum (Interpositum)	"Pseudopeltoceras"	Rota	CORONATUM	
			moyen	"CORONATUM"	Grossouvrei	Grossouvrei Obductum Posterius	Rota/Regulare Waageni	Leuthardti		moyen
					Obductum	Obductum	Leuthardti Baylei	Baylei		
				JASON	Jason	Jason α Jason β	Villanyensis Richei	Tyranniformis	ANCEPS	
					Medea	Medea	Blyensis Turgidum Bannense	Stuebeli		

Cariou et al. 1997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50 km

OXFORDIAN REEFS

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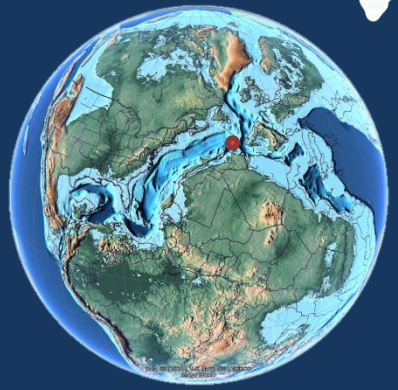
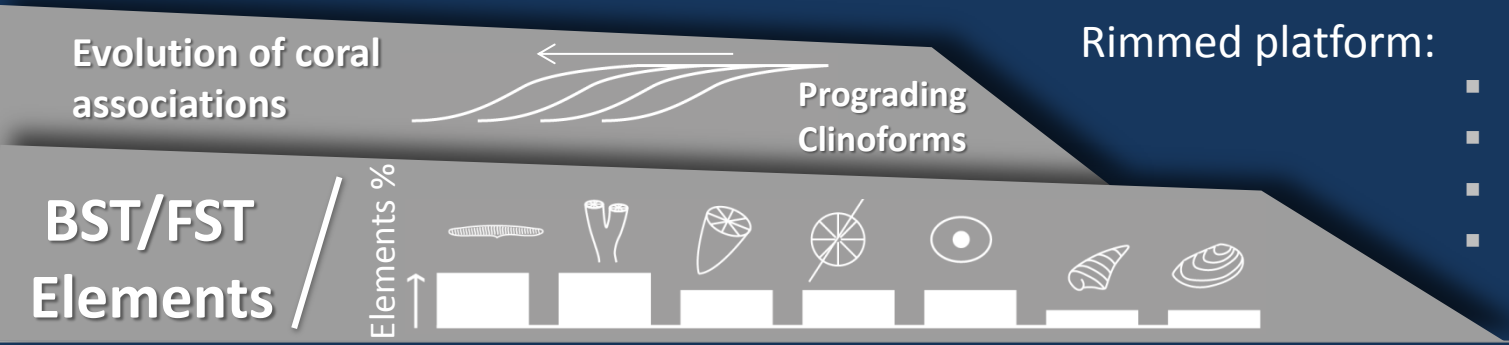


Oxfordian-Kimmeridgian Palaeomap

From Scotese, 2011



Rimmed platform:

