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Relative convergence of the Nubia Plate towards the Eurasia Plate: the case of the lack of seismicity in the Algerian-Tyrrhenian Trough

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The convergence of the Nubia Plate towards the Eurasia Plate, mostly focused along the southern Mediterranean coast, produces a high level of seismic activity. Some of these earthquakes are quite destructive and are capable of producing tsunamis such as the Catania earthquake in 1693, the El Asnam earthquake in 1980 or the Boumerdes-Zemmouri earthquake in 2003. Despite that, this highly active broad boundary reveals a seismically quieter sub-region that is situated along the Algerian-Tyrrhenian Trough. This reduction in seismic activity agrees with the apparent lack of re-activation along the Neogene thrusts of the Sardinia-Tunisia channel, related to the "Alpine" tectonics, confirmed by several studies that attempted to map the Nubia-Eurasia plate boundary in this region.

This study compiled a catalogue of Centroid Moment Tensor (CMT) solutions using data from the European-Mediterranean Regional CMT and the Swiss Regional CMT. We also used seismicity data obtained from the European-Mediterranean Seismological Centre (EMSC) agency and used a new compilation of GPS data to try to understand the cause of this aseismic region. The seismicity catalogue was declustered to remove its temporal incompleteness and a magnitude-frequency analysis was carried out to identify the variation of the EMSC network detection threshold. This revealed that one of the reasons for the apparent low level of seismic activity for the region is due to the higher magnitude of completeness in the catalogue for the Algerian-Tyrrhenian Trough, meaning that the EMSC network is only able to localize the relatively higher magnitude earthquakes in this region. Despite this fact, the declustered and magnitude filtered catalogue still shows that the Algerian-Tyrrhenian Trough is a relatively quieter seismic region in comparison to neighboring regions.

The integration of the filtered catalogue, the CMT solutions and the GPS data to obtain continuous strain rates and velocity fields for the region, revealed a very slow rate of convergence along the Tunisian part of the Algerian-Tyrrhenian Trough. It shows that, at its west, the deformation is mainly focused along the Algerian coast. At its east, the deformation spreads all along the eastern cost of Tunisia. The Pelagian shelf between Tunisia and Sicily is mainly affected by strike-slip deformation caused by the different rates of convergence for the North African section and for the Sicilian section.

These findings suggest that the deformation caused by the convergence of the Nubia plate towards the Eurasia plate is mostly focused at the boundary between continental and oceanic crust onto the Algerian and Sicilian segments, whereas it is diffuse in-between. This contrasting style of deformation may be related to the deep structure of the Tunisian and Pelagian shelfs: both areas may have been rheologically weakened following the widespread intracontinental extension that lead to the formation of the Pelagian grabens from upper Miocene to Recent times. The NW-SE normal faults that controlled the formation of these grabens are presently re-activated in transtension.