Seismic imaging of submarine seismogenic faults beneath the western Alboran Sea (SE Iberian margin)

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Seismogenic faults may be silent in the historical period and, therefore, its seismic potential may remain inadvertently hidden. Paleoseismological analysis characterize the seismic potential of these faults providing their seismic parameters, also in slow moving faults. A number of seismogenic faults with low slip-rate are present in the boundary between Iberian and African plates. This boundary has migrated to the West over the last 30 milions years, with sideward expansions to form the Gibraltar and Calabrian arcs. Seismicity is mainly characterized by low to moderate magnitude events. Nevertheless, large destructive earthquakes (MSK Intensity IX-X) have occurred in the region, revealed by historical records. This may pose significant earthquake and tsunami hazards to the coasts of Spain and North Africa.

The main goal of the EVENT and TOPOMED-GASSIS national projects, last under the framework of the ESF TopoMED project, is: a) to characterize selected active offshore faults located in the Alboran Sea; b) the imaging and characterization of the deep crustal and mantle structure of the area; and c) to relate the surface processes to the deep lithospheric structure of the margin. These structures may represent a seismic and tsunamigenic hazard for the surrounding coasts of South Iberia and North Africa.

During the EVENT-DEEP (2010) and TOPOMED-GASSIS (2011) cruises, the geomorphology and geometry of some active strike-slip fault tectonic structures identified in the Western Alboran Sea, focusing on the Alboran Ridge, and particularly the left-lateral strike-slip Al Idrissi fault were investigated in order to evaluate their seismic potential. Fault exploration has integrated a multiscale acoustic and sub-seafloor seismic dataset, including multibeam echosounder, parametric sub-bottom profiler and multichannel seismic data, in order to accurately determine the fault seismic parameters.

Preliminary stack seismic profiles image the main structures across the Alboran Ridge and Al Idrissi fault. We clearly identify the base of the Messinian erosional unconformity (5.96-5.33 Ma), when the Mediterranean Sea desiccation ended by the invasion of the Atlantic sea water through a mega-flood. We have mapped the extension and structure of the Al Idrissi fault, located around 40 km offshore the port city of Al Hoceima (Morocco), which was the epicentre of the Mw 6.4 earthquake occurred the 24th February 2004, causing 571 deaths and 20000 wounded. Focal mechanism is consistent with strike-slip of the numerous NE-SW trending faults in the area. The epicentral region is the most seismically active area in Morocco, in the vicinity of the epicenter of the May 26 1994, Mw 6.0.