- Coral reefs
- MST / PST / BST
- Diachronism
- Shallowing upward

TIDILI FORMATION

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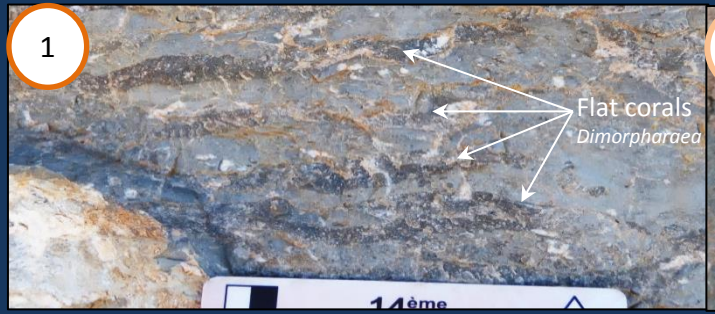
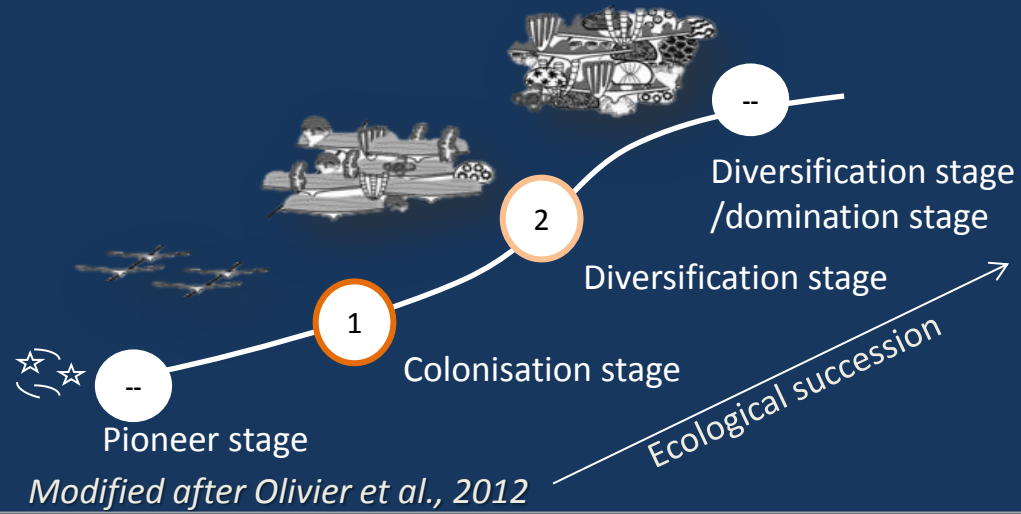


Dolomitic Bst
corals (platy, branching), serpulids, brachiopods…

Dolomitic F/Rst (W/Pst)
coral fragments, crinoids, shells…

OXFORDIAN REEF ECOLOGICAL SUCCESSION



Modified after Olivier et al., 2012

Dolomitic fine P/Gst : shelly fragments, brachiopods, gastropods …

TIDILI FORMATION

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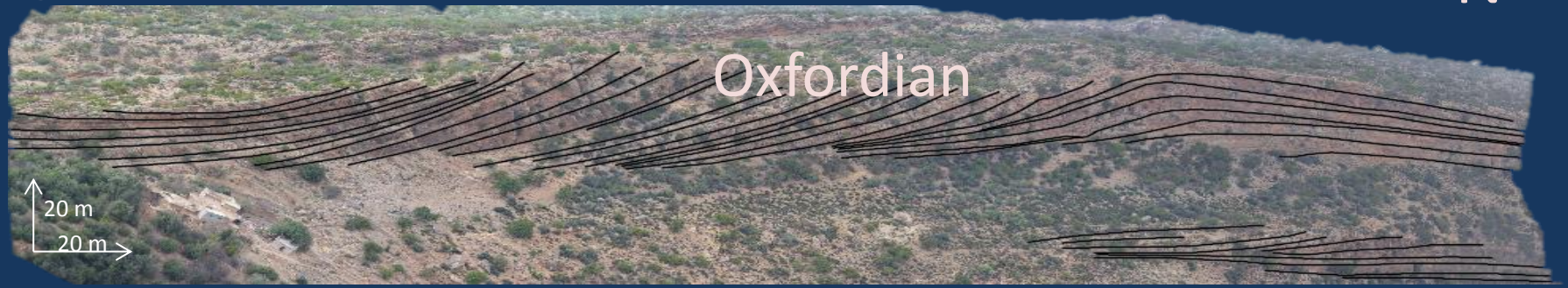
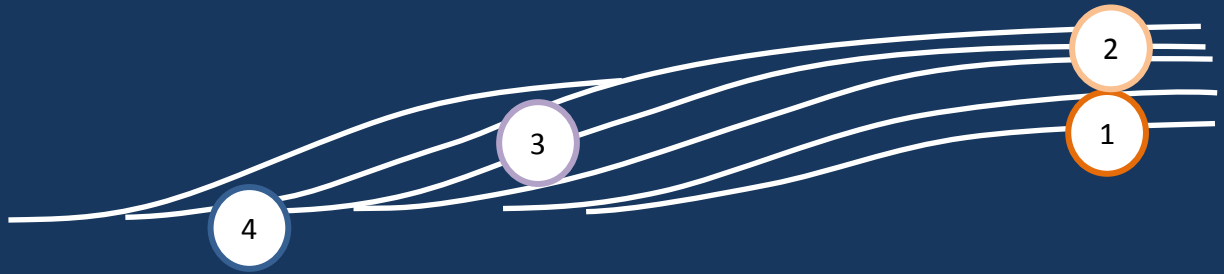


