Structural Architecture and Evolution of the Southern Atlas Fold and Thrust Belt of Tunisia as Revealed by Field Data, Seismic Reflection Profiles and Cross-Section Balancing*

Mohamed Gharbi[1,2,3], Nicolas Espurt[1], Olivier Bellier[1], and Amara Masrouhi[2]

Search and Discovery Article #50840 (2013)**
Posted August 19, 2013

*Adapted from oral presentation given at AAPG European Regional Conference & Exhibition, Barcelona, Spain, April 8-10, 2013

[1]CEREGE UM 34, Aix-Marseille Université, CNRS, 13545 Aix en Provence, France (gharbi@cerege.fr)
[2]University of Gabes, Department of Earth Sciences, Faculty of Sciences of Gabes, Tunisia
[3]University of Sfax, Faculty of Sciences, Tunisia

Abstract

The structural architecture of the southern Atlas fold-and-thrust belt of Tunisia was investigated using new detailed geologic mapping and cross section balancing, complemented by exploration wells and seismic reflection data. The construction of a regional balanced cross section and seismic reflection data show that the thrust system is characterized by a mixed thick- and thin-skinned tectonic style. The thin-skinned thrusts propagated above the Triassic evaporitic series. The thick-skinned thrusts superimposed on pre-existing structures inherited from the southern Tethyan margin. Field and seismic reflection data show that these inherited structures correspond to E- to NNW-trending normal faults active during the Triassic-Jurassic and Aptian-Albian rift periods. This normal faulting is associated with complex horst and graben systems. During the Cenozoic compression, these faults have been inverted and favored the development E-trending thrust systems such as the Chemsi and Orbata thrusts and NW-trending lateral ramps. Structural inversion started during the late Campanian-Paleocene period and can be correlated with the onset of the convergence between Africa and Eurasia. A second event of shortening occurred in the Serravalian Tortonian and is still active.

References Cited

Ahmadi, R., J. Ouali, E. Mercier, J.L. Mansy, B. Van Vliet Lanoe, P. Launeau, F. Rhekhiss, and S. Rafini, 2006, The geomorphologic imprints of hinge migration in the fault-related folds: A case study in southern Tunisian Atlas: Journal of Structural Geology, v. 28, p. 721-728.

Said, A., D. Chardon, P. Baby, and J. Ouali, 2011, Active oblique ramp faulting in the southern Tunisian Atlas: Tectonophysics, v. 499/1-4, p. 178-189.

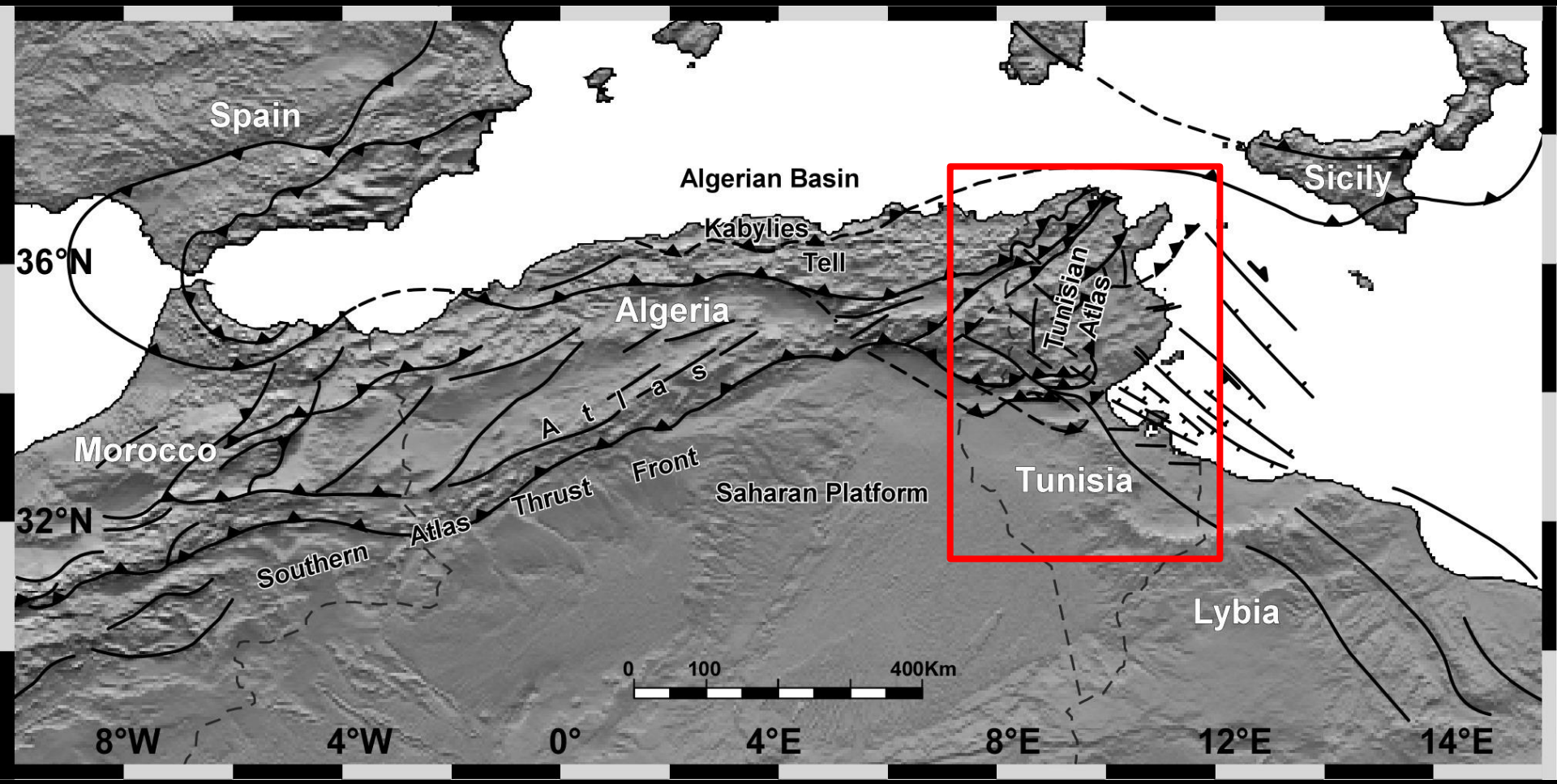
Structural architecture and evolution of the southern Atlas fold and thrust belt of Tunisia as revealed by field data, seismic reflection profiles and cross-section balancing

