# ACTIVE TECTONICS AND PALEOSEISMICITY IN THE YUSUF FAULT (ALBORAN SEA) EVIDENCED BY MULTI-SCALE IMAGING

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The NW-SE convergence (4-5 mm/yr) between the African and Eurasian plates controls the present-day crustal deformation along the southern Iberian and northern African margins. The strain due to this convergence is accommodated over a deformation zone with significant seismic activity across the Alboran sea. Although seismicity is mainly characterized by low to moderate magnitude events (Figure 1), large and destructive earthquakes (Intensity > IX) have occurred in the region, as shown by the historical and instrumental earthquake catalogues (i.e., 1522 Almeria, 1790 Oran, 1910 Adra, 1994 and 2004 Al-Hoceima or 2016 Al-Idrissi earthquakes). The location and characterization of the active structures in the Alboran Sea trough sub-aqueous paleoseismological studies is, therefore, essential to significantly improve the knowledge

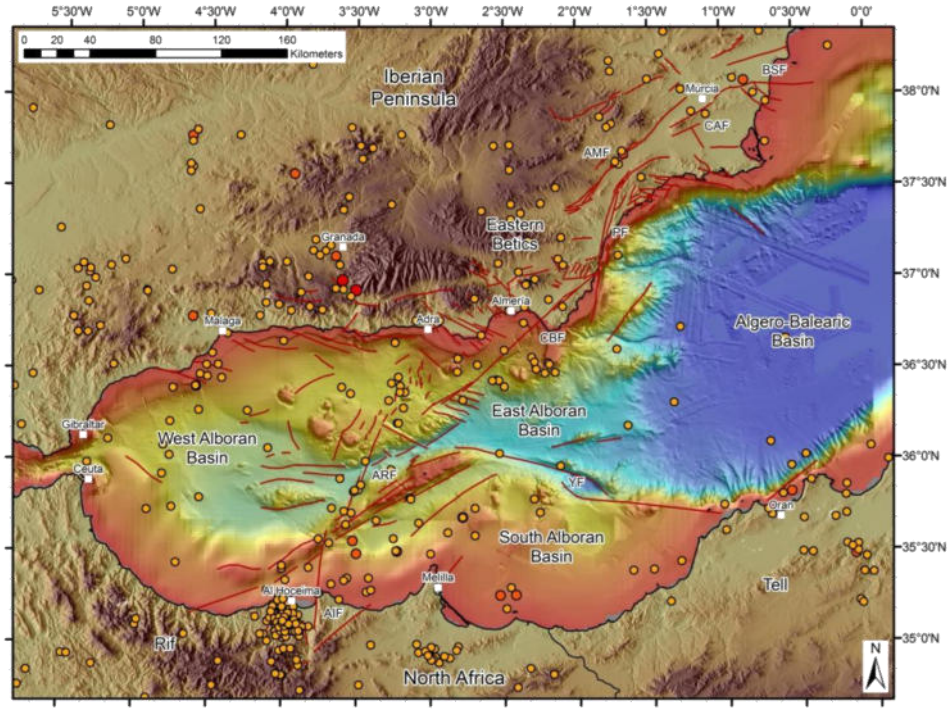


**Figure 1.** Map of the Alboran Sea and surroundings showing the main active faults in the area and the instrumental seismicity (M >4). Active faults: AIF: Al-Idrissi; AMF: Alhama de Murcia; ARF: Alboran Ridge; BSF: Bajo Segura; CAF: Carrascoy; CBF: Carboneras; PF: Palomares; YF: Yusuf.

about earthquake and tsunami hazards along the coasts of Spain and North Africa.

During the EVENT-DEEP and SHAKE cruises multi-scale seismic and bathymetric data were acquired along and across the main active faults systems in the Alboran Sea. The Yusuf fault, localized between the Eastern and Southern Alboran basins, is one of the main active faults in the area. It is a dextral strike-slip fault that trends WNW-ESE and has a length of ~150 km. The fault has been divided into two main segments, the western segment with ~87 km and trending N100 and the eastern segment with ~105 km and trending N095. Both segments overlap in the pull-apart Yusuf basin (Figure 2). The available geophysical dataset imaging the Yusuf fault includes bathymetry of high (30m) and ultra-high resolution (1m, acquired with AUV), parametric sub-bottom and CHIRP (with cm vertical resolution acquired with AUV) profiles, and medium and high penetration multichannel seismic profiles (MCS).

The analysis of the acquired data reveals that the Yusuf fault is a more complex fault system composed by several strike-slip faults fairly vertical. The seismic data show that some of these faults reach the seafloor surface offsetting it, which implies Quaternary activity on the fault system. According to the paleoseismological analysis carried on the high-resolution CHIRP profiles acquired in the western segment of the Yusuf fault, the fault may have generated at least 8 earthquakes during the last 200 ka, the last one occurred in a quite recent time (historical?) with an average recurrence interval of 27.5 ka. The estimated average vertical offset would be 0.64 m and the vertical slip rate would be around 0.03 mm/yr. However, this has to be considered as a minimum rate since this is a dextral strike-slip fault and the lateral slip must be much larger than the vertical. According to different empirical relationships the fault could produce earthquakes larger than 7.0.

Even with some uncertainties, our results show that detailed geomorphological, structural and paleoseismological studies are essential to reveal their present activity and to characterize their seismic behaviour and, thus, improve the seismic hazard assessment in surrounding coastal areas.

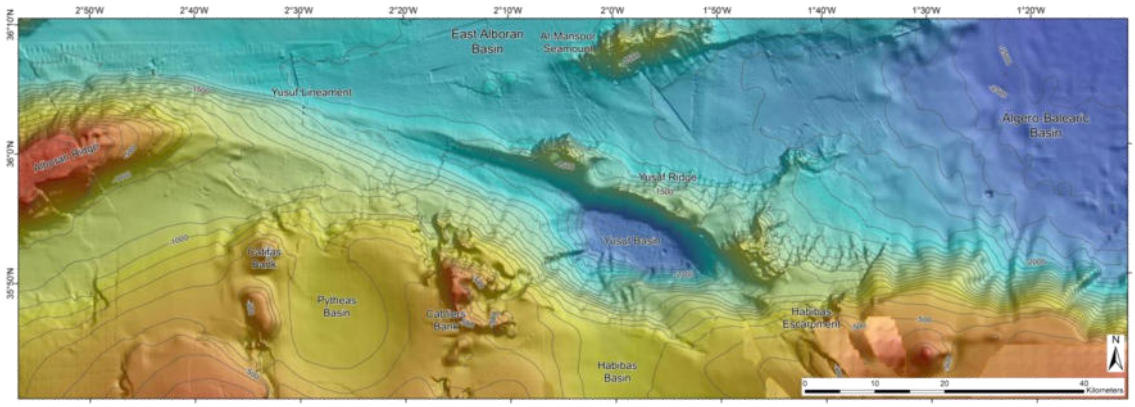


**Figure 2.** Coloured bathymetric map of the Yusuf identifying some of the main geomorphologic characteristics.