[PS]Recent Spatial and Temporal Changes in the Stress Regime along the Southern Tunisian Atlas Front and Gulf of Gabes: New Insights from Fault Kinematics Inversion and Seismic Sections*

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Abstract

The Southern Atlassic Front of Tunisia results from the convergence between Nubia and Eurasia. We present evidence for spatial and temporal changes in the stress state by inversion of geologically determined fault slip vectors. The inversions of fault kinematics data reveal distinct temporal changes in states of stress during the Miocene-Pliocene and Quaternary deposits. The paleostress (older) state is characterized by a regional compressional tectonic regime with a mean N131°09°E trending horizontal maximum stress axis (σ1). The modern (younger) state of stress also corresponds to compressional tectonic regime with a regionally mean N04°07°E trending horizontal σ1. Locally the modern stress states correspond to a compressional tectonic regime with NE trending σ1, due to stress deviations related to lithological/rheological inhomogeneities or to fault kinematics. The modern stress states, deduced from the youngest fault kinematics data, reveal the recent tectonic activity along the foreland of Atlassic structures and probably generate the newly thrusting structures. Eastward, the Gulf of Gabes is characterized by extensional structures at a crustal scale related to the N to NNW trending right-lateral transtensional margin. We propose that the spatial and temporal changes in the stress during the Miocene-Pliocene and Quaternary may result from two structural effects: [1] The migration of the convergent boundary between Nubia and Eurasia toward the south in the internal zone (i.e., Atlassic domain) attested by the tectonic inversion of the inherited structure; and [2] the Mesozoic Ionian oceanic lithosphere in the Sicilian basin (Eastward of SAFT) which generated transtensional basin.

Recent spatial and temporal changes in the stress regime along the Southern Tunisian Atlas front and gulf of Gabes: New insights from fault kinematics inversion and seismic sections.

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The inversions of fault kinematics data reveal distinct temporal changes in states of stress during the Miocene-Pliocene and Quaternary periods. The paleostress (older) state is characterized by a regional compressional tectonic regime with a mean N131±09°E trending horizontal maximum stress axis ($\sigma 1$). The modern (younger) state of stress also corresponds to compressional tectonic regime with a regionaly significant mean N04±07°E trending horizontal $\sigma 1$.

The change from the paleostress to modern stress states showed locally the compressional tectonic regimes with NNE trending $\sigma 1$.

The modern stress states, deduced from the youngest fault kinematics data, correspond to the recent tectonic activity along the foreland of Atlassic structure and probably produce recent thrusting structures.

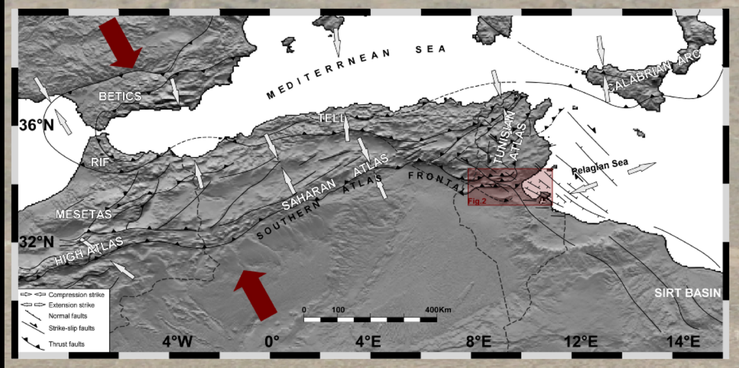
Eastward, recent structural frame of the Gulf of Gabes could consist in a negative flower structure at a crustal scale related to the N to NNE trending right-lateral transtensionnal margin.

The spatial and temporal changes in the stress during the Miocene-Pliocene and Quaternary can result from two combined tectonic effects:

[1] The migration of the convergent boundary between Nubia and Eurasia toward the south in the internal zone (i.e., Atlassic domain) implying a migration of the tectonic inversion of the inherited extensional structures in the NW.

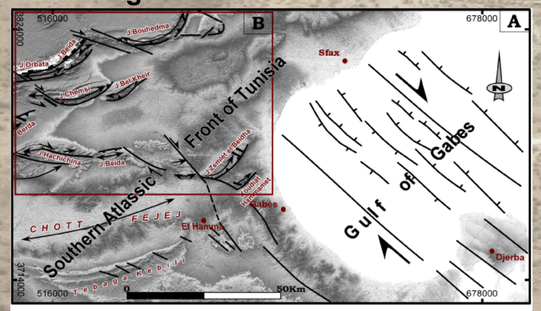
[2] The extension of the Mesozoic Ionian oceanic lithosphere in the Sicilian basin (Eastward of SAFT) which generats a transtensional basin regime in the Gulf of Gabes.