Mohamed GHARBI [1,2,3], Nicolas ESPURT[1], Olivier BELLIER[1], Amara MASROUHI[2]

gharbi@cerege.fr

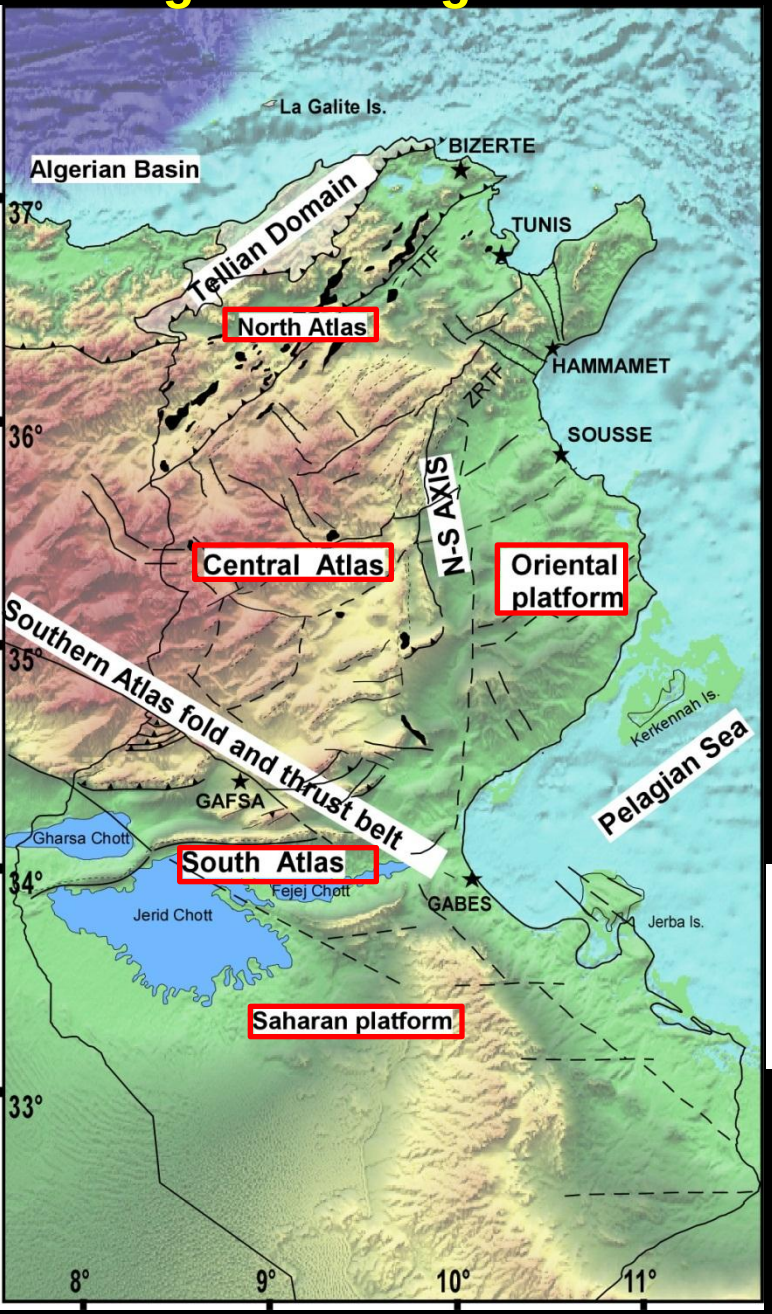
1-CEREGE UM 34, Aix-Marseille Université, CNRS, 13545 Aix en Provence, France.
2-University of Gabes, Department of Earth Sciences, Faculty of Sciences of Gabes, Tunisia.
3-University of Sfax, Faculty of Sciences, Tunisia.