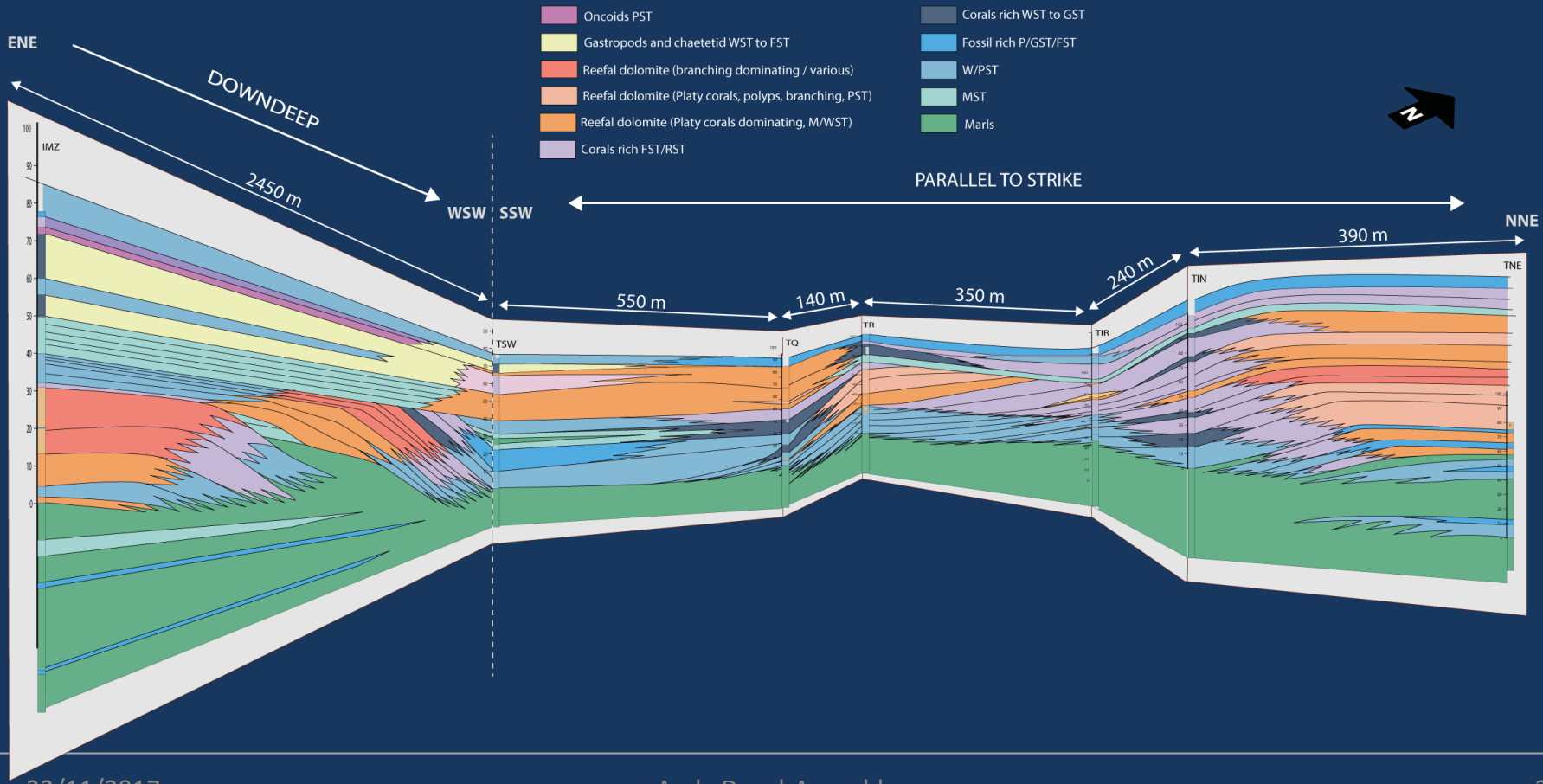
~ 30°

Large clinoforms offlapping the reef structure

REEF EDGE / CLINOFORMS



TIDILI FORMATION



SILICI-CLASTIC INFLUX

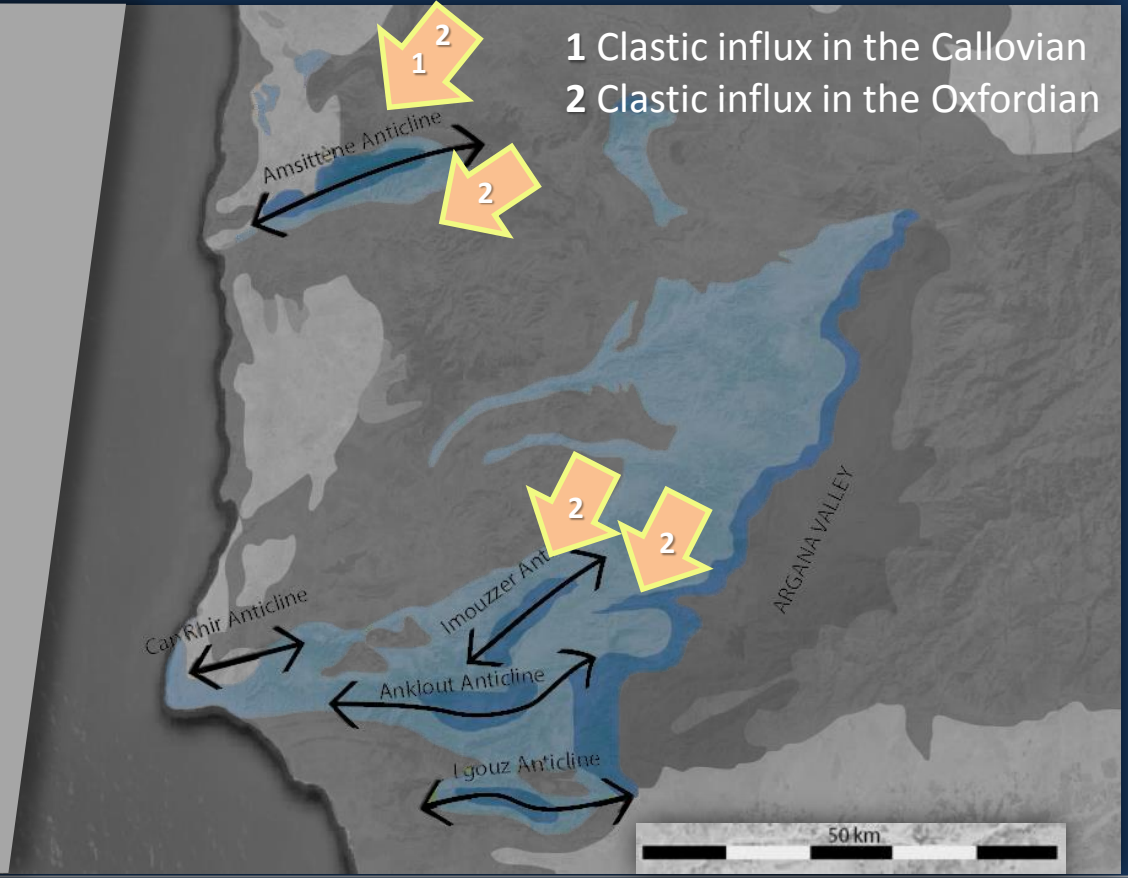
