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Revealing the earthquake history during the last 200 ka on a large submarine strike-slip fault: The Yusuf Fault System (Alboran Sea)

Hector Perea[1], Eulàlia Gràcia[2], Stefanie Almeida[2], Laura Gómez de la Peña[3], Sara Martínez-Loriente[2], and Rafael Bartolomé[2]

[1]Universidad Complutense de Madrid, Facultad de Ciencias Geológicas, Madrid, Spain (hperea01@ucm.es)
[2]Consejo Superior de Investigaciones Científicas, Institut de Ciències del Mar, Barcelona, Spain (egracia@icm.csic.es; stfy_almeid@hotmail.com; smartinez@icm.csic.es; rafael@icm.csic.es)
[3]GEOMAR, Helmholtz Centre for Ocean Research Kiel, Kiel, Germany (lgomez@geomar.de)

The NW-SE convergence (4-5 mm/yr) between the African and Eurasian plates controls the present-day crustal deformation in the Alboran Sea (westernmost Mediterranean). Although seismic activity is mainly characterized by low to moderate magnitude events, large and destructive earthquakes (I > IX) have occurred in this region (i.e., 1522 Almeria, 1790 Oran, 1910 Adra, 1994 and 2004 Al-Hoceima or 2016 Al-Idrissi earthquakes). The identification and the seismogenic characterization of the active structures in the Alboran Sea using ultra high-resolution (UHR) geophysical data is essential to evaluate better the exposure of the South Iberian Peninsula and North African coasts to related natural hazards (i.e., large earthquakes and related tsunamis and triggered landslides). During the SHAKE cruise, the Asterx and Idefx AUVs (Ifremer, france) were used to acquire UHR bathymetric (1m grid) and seismic (cm vertical resolution) data across the main active faults systems in the Alboran Sea with the aim to carry out sub-aqueous paleoseismological studies. One of the studied active structures has been the Yusuf Fault System (YFS), a dextral strike-slip system that is one of the largest structures in the Alboran Sea and a lithospheric boundary between different crustal domains: the East Alboran Basin to the north and the North African Margin to the south. It trends WNW-ESE, is ~150 km-long and can be divided into two main segments (W and E), producing the formation of a pull-apart basin where both overlap. The analysis of the UHR geophysical dataset reveals that in the imaged area this system is a complex structure composed by an array of strike-slip faults. Most of them reach up and offset the seafloor and the upper Pleistocene to Holocene sedimentary units. The results of the on-fault paleoseismological analyses reveal that the YFS may have generated at least 8 earthquakes in recent times. Although a detailed on-site geochronology is not available, a regional chronostratigraphic correlation have allowed estimating that the events have occurred during the last 200 ka, then providing an average recurrence interval of 27.5 ka. The estimated average vertical offset is about 0.64 m while the vertical slip-rate would be around 0.03 mm/yr. However, this value needs to be considered as a minimum since YFS is predominantly a strike-slip fault and the lateral slip will be much larger than the vertical one. According to different empirical relationships, the YFS could produce earthquakes above magnitude M_w 7.0. Finally, our results demonstrate that detailed geomorphological, active tectonic and paleoseismological studies are

essential to reveal the present-day activity and to characterize the seismic behavior of the YFS, with crucial implications for seismic (and tsunami) hazard assessment in the surrounding coastal areas.