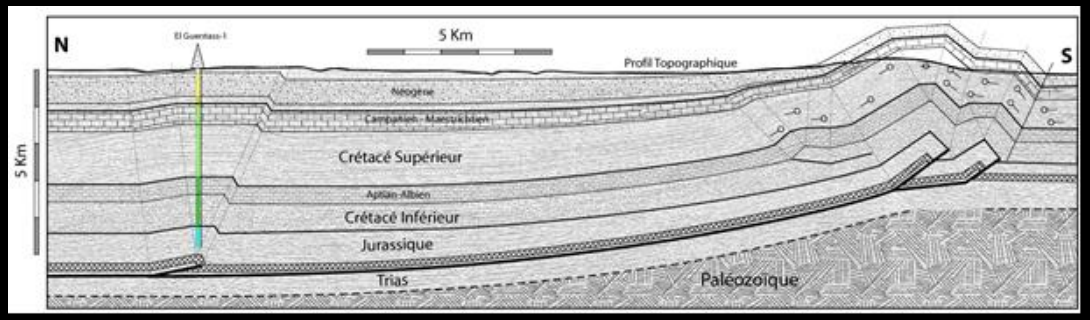
Introduction



Tectonic map of the Atlas belt

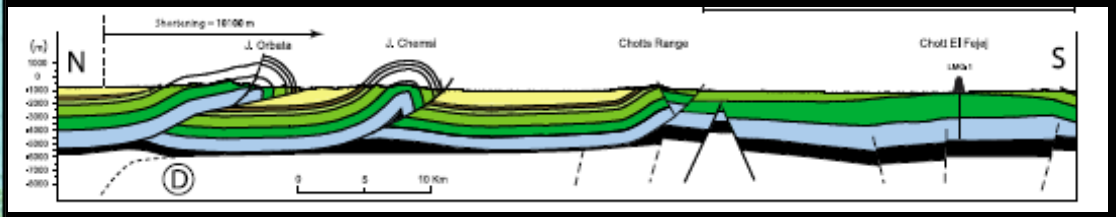
Geological settings





Ahmadi, 2006

Thin-skinned tectonic style

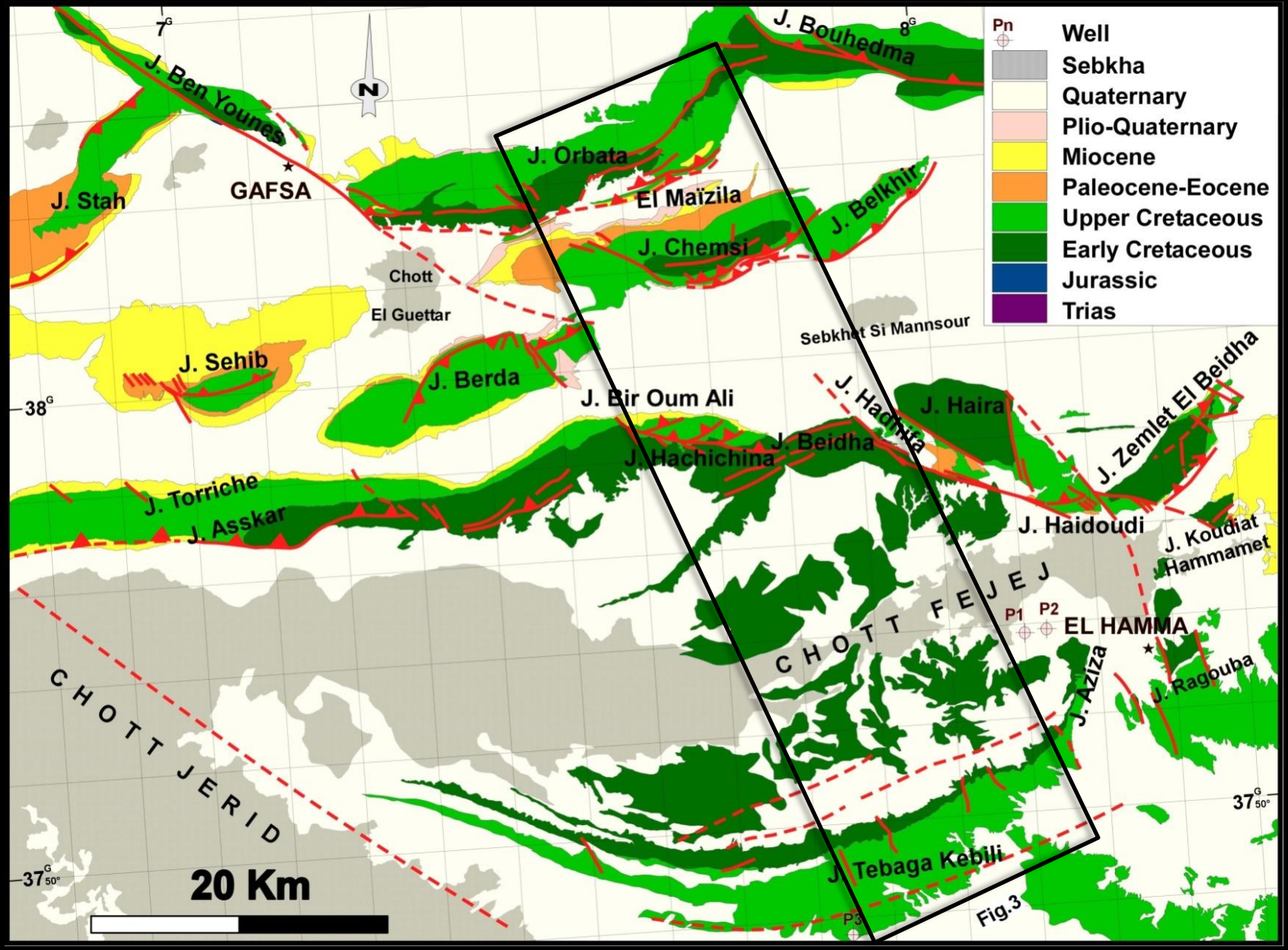


Said et al., 2011

Mixed tectonic style

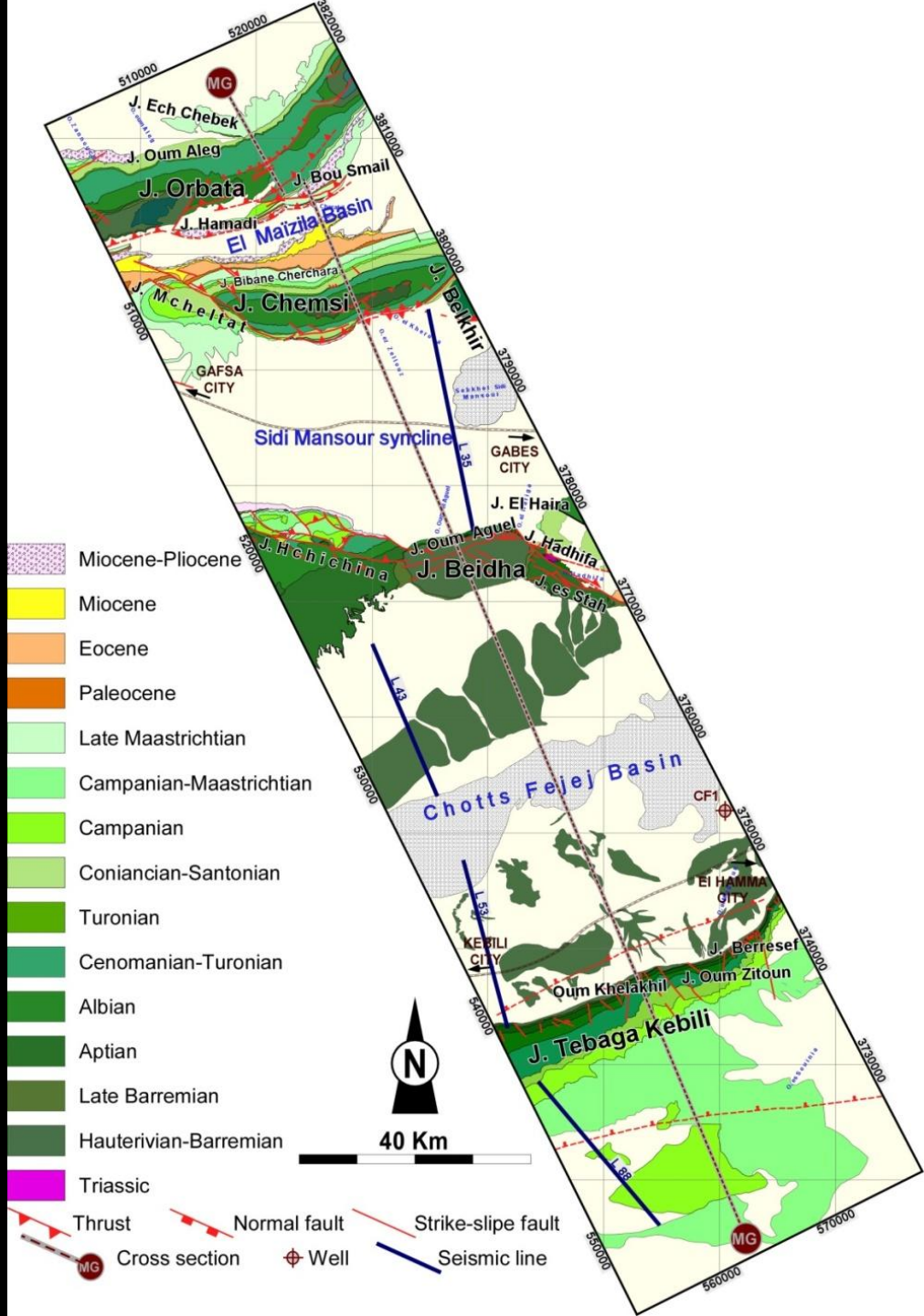
Simple sketch of the main structural domains of Tunisia

