

# **Allochthonous Salt Sheets Associated with Cretaceous Rifting in the North African Margin, Examples from North Tunisia and Petroleum Implication\***

**Amara Masrouhi<sup>1</sup> and Olivier Bellier<sup>2</sup>**

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## **Abstract**

The eastern part of the Atlas system, in the North African margin, exposes a Triassic salt (200-250 Ma). Salt structures in this area, which range in size from a few meters to a few hundred km<sup>2</sup>, are the subject of debate. Two models have been proposed: (i) a diapir or dome model, describing a scenario where the salt actively pierced the overburden and tectonically reduced the thickness of the overburden sequences in the limbs of the structure; and (ii) an allochthonous salt model which is based on a scenario where salt flows at the sediment-water interface or below a thin layer of marine sediments forming a sheet of allochthonous salt concordant with the underlying sediments.

In Mesozoic times, North Africa (south margin of Tethys Ocean) was an extensional margin showing salt movement. The context of the extensional tectonic regime related with the Cretaceous margin structural setting offers at least two factors allowing salt to extrude onto the sea floor and flow downslope toward deeper marine conditions: (i) tectonic extension, which weakened the overburden units by forming the main normal faults and creating the space for the rise of the salt. This tectonic regime was also responsible for a submarine slope, on which salt can flow and spread out, and (ii) differential sedimentation; this structural setting led to differential sedimentation that drove the salt. This scenario is similar to the sheets of allochthonous salt described in other salt provinces, such as the Gulf of Mexico, the Atlantic margin of Morocco, the Brazilian Atlantic margin, and the Angolan margin. These salt categories, which characterize some passive continental margins, can lend new insights for petroleum exploration in North Africa.

### **Selected References**

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Stovba, S., and R. Stephenson, 2003, Style and timing of salt tectonics in the dnier-donets basin (Ukraine) from seismic data, *in* Anonymous (ed.), *Geophysics of the 21<sup>st</sup> Century – The Leap into the Future*: Society of Exploration Geophysicists United States, European Association of Geoscientists and Engineers International, p. abstract 8843.

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# Allochthonous salt sheets associated with Cretaceous rifting in the North African margin, examples from North Tunisia and petroleum implication

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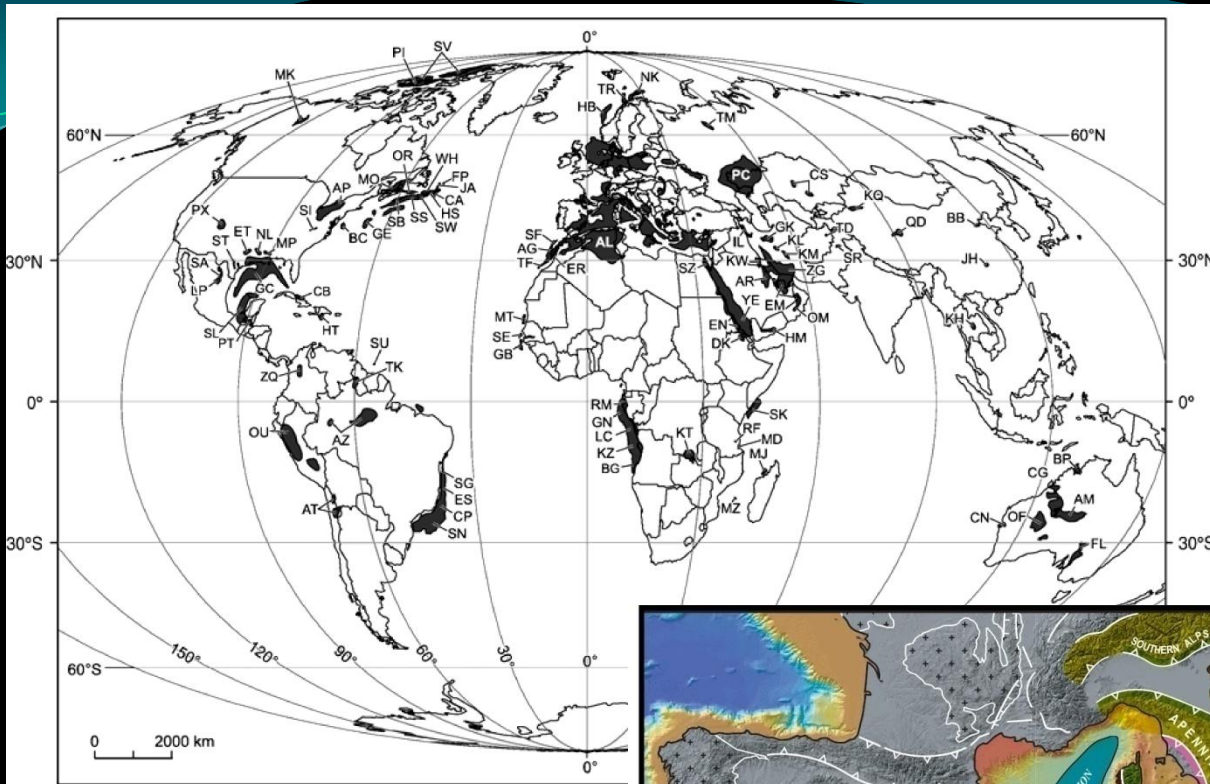
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<sup>b</sup> Aix-Marseille Université, CNRS, IRD, CEREGE, UM34, 13545 Aix-en-Provence Cedex 4, France



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# GEOLOGICAL SETTING



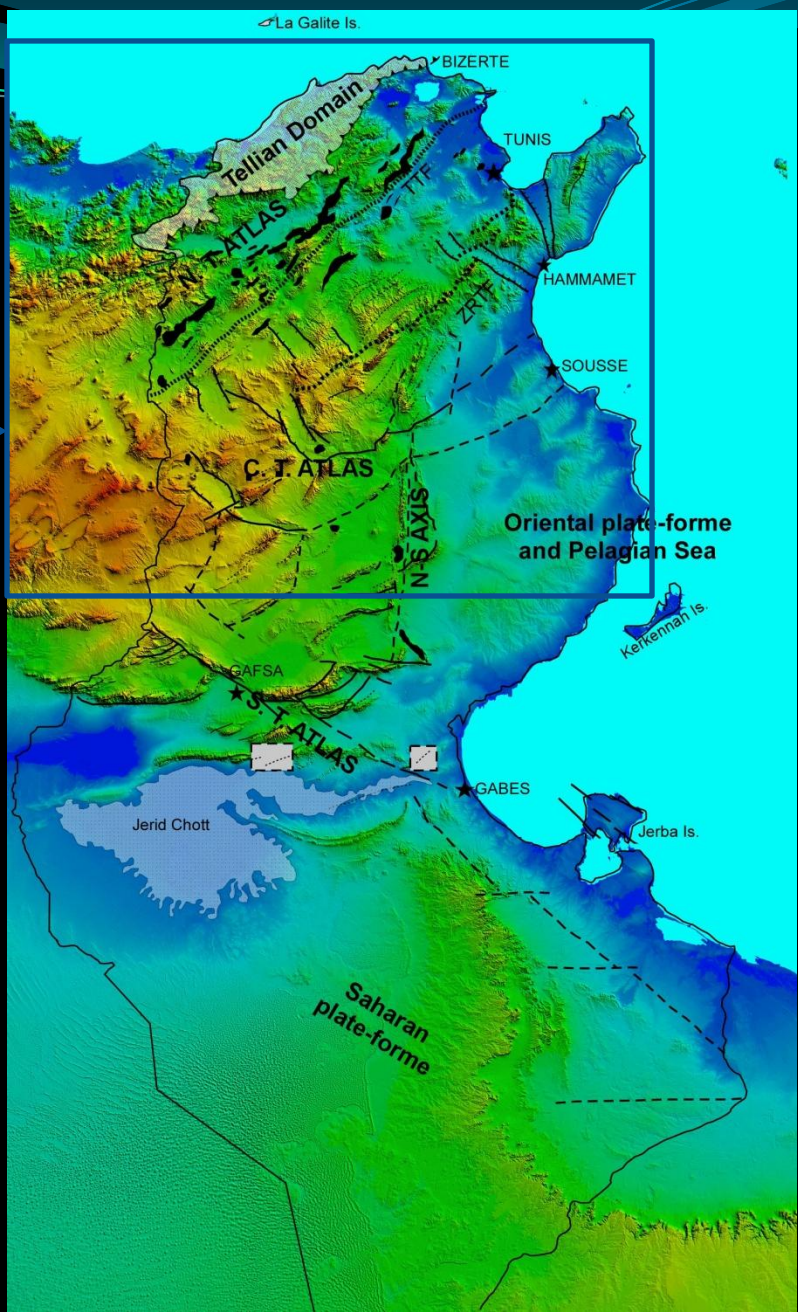
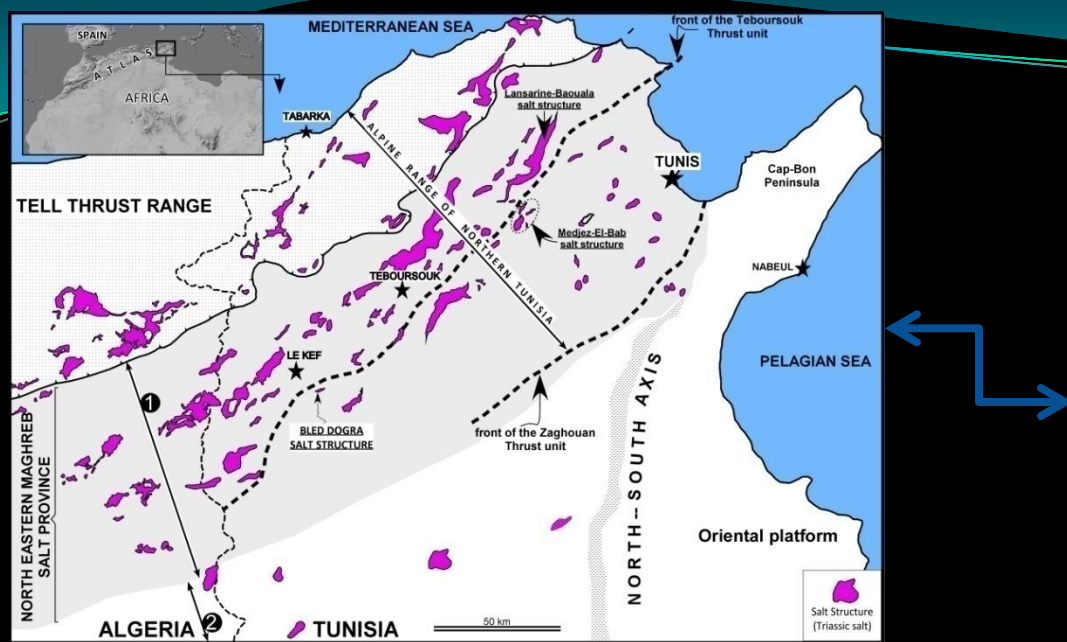
Equal-area Mollweide projections showing global distribution of basins containing salt (dark-gray areas) structures (after, Hudec & Jackson, 2007)