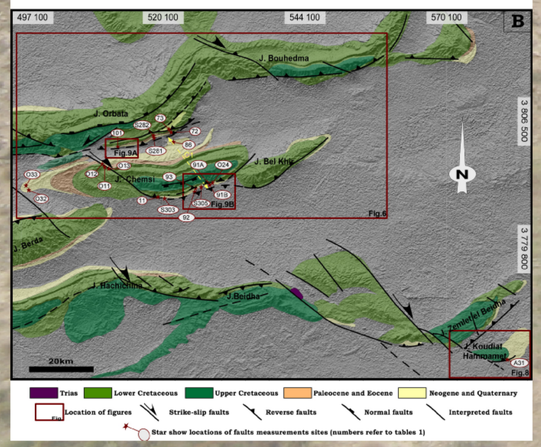
Introduction



Tectonic map of the Atlas belt. Gray arrows correspond to the present-day horizontal compression direction of Africa with respect to Eurasia
Red square indicates the location of study area.

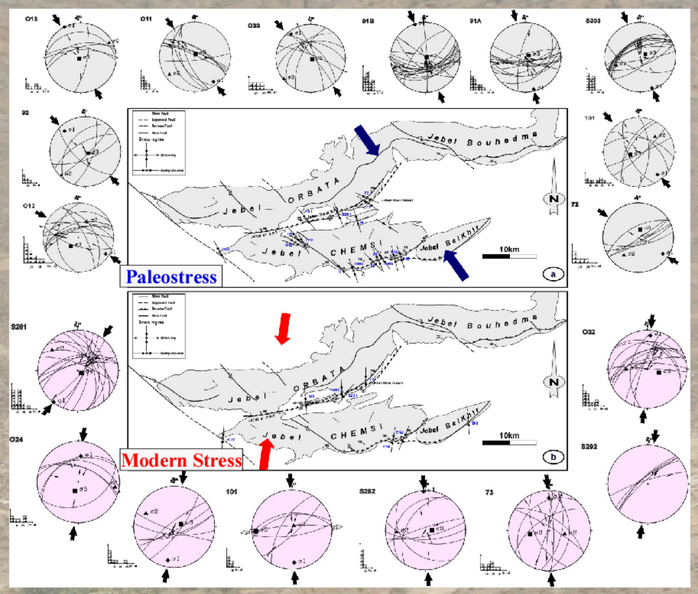
Geological setting



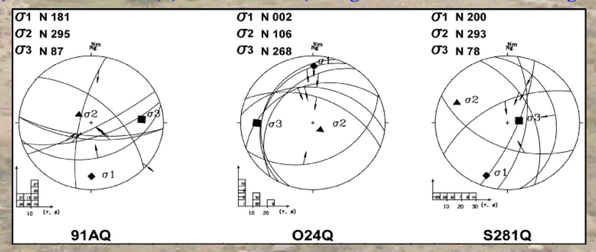


(A) Structural trend map of the Southern Tunisia and Gulf of Gabes. (B) Boxed area in A.
Geologic map of the studied region showing kinematic measurement sites.
The map is redrawnand simplified from the geological map of Tunisia in scale 1/500.000.

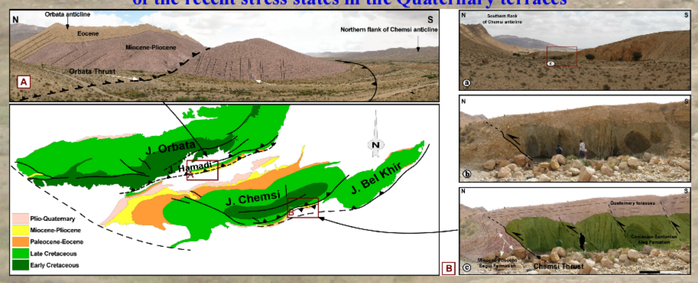
Data and Result



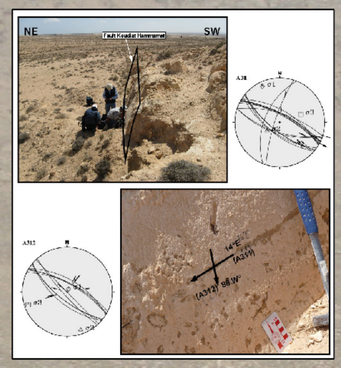
Trend of $\sigma 1$ (maximum horizontal stress) axis for the strike-slip and compressional stress regimes deduced from the fault kinematics inversions (Figs. 4-5)
(a) Paleostress state (b) Modernstress (see fig. 2B for location of this figure).