Geological settings



Geological map of south Atlas fold and thrust belt of Tunisia

Stratigraphy and décollement levels



Stratigraphy and décollement levels

Alpine Event

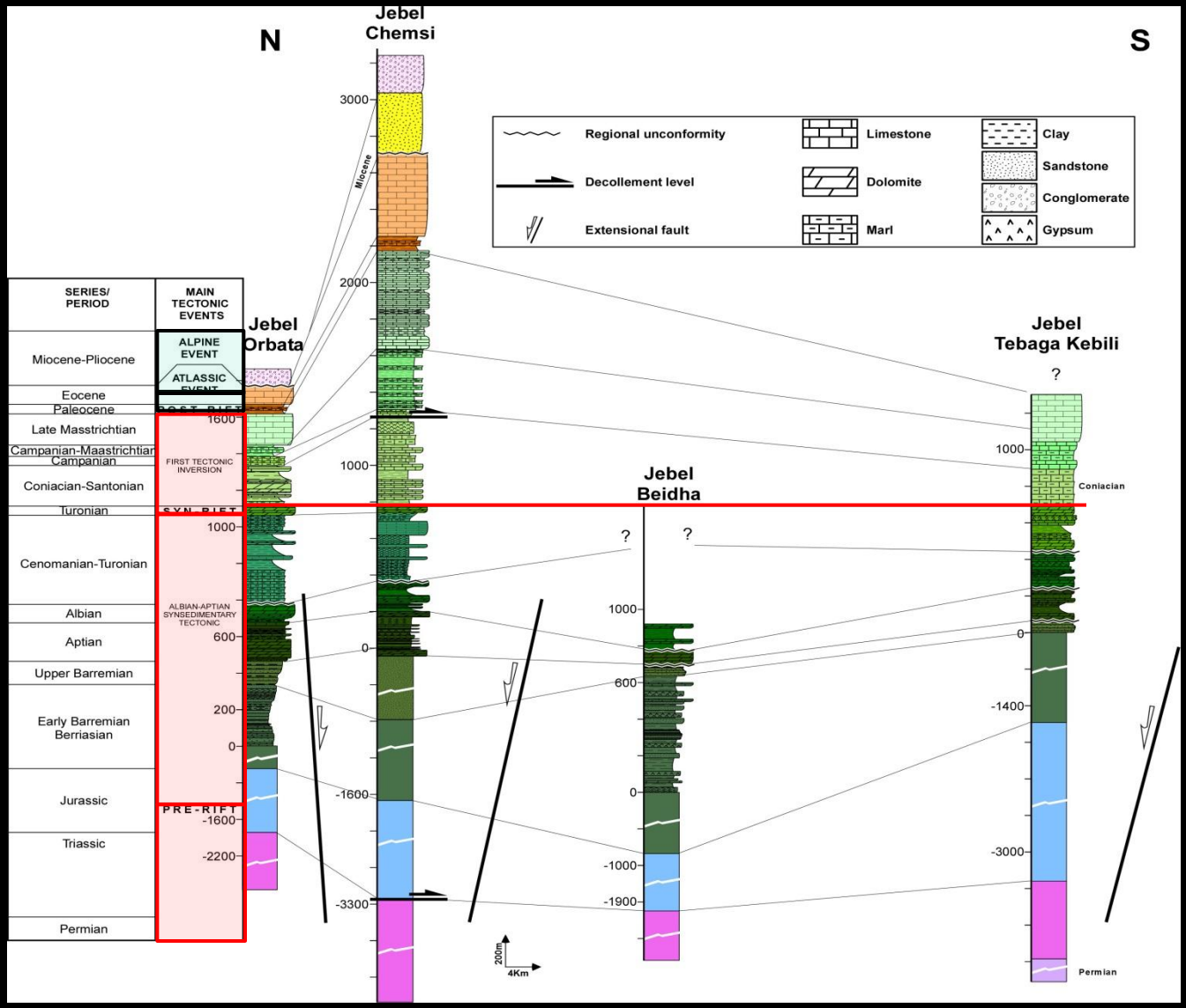
Atlassic Event

Post-Rift

The bottom of the Coniacian-Santonian deposits