Generalized map of the Mediterranean alpine chains showing the location of the Maghrebides fold-and-thrust belts (after Roure et al., 2012)





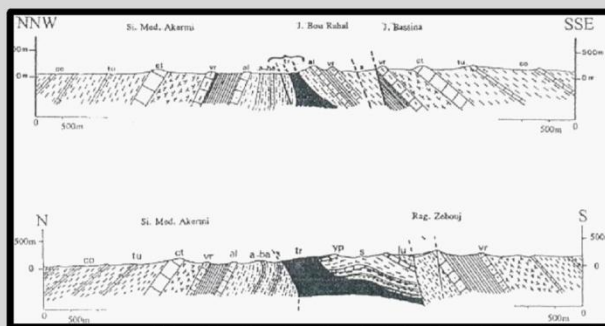
# GEOLOGICAL SETTING



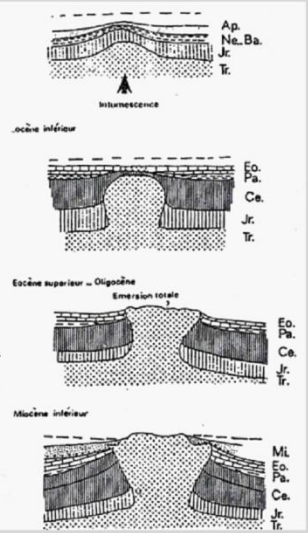
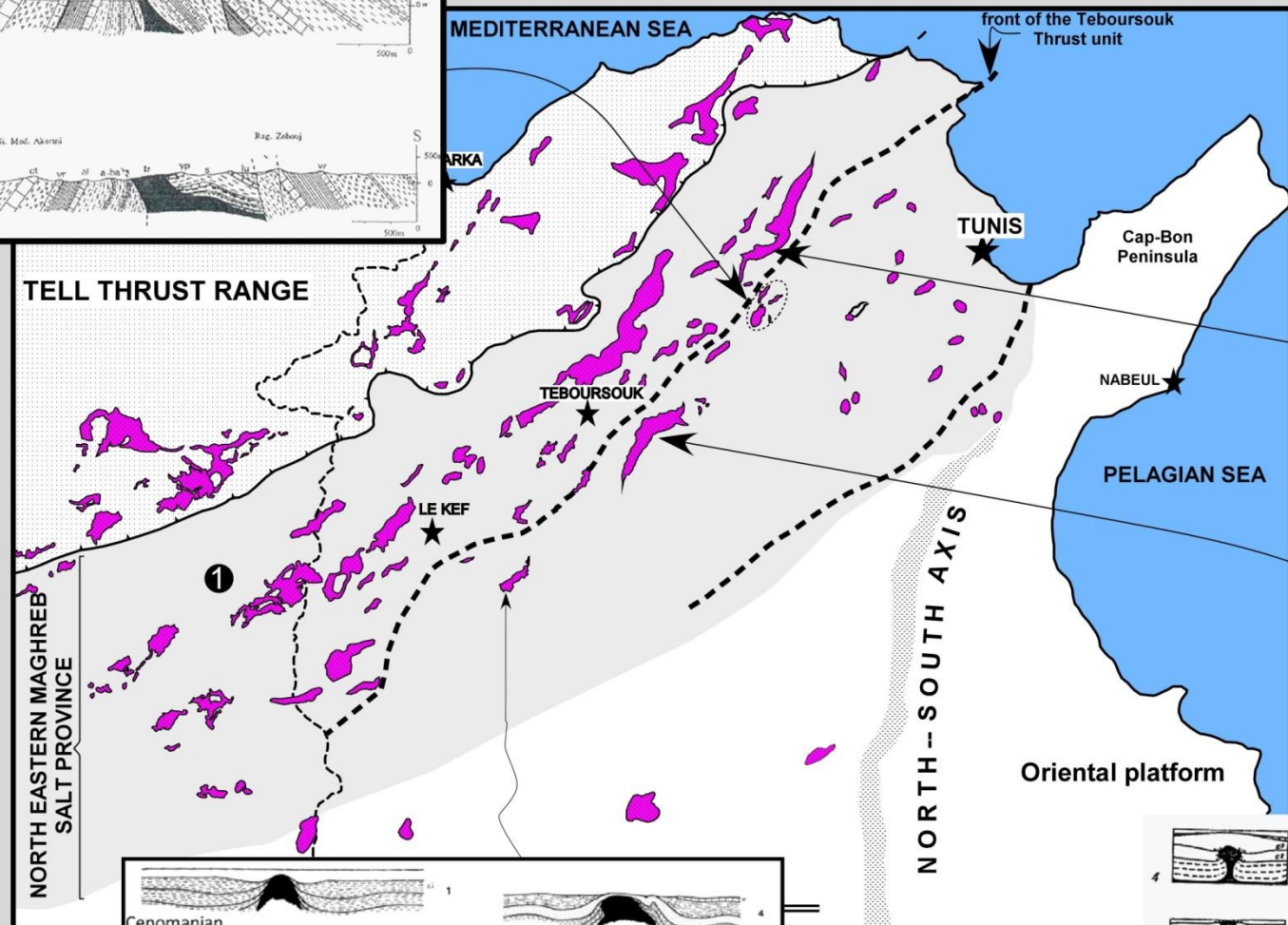
CHRONOSTRATIGRAPHY		LITHOSTRATIGRAPHY		TECTONIC EVENT	
Ma					
0.01	QUATERNARY	PLEISTOCENE	Red Beds / Caliche		
		VILLAFRANCHIAN			
5.5	NEOGENE	PLIOCENE	Porto Farina		Plio-Quaternary phase
		PIACENZIAN	Segui		
11		ZANCLIAN	Porto Farina		
		MESSINIAN	Segui		
		TORTONIAN	Segui		
		SERRAVALLIAN	Segui		
16.5		LANGHIAN	Segui		
		BURDIGALIAN	Segui		
24		AQUITANIAN	Segui		
		CHAT TIAN	Segui		
36		RUPELIAN	Segui		
		PRIABONIAN	Segui		
55		BARTONIAN	Segui		
		LUTETIAN	Segui		
		YPRESIAN	Segui		
		THANETIAN	Segui		
66		DANIAN	Segui		
		MAASTRICHTIAN	Segui		
		CAMPANIAN	Segui		
80		SANTONIAN	Segui		
		CONIACIAN	Segui		
97.5		TURONIAN	Segui		
		CENOMANIAN	Segui		
124		ALBIAN	Segui		
		APTIAN	Segui		
140		BARREMIAN	Segui		
		HAUTERIVIAN	Segui		
		VALANGINIAN	Segui		
		BERRIASIAN	Segui		
160		TITHONIAN	Segui		
		KIMMERIDGIAN	Segui		
		OXFORDIAN	Segui		
		CALLOVIAN	Segui		
		BATHONIAN	Segui		
		BAJOCIAN	Segui		
		ALENIAN	Segui		
183		TOARCICAN	Segui		
		PIENSBACHIAN	Segui		