SILICI-CLASTIC INFLUX

Influence on the platform development :

- Reduces species diversity
- Reduces the accomodation space
- Increase the water turbidity

Influence on the coral reefs :

- Favours branching corals over flat corals
- Suppresses coral reef growth



BIOSTRATIGRAPHY

BIOSTRATIGRAPHY

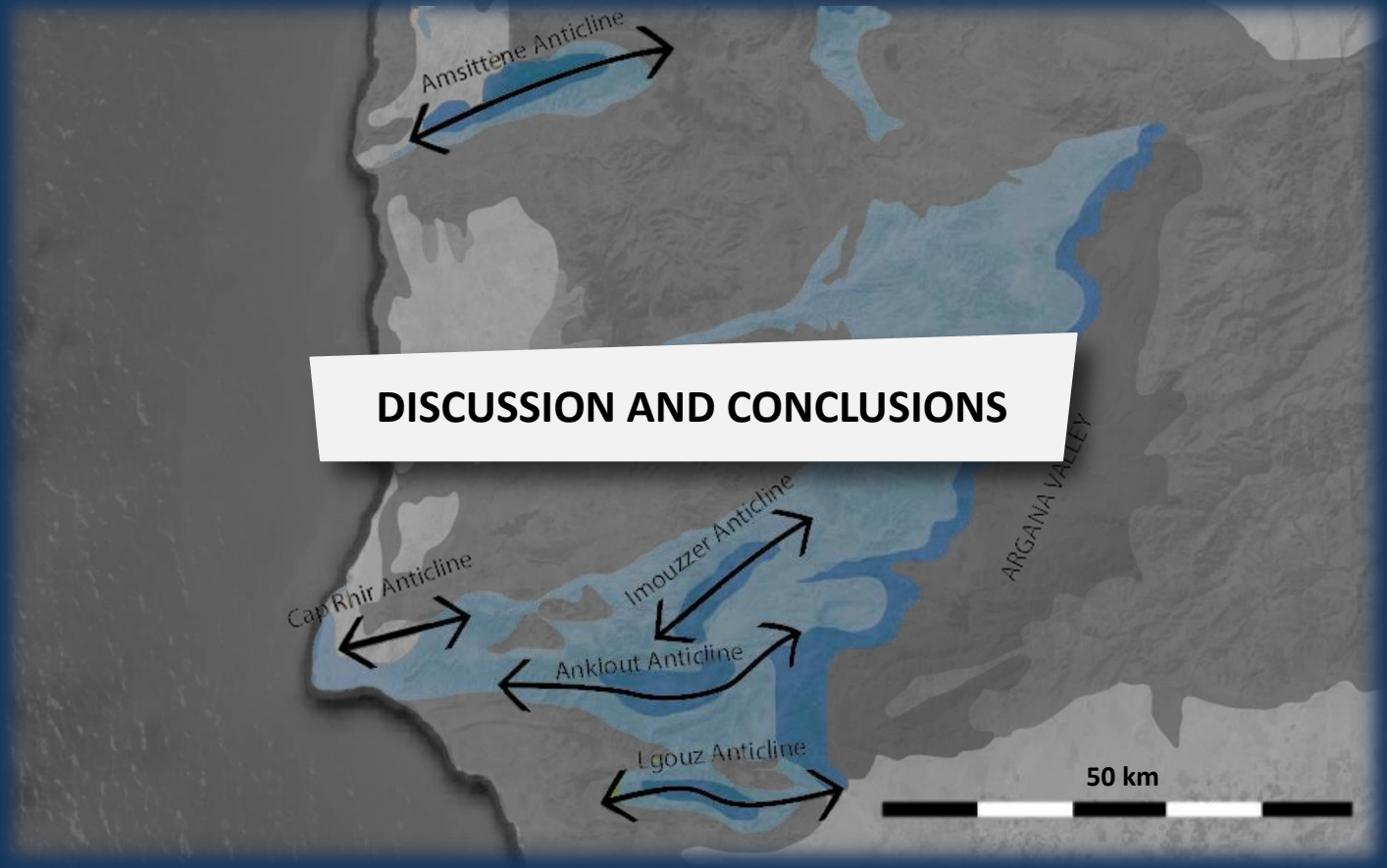
Ammonites:
- Precise time constraints Callovian
- Cap Ghir Upper Oxfordian reef