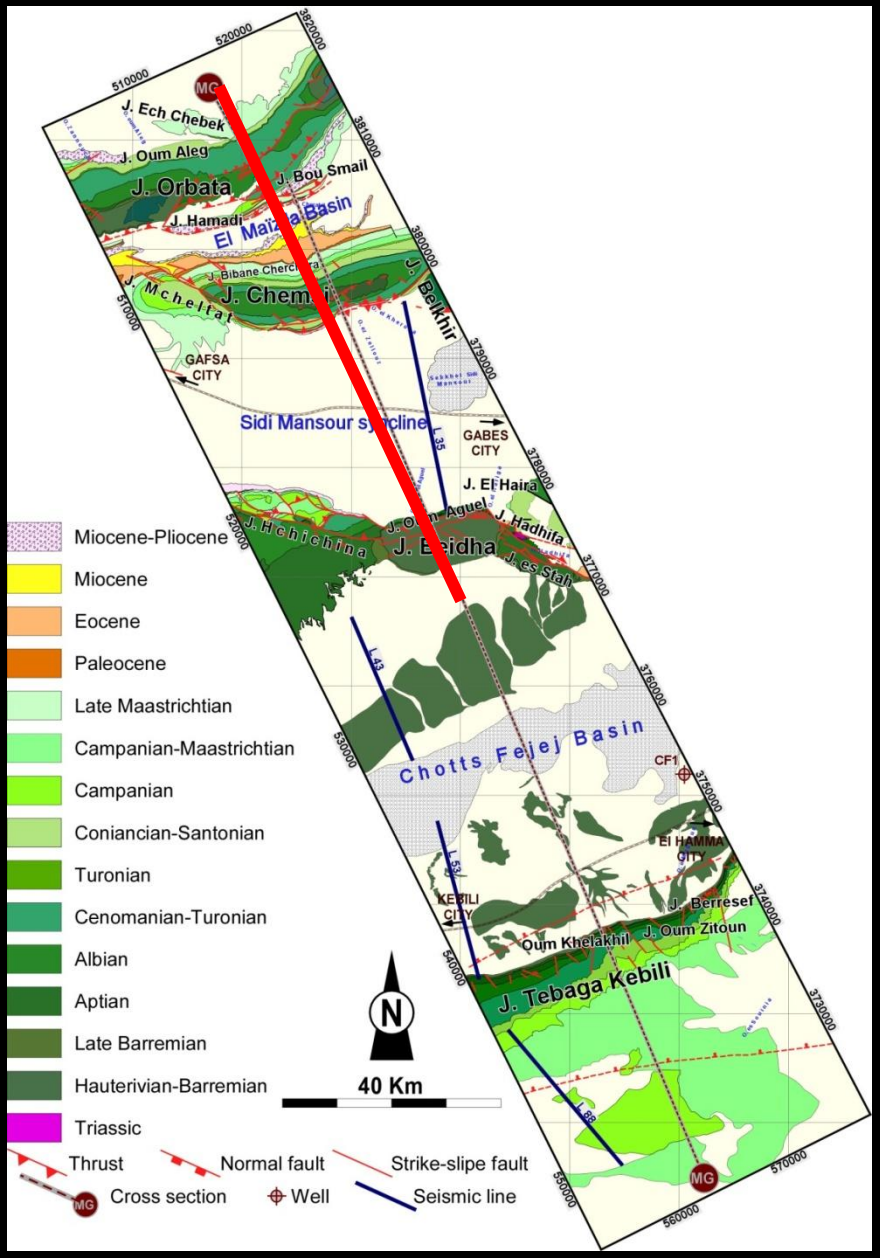
Syn-rift

Pre-Rift



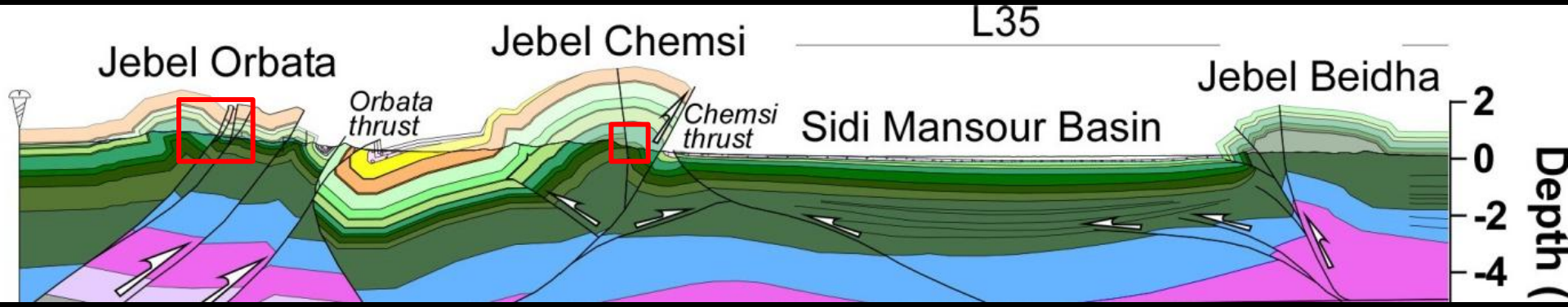
Stratigraphic and lithotectonic sedimentary sections across the Jebel Orbata, Chemsi, Beidha and Tebaga Kebili

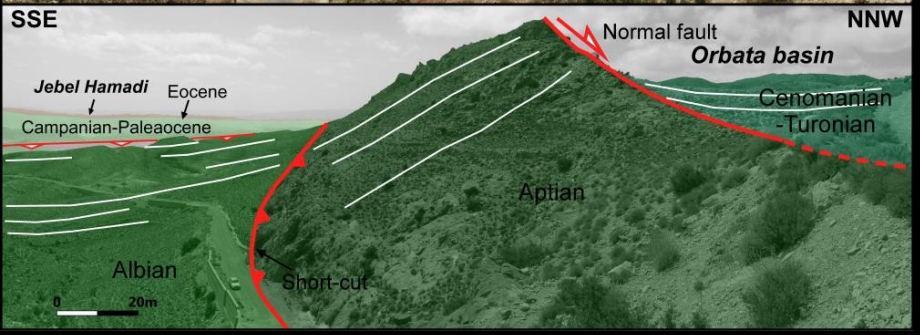
Rift structures as revealed by surface and subsurface data