Previous interpretations: Examples Previous workers were mainly interpreted the salt structures as atectonic diapirs

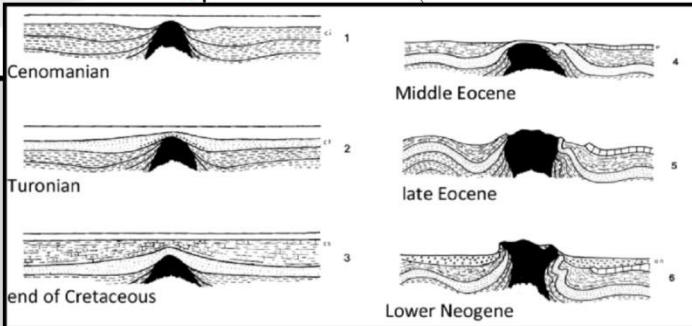


**Medjez-El-Bab Structure**  
El Ouardi, 1996

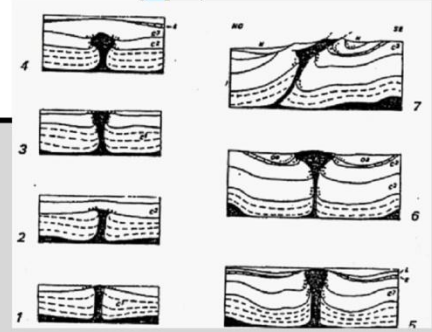


**Lansarine structure**  
Zargouni, 1975

**Lorbeus Structure**  
Perthuisot, 1978

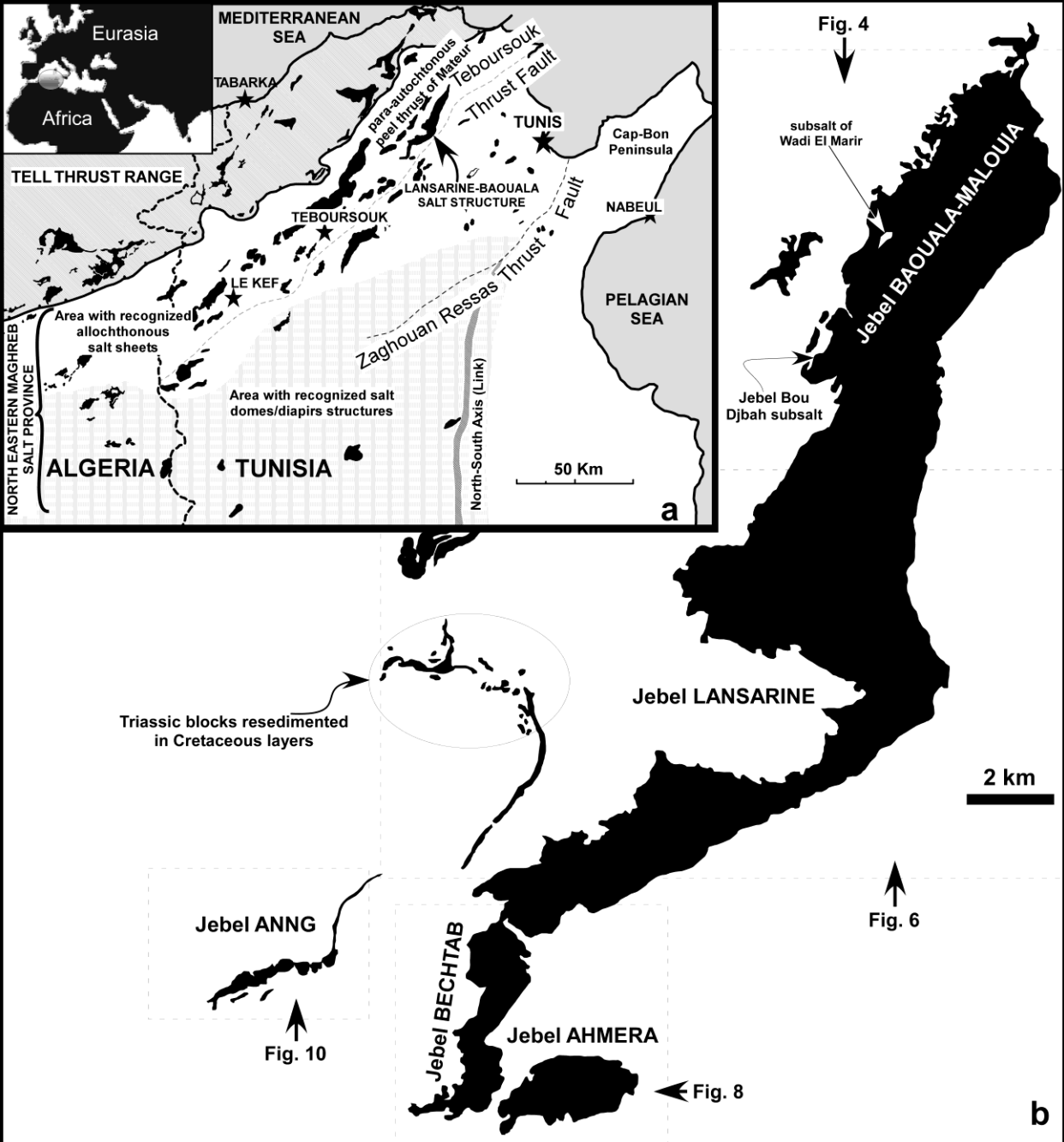


**Jebel Cheid Structure**  
Perthuisot, 1978



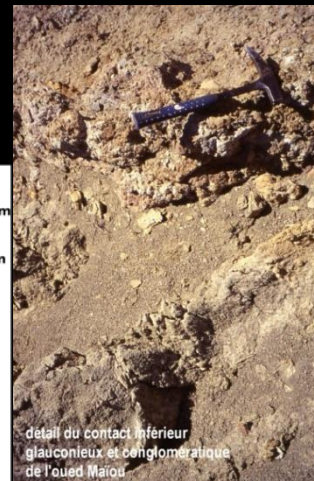
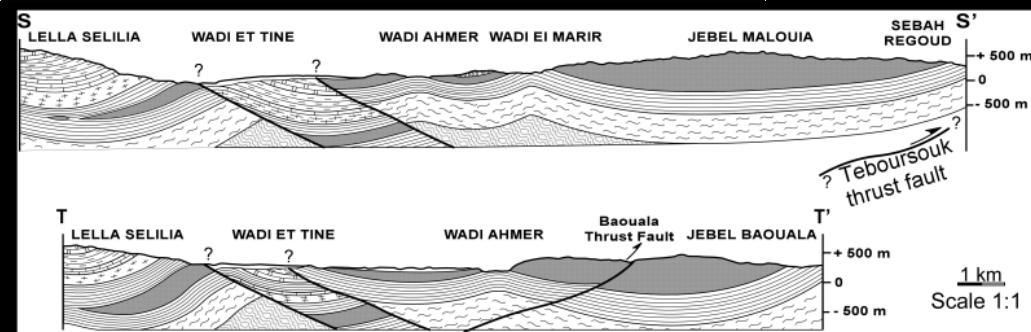
# Lansarine-Baouala salt structure (LBSS)

General location.(a) Location of the Atlas system in the Mediterranean zone; map of outcrop salt structures in northern Tunisia and northeastern Algeria: northeastern Maghreb Salt Province; (b) general structural trend map of salt outcrop distribution of the Lansarine–Baouala salt structure