Brachiopods:
- Time correlations Cal/Ox
- Water depth

Gastropods:
- Nerinea for Ox/Kim boundary

Foraminifers:
- Ox/Kim dating

Bivalves and Echinoderms:
- Environmental conditions



DISCUSSION AND CONCLUSIONS

PLATFORM EVOLUTION

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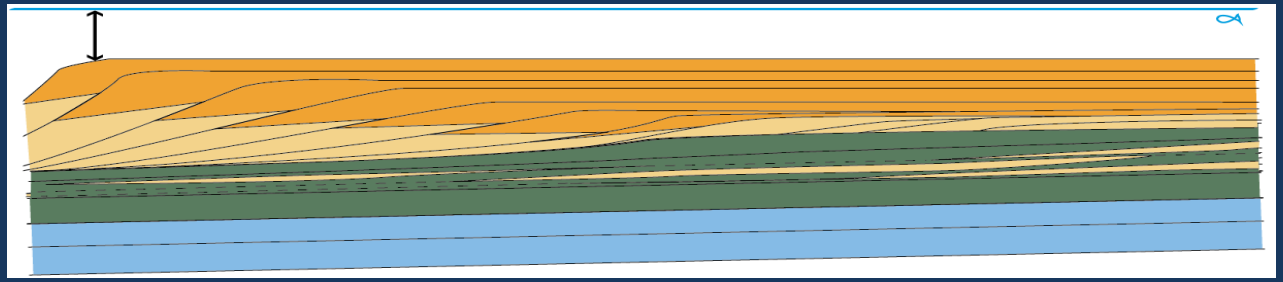
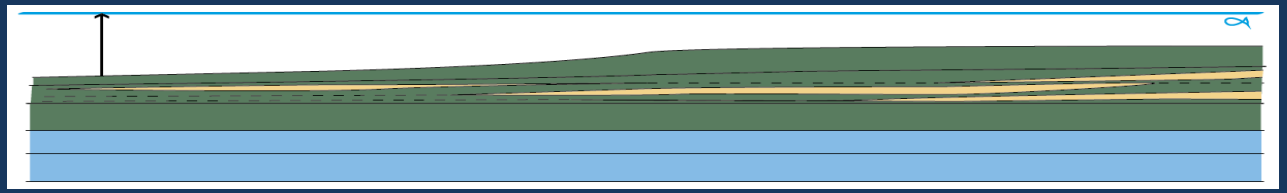
EXAMPLE OF THE TIDILI AREA