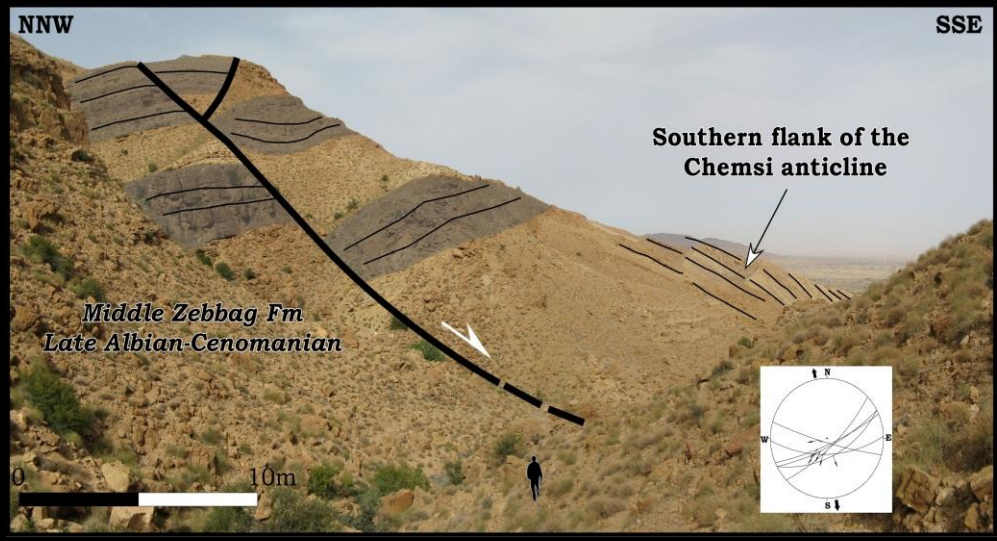


Detailed geological map

Rift structures as revealed by surface and subsurface data

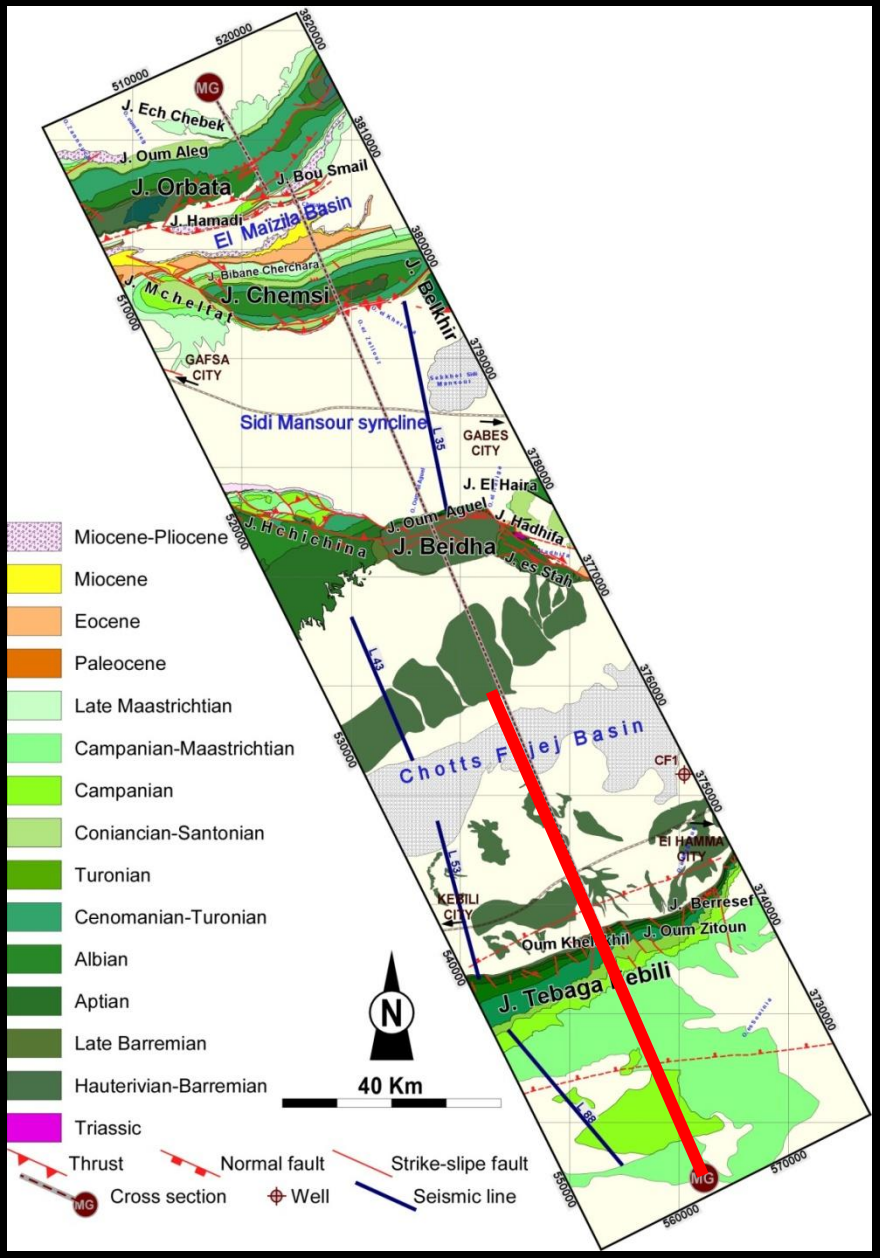




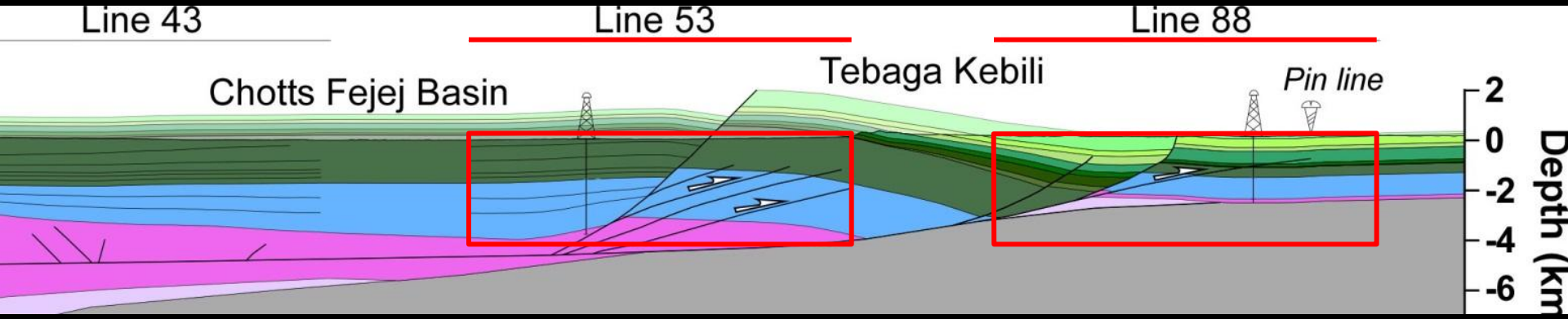


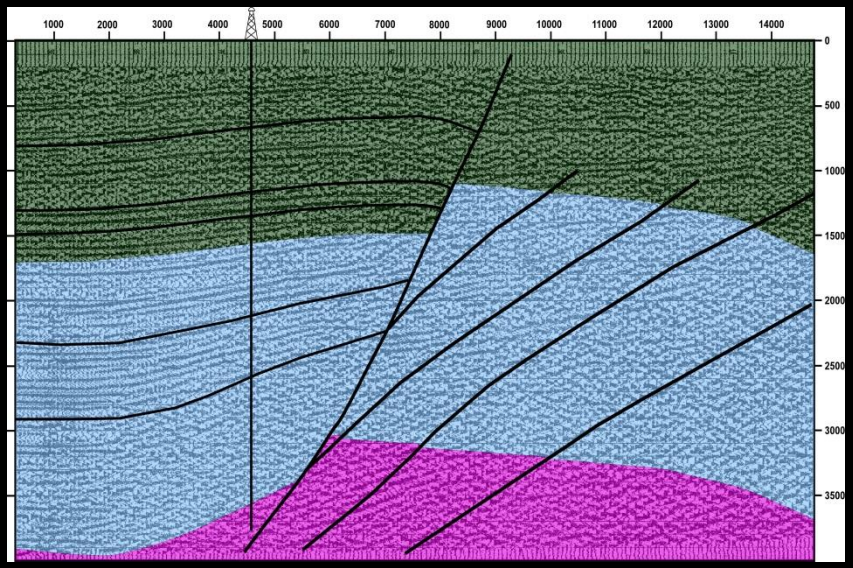
Inherited Cretaceous normal fault in the Orbata anticline.