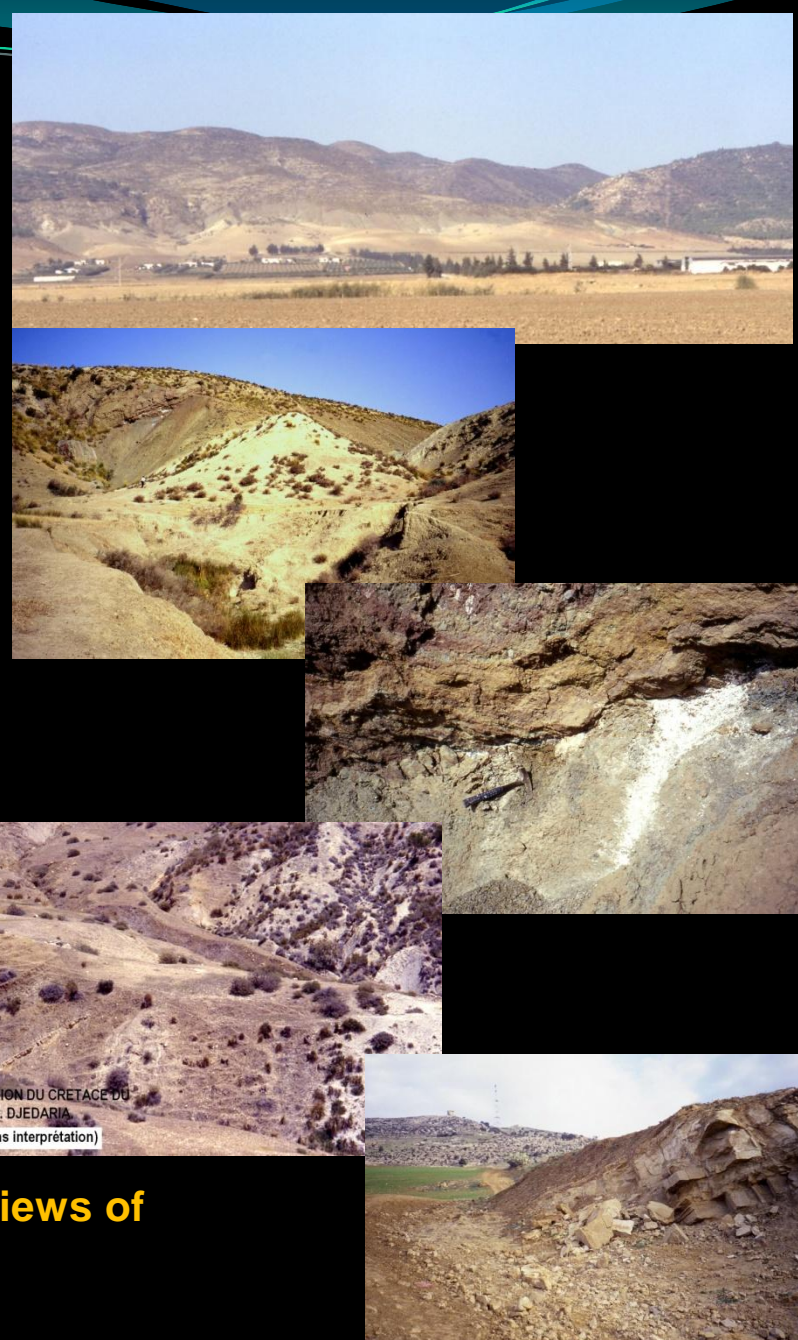
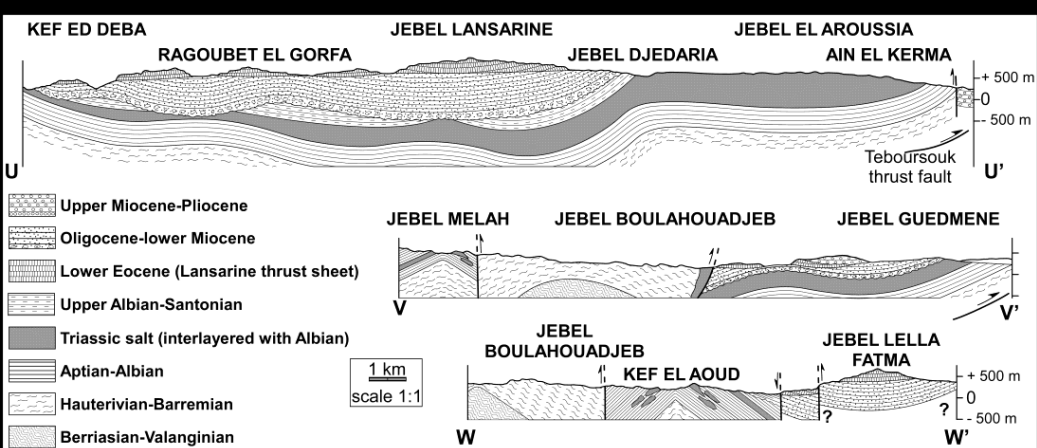
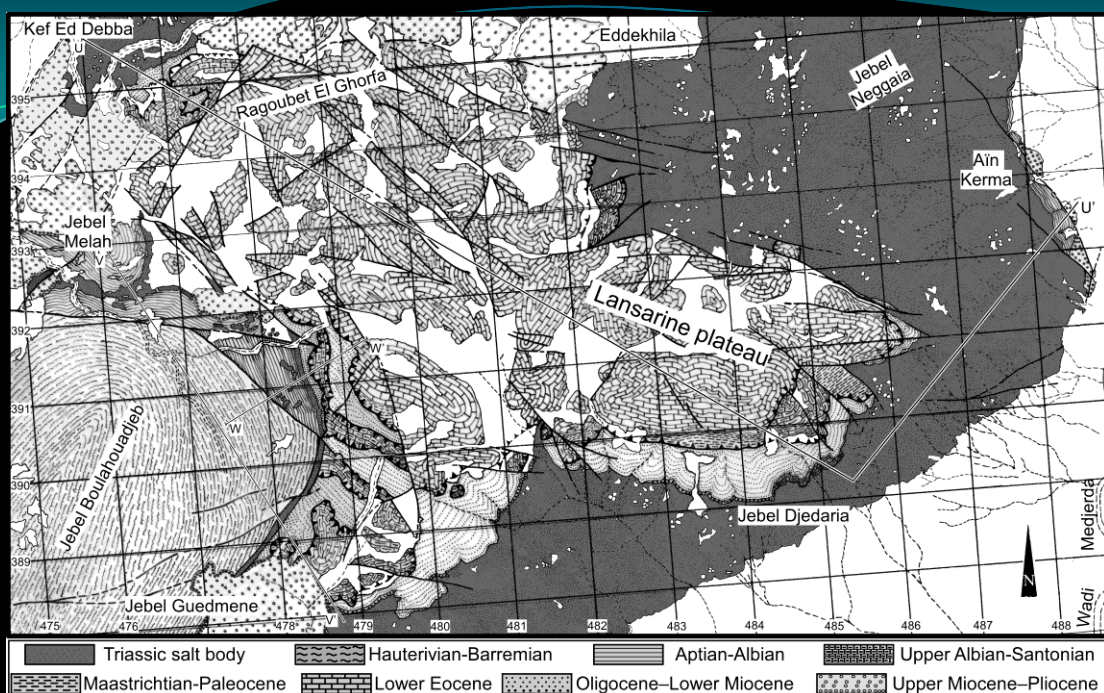