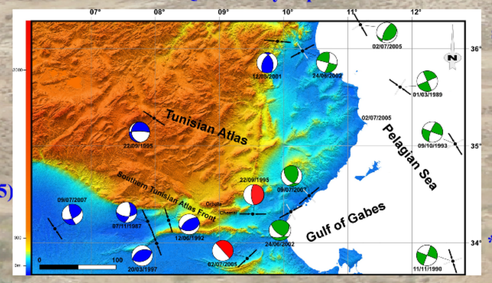
Lower hemisphere stereograms of fault slip data together with the inversion results of the recent stress states in the Quaternary terraces



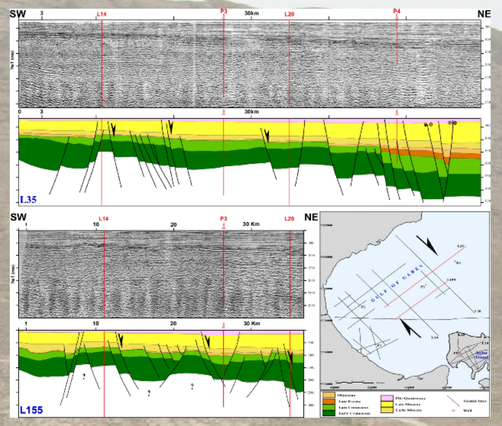
Fault-scale geological expression of the paleostress and modern stress states in the SAFT.
*A: The E-W- trending of thrust fault bordered the Orbata anticline.
*B: Active tectonics evidences at the southern flank of the anticline Chemsi.
b and c: Backthrust affected the conglomerate deposit Miocene-Pliocene explains the recent thrusting structures.



The NW- trending strike-slip fault of the Koudiat Hammamet (see fig. 2B) associated with chronology of fault planes in the Quaternary deposit

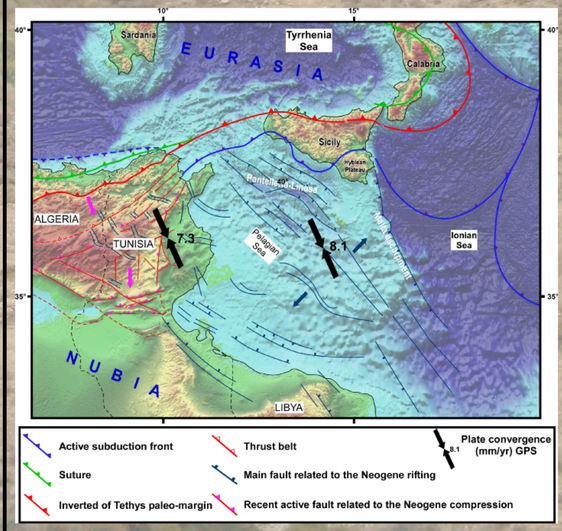


Map of Tunisian Atlas associated with earthquake focal mechanisms data:
*NW- to NNW-trending of the compression stress in the SATF.
*the transtensional stress along the NW-SE corridor fault drawing the pattern of the Gulf of Gabes.



Seismic reflexion profiles L35 and L155 across the Gulf of Gabes showing the evidences for youngest extensional stress regime related to right lateral strike-slip faults

Conclusion



As presented in the current study, fault kinematic analysis in SAFT combined with the use of some seismic profiles in the Gulf of Gabes and earthquake focal mechanisms provide evidence for spatial and temporal changes in the stress regimes from Miocene-Pliocene to the present day. In the SAFT, the Miocene-Pliocene paleostress was characterized by a regional mean of N134±09°E trending horizontal compression ($\sigma 1$) tectonic regime. The modern state of stress shows compressional tectonic regime with a regional mean of N05±10°E trending horizontal $\sigma 1$ drastically different from the paleostress $\sigma 1$ direction. The change from paleostress to modern stress states is associated by the active thrusting in the SAFT and the transtensional movement in the Gulf of Gabes

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