Still preserved, a normal fault affecting the Albian series in the core of the Chemsi anticline.

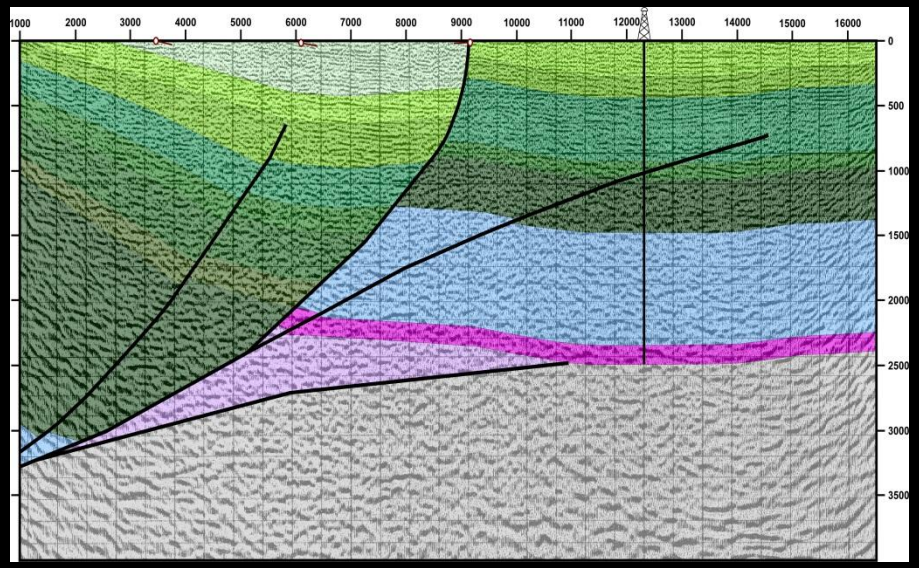
Rift structures as revealed by surface and subsurface data



Rift structures as revealed by surface and subsurface data







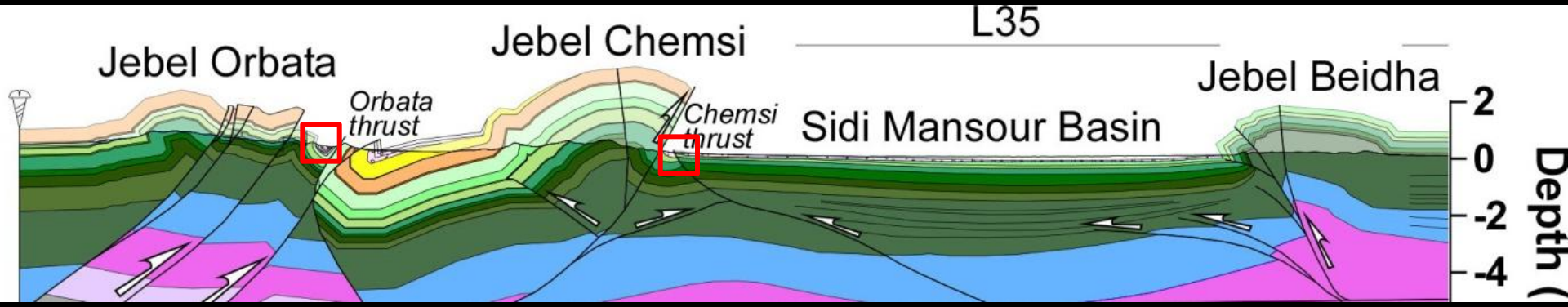
*Inherited normal fault has controlled the thick thickness in the Chott Fejej basin.