## Geological map, cross-sections and field Panoramic views of the central portion of the LBSS





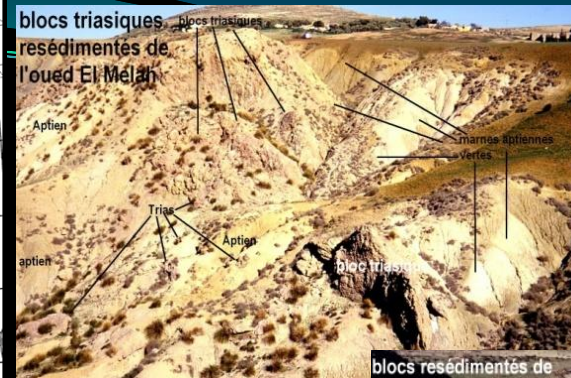
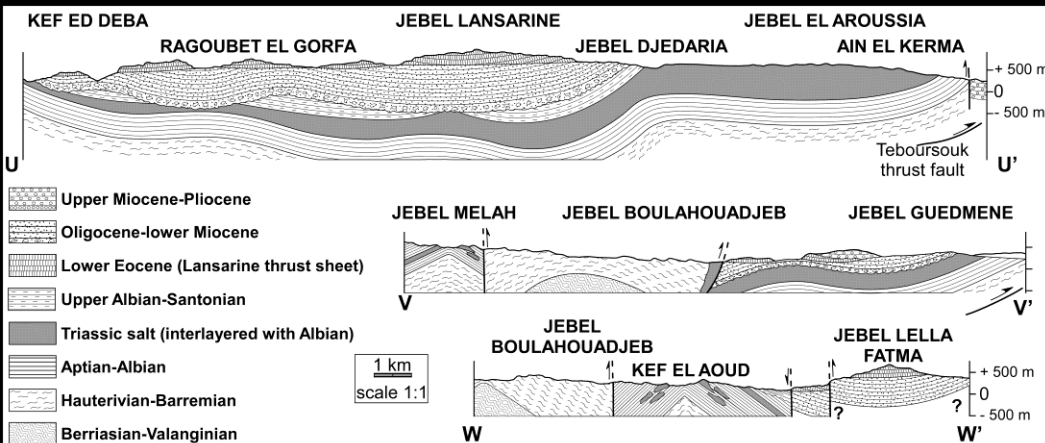
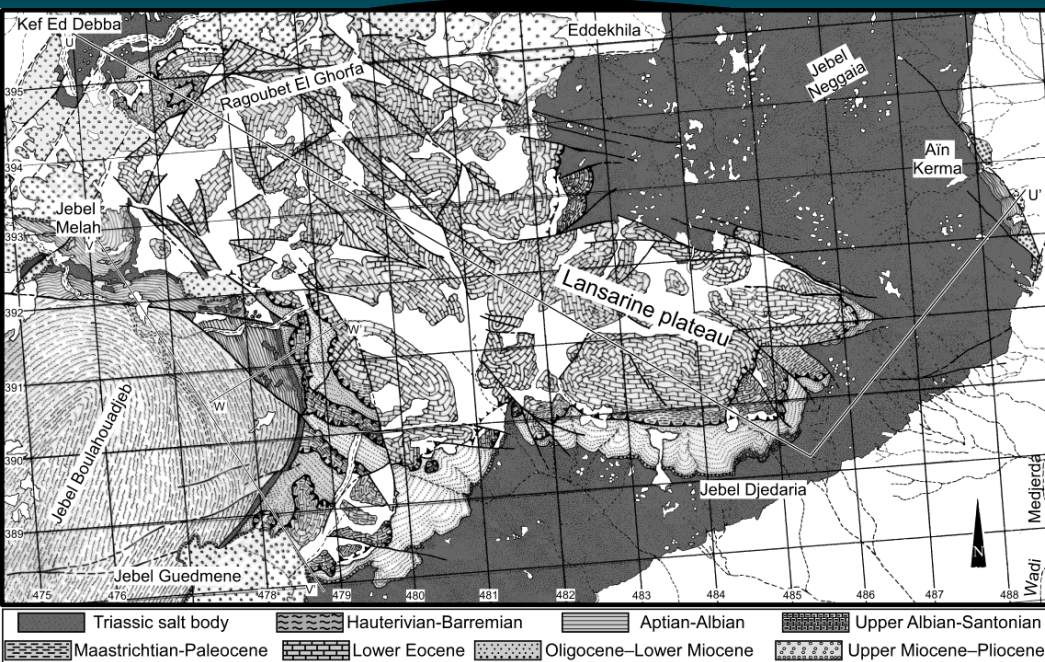
# Central portion of the LBSS



Geological map, cross-sections and field Panoramic views of the central portion of the LBSS



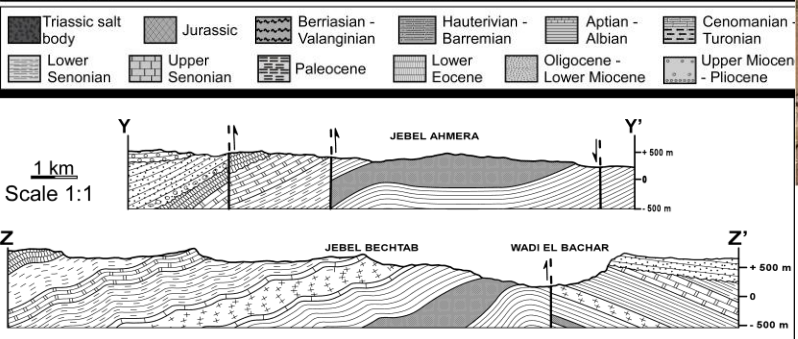
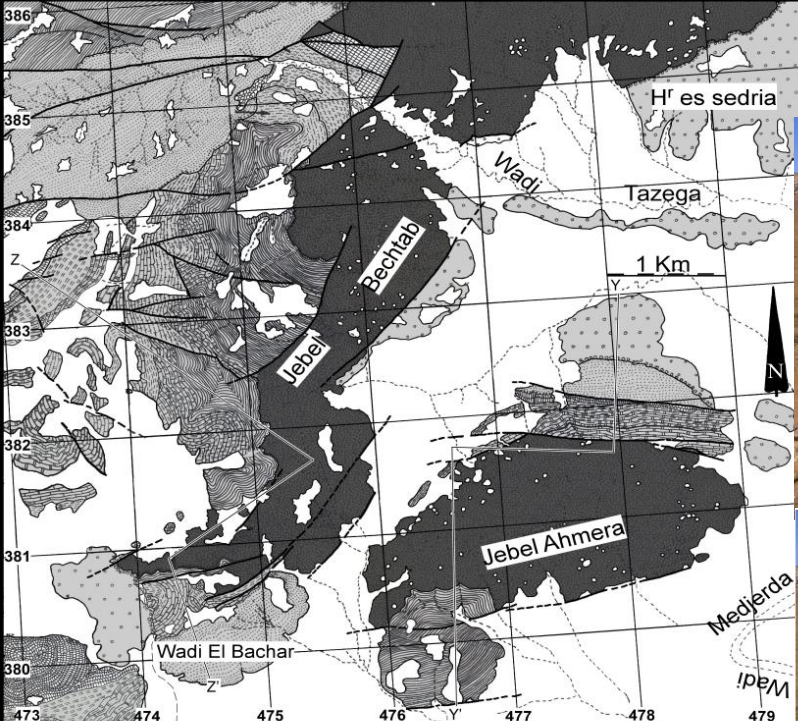
# Western portion of the LBSS



