The strike-slip Yussuf fault system (Alboran Sea): Multi-scale seismic imaging and evidences of Quaternary activity

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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 wide deformation zone with significant seismic activity. Although seismicity is mainly characterized by low to moderate magnitude events, large and destructive earthquakes (Intensity > IX) have occurred in the region, as shown by the historical and instrumental earthquake catalogues. 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 about earthquake and tsunami hazards along the coasts of Spain and North Africa.

During the EVENT-DEEP (May-June 2010) and TOPOMED (September-October 2011) cruises the geomorphology and geometry of some active strike-slip faults identified in the Eastern Alboran Sea were investigated. Along the dextral strike slip Yussuf fault system medium (22) and high (7) penetration multichannel seismic profiles (MCS) and parametric sub-bottom profiler lines were acquired. At the same time, a high resolution bathymetric coverage of the area was collected by means of multibeam echosounder.

The energy source used during the EVENT-DEEP cruise to acquire the medium penetration MCS was an 800 c.i. volume airgun array, working at 2000 psi pressure, towed at 2 m depth and triggered every 18 m. The receiver consisted on a 600 m long streamer, composed by 96 channels separated 6.25 m. This configuration allowed us to penetrate an average depth of 1.5 s TWTT. In order to study the deeper part of the margin, the source of the high penetration MCS used during the TOPOMED-GASSIS cruise was an airgun array of 3160 c.i., towed at 7.5 m and triggered every 50 m at 2000 psi of pressure. The receiver consisted on a 5379 m long streamer, composed by 431 channels separated 12.5 m. The average penetration of the seismic profiles reached with this configuration was 4 s TWTT.

The preliminary analysis of the acquired data allow us to describe some characteristics of the Yussuf fault. First of all, this is a fault system composed by several strike-slip faults fairly vertical and with WNW-ESE direction. Moreover, the dextral strike-slip movement along these faults has produced the formation of a pull-apart basin. Finally, we have observed some of the faults reaching the seafloor surface and in some places offsetting it, implying the Quaternary activity along the fault system. Much analyses is needed in order to accurately determine the fault seismic parameters of the Yussuf fault system (e.g. geometry, slip rate, maximum event magnitude, recurrence interval and time elapsed since the last earthquake, maximum earthquake they can produce) and to investigate how it accommodates the present-day strain along the plate convergence.