OXFORDIAN

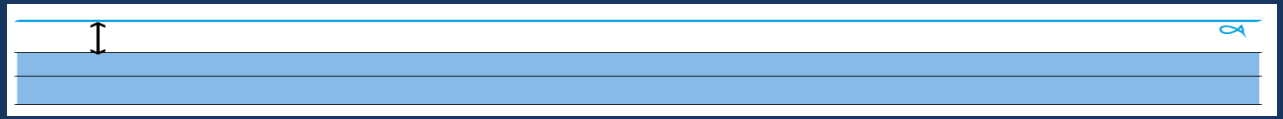


Reefs prograding and clinoforms:
Coral boundstones and bioclastic clinoforms

CALLOVIAN



Drowning of the Platform:
Marls deposits and locally shoals/ bioclastic levels

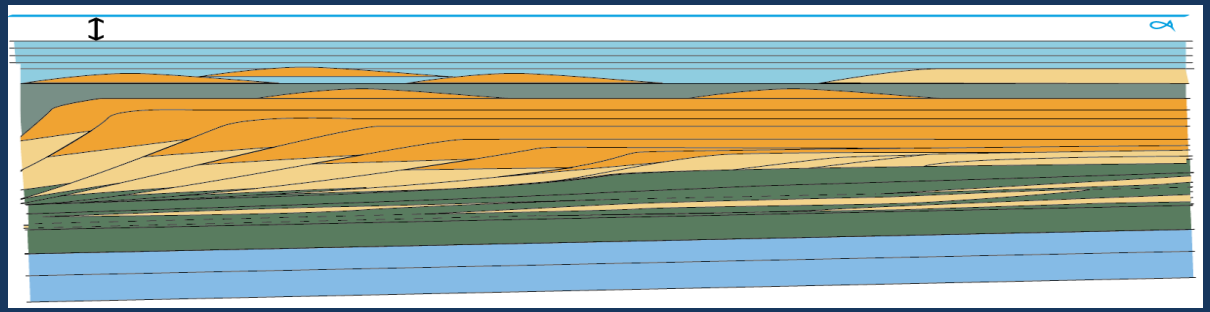


Callovian Platform:
Bioclastic GST/PST
Brachiopods rich

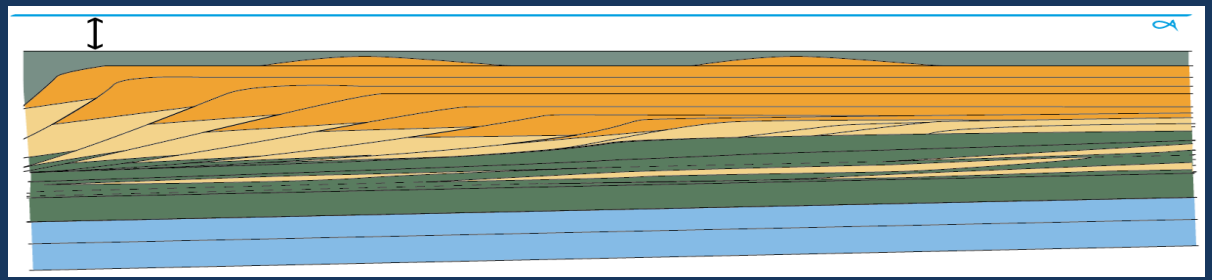
PLATFORM EVOLUTION

EXAMPLE OF THE TIDILI AREA

OXFORDIAN



Shallowing of the Platform:
Small patch reefs and shoals followed by peritidal WST