**Geological map, cross-sections and field  
Panoramic views of the Western portion of the  
LBSS**



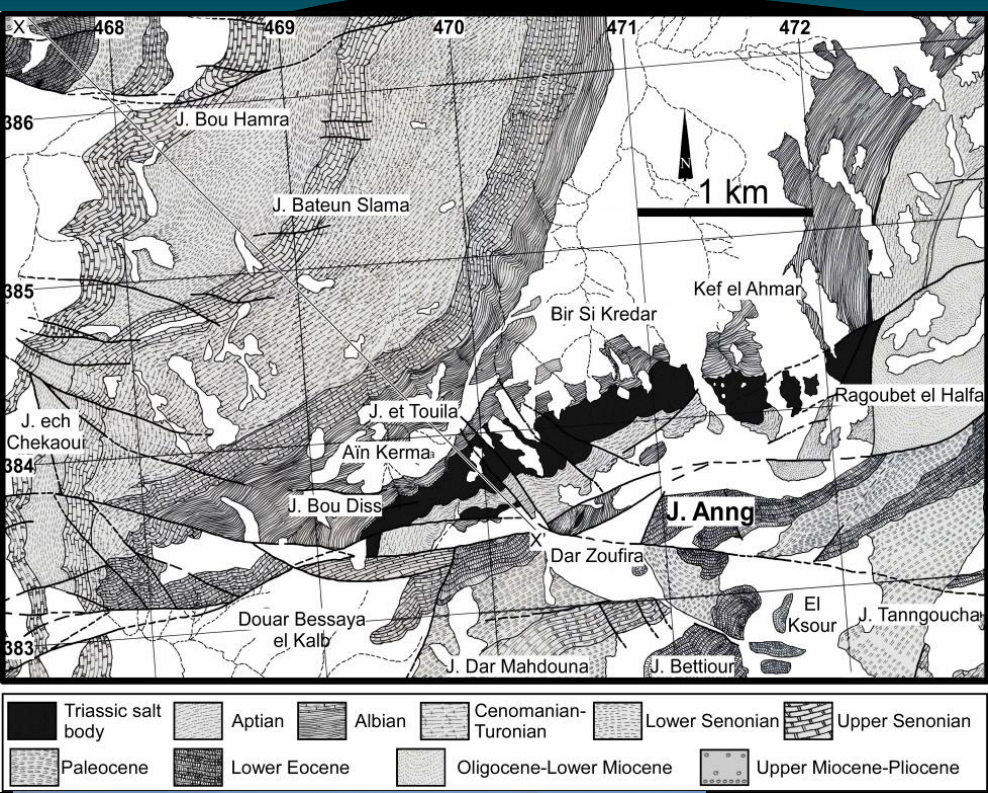
# South portion of the LBSS



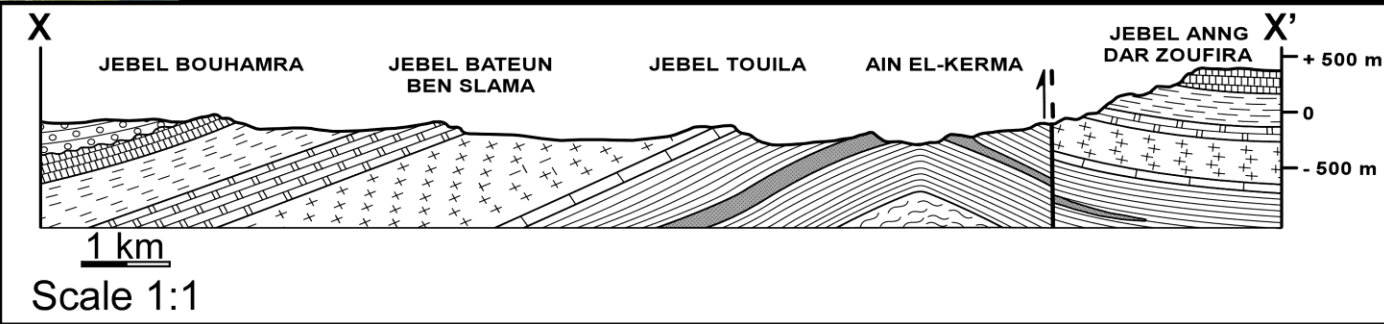
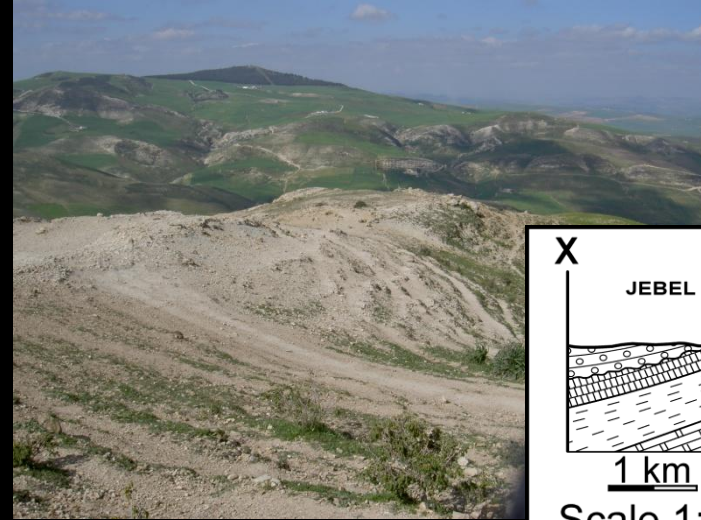
**Geological map, cross-sections and field Panoramic view of the Southern portion of the LBSS**