*Affected by Shortcut inverted normal fault.

*Preserved normal fault controlled the thick thickness in the South of the Tebaga Kebili

*Affected by shortcut inverted normal fault in the footwall of the Sahara platform.

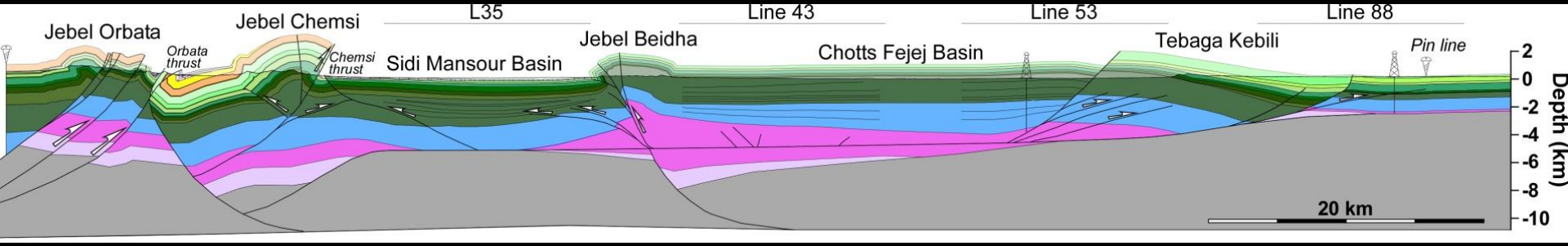
Timing of the inversion



Growth strata deposit suggest compressional deformation and structural inversion since the Miocene.

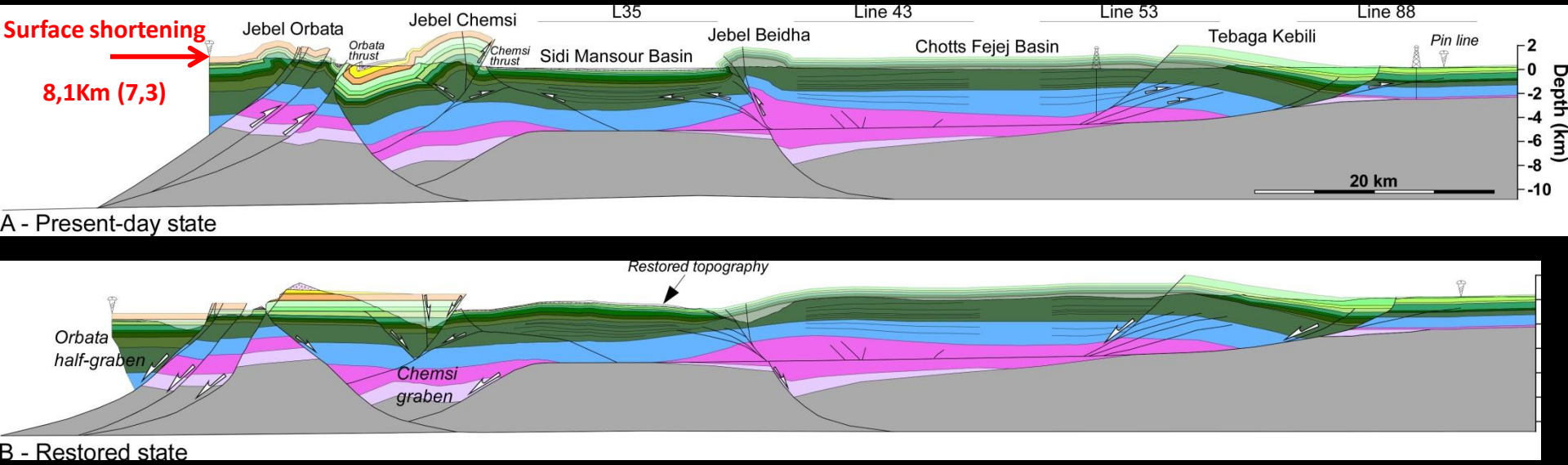
Tectonic inversion is still active as shown by the deformed quaternary terraces and produce recent thrusting structures in south front of Chemsi anticline

Balanced and restored cross section of the Tunisian Atlassic foreland



*Thick-skinned tectonic style with basement implication
*No major thin-skinned tectonics style
*Tectonics inheritance from the Cretaceous rifting
*Salt tectonics

Balanced and restored cross section of the Tunisian Atlassic foreland



- Balancing and restoration of the southern Atlas folds thrust belt displays a total shortening of 8,1 km or 7,3%.
- The shortening is controlled by the inherited extensional structures involving the Paleozoic basement.

Conclusions

- The structural study of the south Atlas fold and thrust belt of Tunisia underlines the predominant role of inherited extensionnal structures acquired during the evolution of the southern Tethyan margin, and their influence of the present-day geometry of the Atlassic fold belt.

- Structures resulted from deep tectonic deformations as mixed tectonic style

➢ Thick-skinned style (attested by the basement deformation) is more important than the thin-skinned style involving the sedimentary cover.

- Restoration of the southern Atlas folds thrust belt displays a total shortening of 8,1 km or 7,3%.

- Inversion tectonic event in the southern Atlas started in the Late Cretaceous.

- The major compressional tectonic is attained during the Serravallian-Tortonian and still active to the present.


Thank you for your attention