Drowning of the main reef:
Establishment of MST and deeper patch reefs

DISCUSSIONS

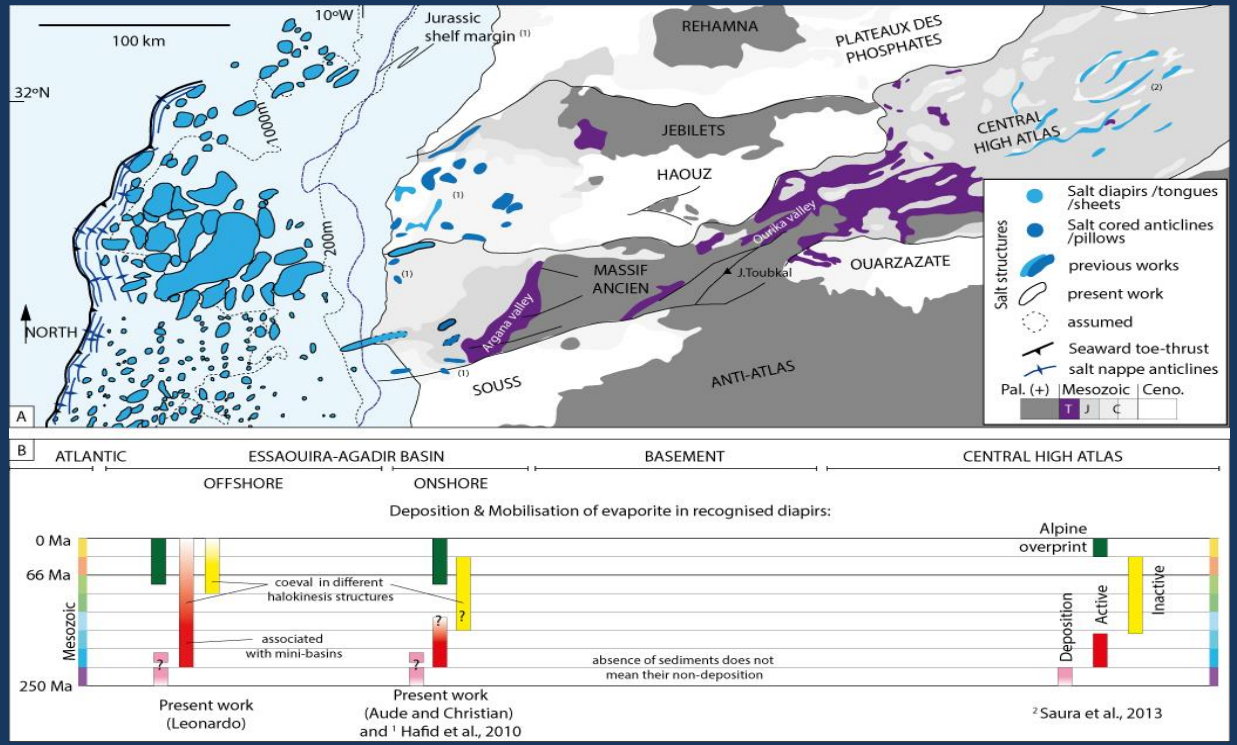
Geometries linked to structural evolution

Onshore salt anticlines:

- Clastics distribution
- Reefs geometries (CHA)

Offshore salt diapirs:

- Mini basins
- Small scale platforms
- Strong facies control



Work from R. Charton, unpublished

DOLOMITISATION

Nawwar Al Sinawi

Distribution and controls of dolomite

- Non stratabound
- Dolomite closely related to faults
- Temperature
- Other controls : *to be identified by geochemical analysis and petrography*

Impact on reservoir properties

- Dissolution of dolomite enhance reservoir quality
- Overdolomitisation occlude porosity
- Dolomitised coral boundstones : potential reservoir

CONCLUSIONS

- **Carbonates stratigraphic evolution**
  - Evolution form open ramp to rimmed platform
  - Geometries and facies linked to structural evolution
  - Reefs size and lateral variations
- **Distribution and controls of dolomite**
  - Environmental and facies controls
  - Best porosity linked to reef facies
- **Central Atlantic Margin**
  - **Better understanding of the Jurassic platforms along the margin**
  - **Good analogue for Nova Scotia**

PUBLICATIONS PLANS

Paper 1 : **Lias** sedimentology and sequence stratigraphy	December - February
Paper 2 : **Callovian-Oxfordian** sedimentology and palaeontology	March - May
Paper 3 : **Reefs geometries** and facies variations – Tidili example	June - July
Paper 4 : Jurassic evolution and **Paleogeography**	August - Octobre

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