# Southwestern portion of the LBSS

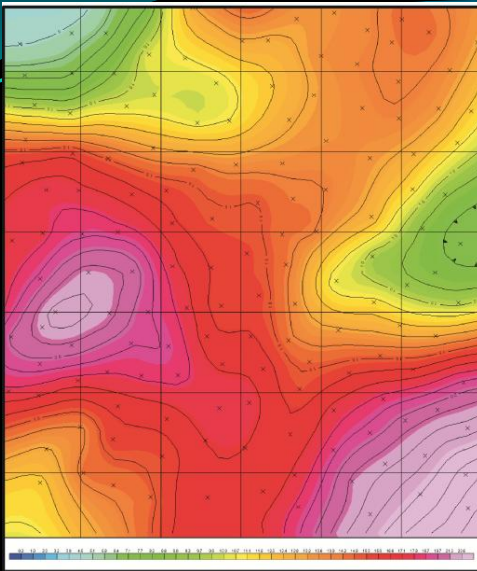


Geological map, cross-section and field  
Panoramic view of the Jebel Anng

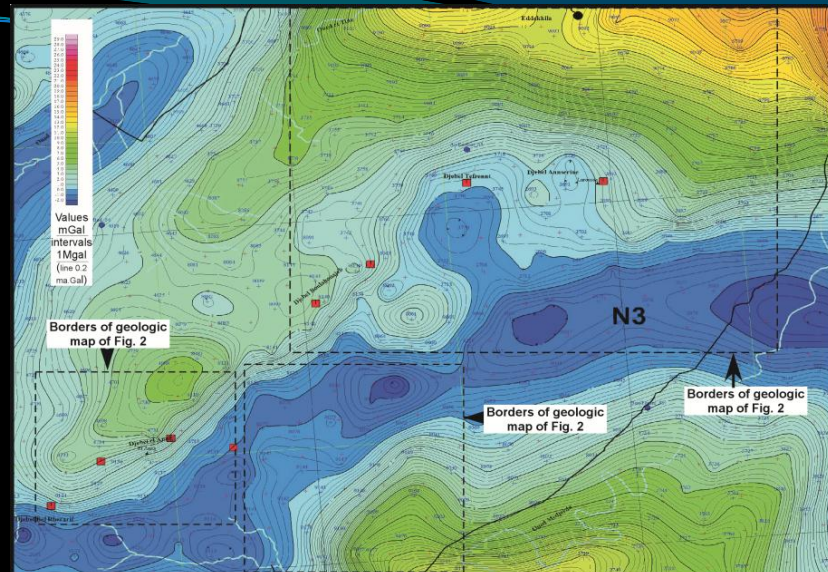




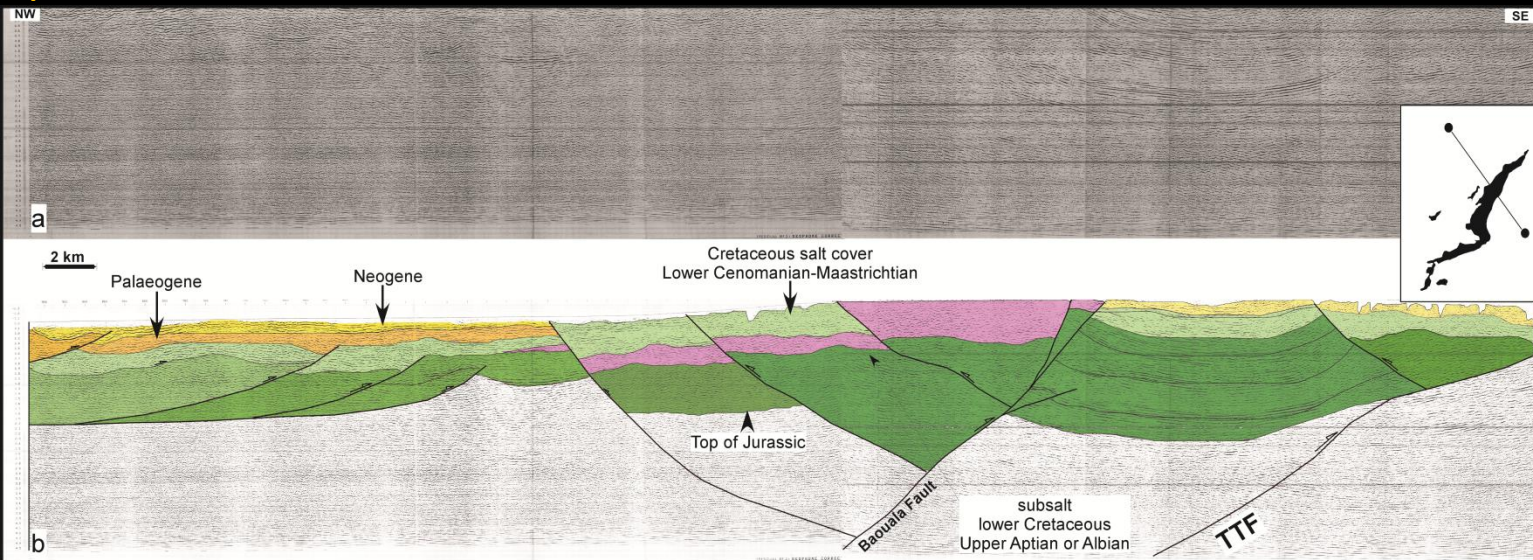
# Geophysical data



**Bouguer gravity map of the northern portion of the LBSS**



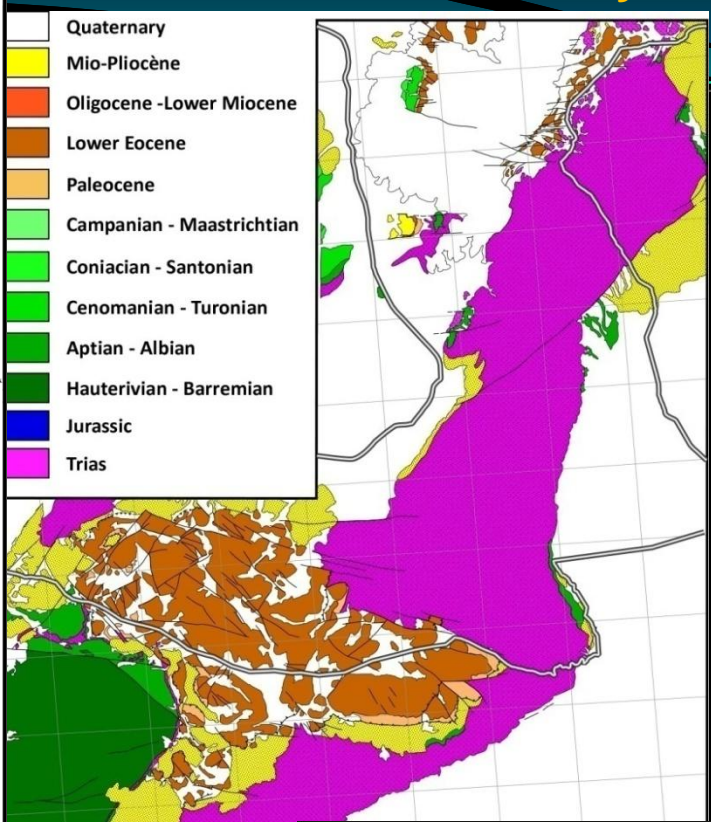
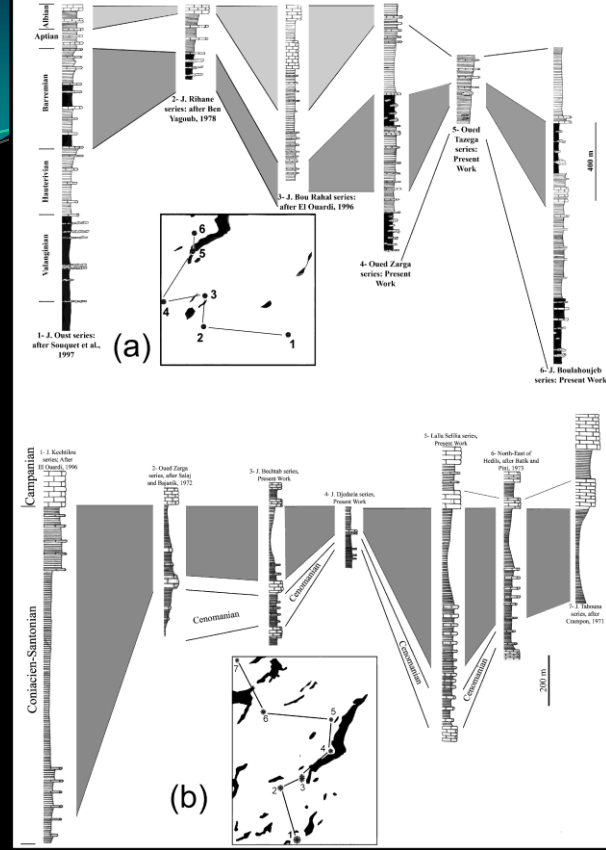
**Bouguer gravity map of southern portion of the LBSS**



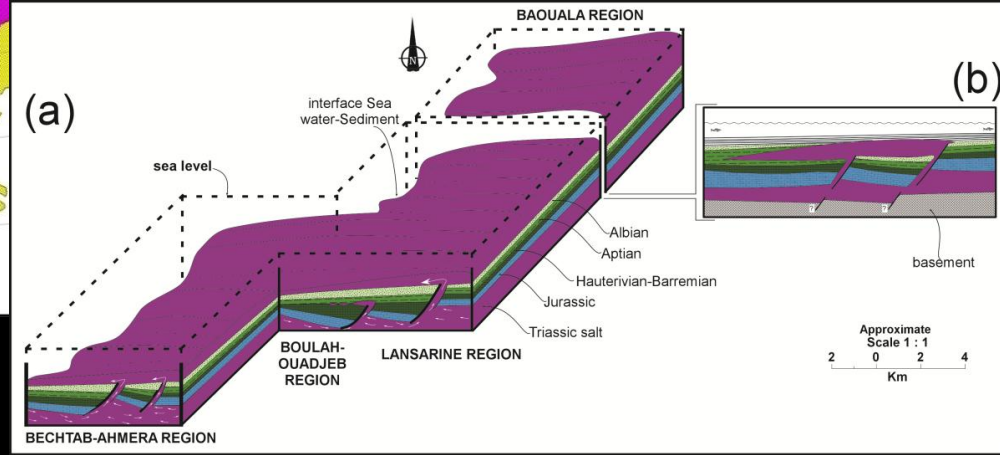
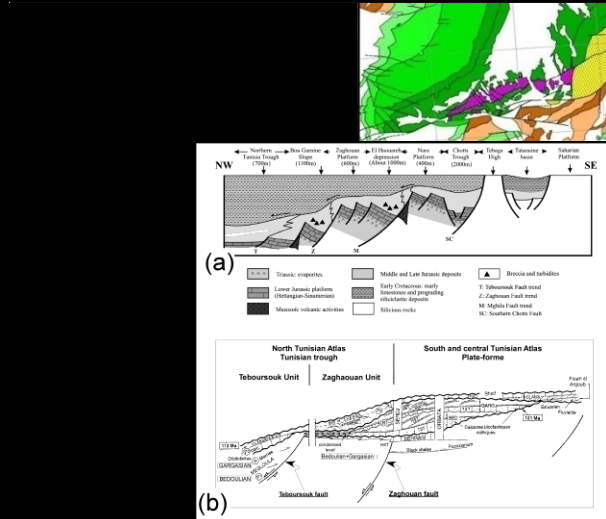
**NW-SE seismic-reflection line from Mateur to Tébourba town, crosses the LBSS in its northern portion. (a) Non-interpreted copy; (b) interpreted copy, slightly modified from Rigo *et al.* (1996). TTF – Teboursouk Thrust Fault.**



# Model, Cretaceous correlations & tectono-sedimentary framework

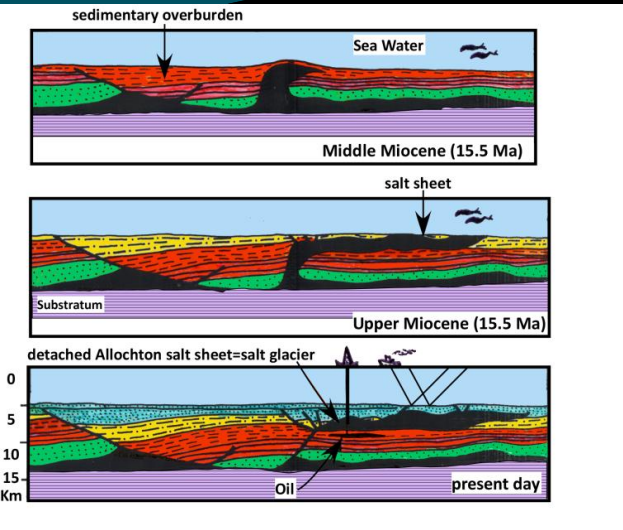


- Normal faulting
- Differential loading
- Northward submarine slope

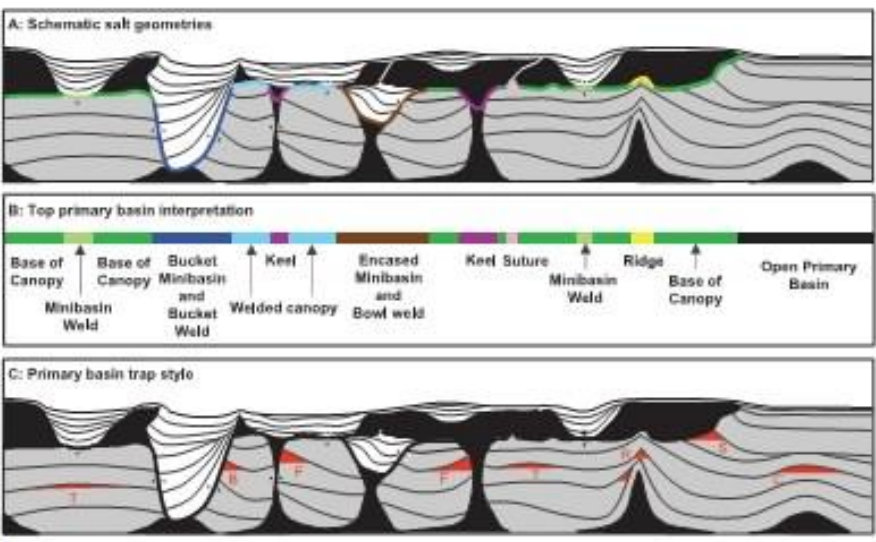




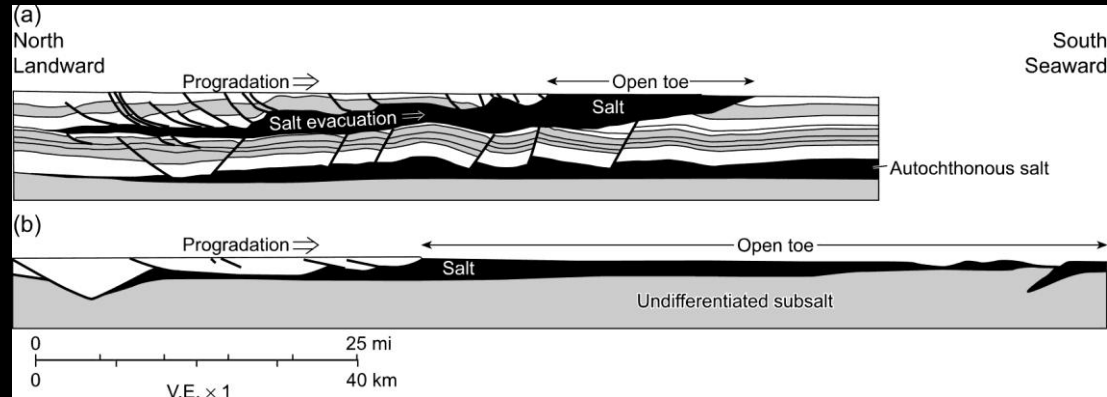
# Gulf of Mexico, present-day examples



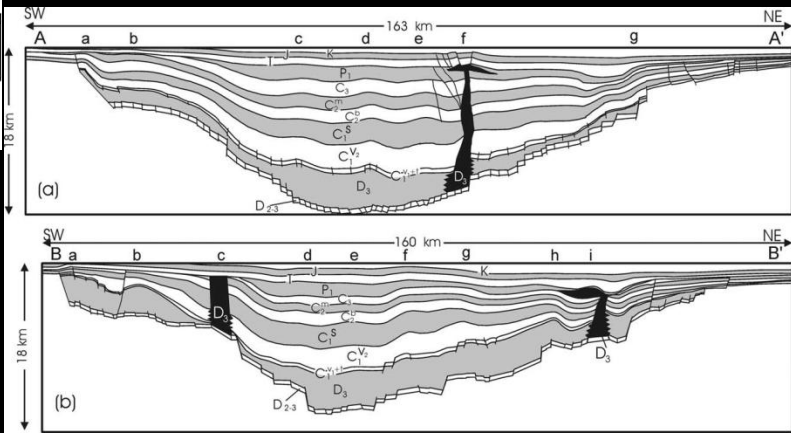
Wu et al., 1990



Pilsher et al., 2001

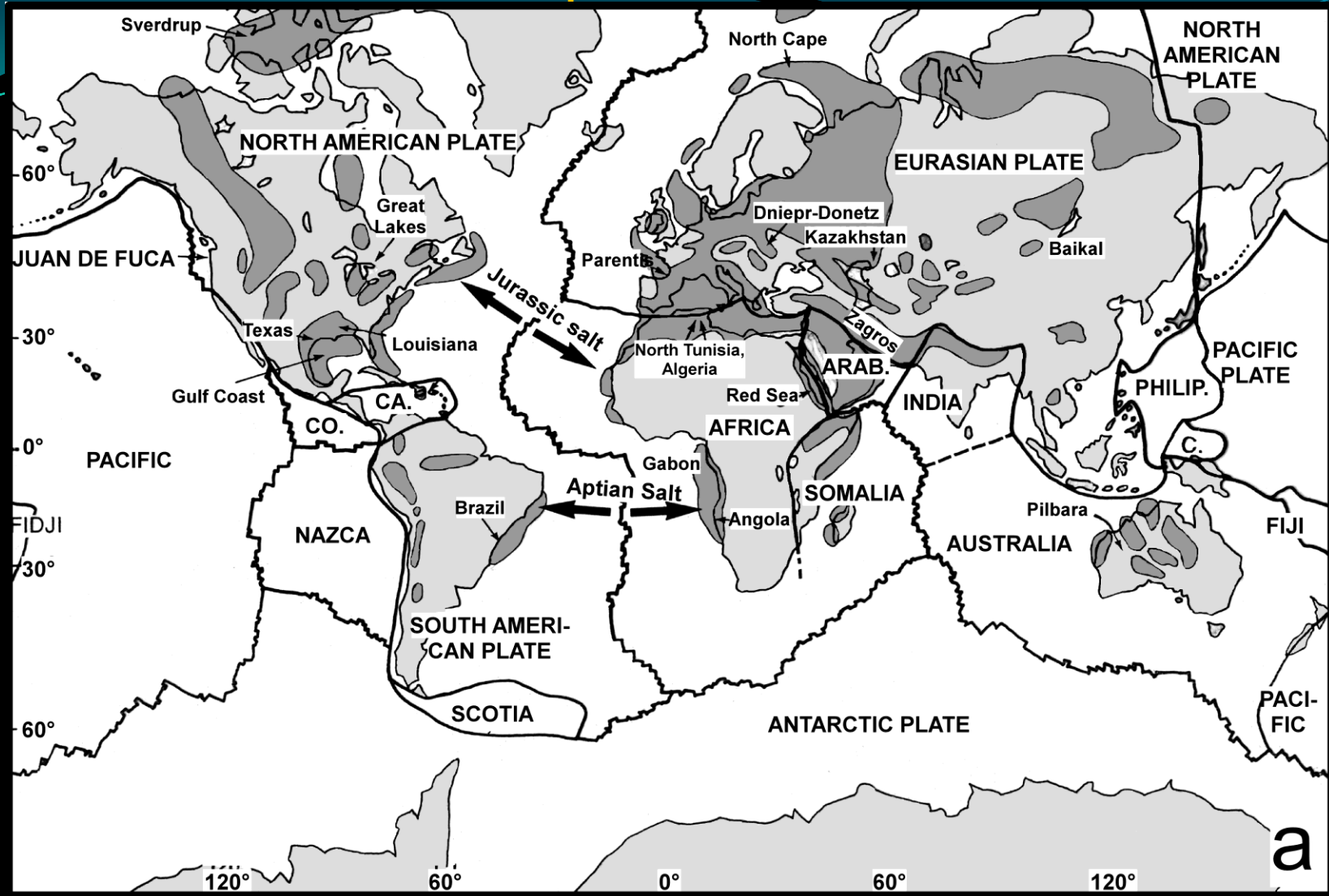


Hudec & Jackson, 2006



Stovba & Stephenson, 2003

# Salt sheet described in others salt provinces



Worldwide salt sheets with superimposed tectonic plates, collected from the works of Jackson, Vendeville & Schultz-Ela, 1994; Diegel *et al.* 1995; Fletcher, Hudec & Watson, 1995; Jackson, 1995; McBride, Rowan & Weimer, 1998; Barde *et al.* 2002; Vila *et al.* 2002; Rowan *et al.* 2003; Maillard *et al.* 2003; Canérot, Hudec & Rockenbauch, 2005; Hudec & Jackson, 2006; Gaullier & Vendeville, 2005; Jackson & Harrison, 2006; Hudec & Jackson, 2007; Mohr *et al.* 2007; Hudec & Jackson, 2009; Talbot & Pohjola, 2009; Davison *et al.* 2000; Brun and Fort, 2012; Fort and Brun, 2012, among others.





Thank you for your attention