HIGH-RESOLUTION IMAGING OF ACTIVE STRUCTURES OFFSHORE ON THE SOUTHWEST IBERIAN MARGIN: IMPLICATIONS FOR PALEOSEISMIC STUDIES

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Abstract

The Southwest Iberian Margin is affected by large earthquakes in Western Europe as it hosts the boundary beween Eurasian and African plates. We identified several active faults which are potential sources of large magnitude earthquakes and tsunamis (Mw > 6). We have acquiered giant piston cores and TOBY mosaics, which allow us to investigate on the past activity of the faults, which has implications for seismic hazard assessment on the southwest Iberian Margin.

Keywords: active faults, turbidite, submarine landslides, TOBI sidescan sonar, earthquakes

The SW Iberian Margin hosts the present-day boundary between the European and African Plates (1, 2, 3). Convergence is accommodated along a wide and diffuse deformation zone characterized by an elevated seismic activity (4), source of the largest and most destructive earthquakes and tsunamis in Western Europe (e.g. 1969 Horseshoe Earthquake Mw=8, 1755 Lisbon Earthquake and Tsunami M=8.5, 5). Two marine cruises have been devoted to this purpose: the HITS cruise ("High Resolution Imaging of Tsunami genic Structures in SW Iberia") carried out on board the Spanish RV *Hesperides* during September-October 2001, was designed to determine the geometry of the active seismogenic structures in the SW Iberian Margin and their sediment instability associated processes. And during the PRIME-PICABIA cruise on board the French RV *Marion Dufresne* during July 2003, we acquired a total of 4 giant CALYPSO piston cores located on the Tagus and Horseshoe Abyssal Plains, and on the footwall (Active faults p.e. Marques de Pombal Fault) and they will be devoted to calculate their recurrance rate by dating of the turbiditic units generated by seismic events. This work is based in a combination of different survey methods and resolution: TOBI sidescan sonar, swath batimetry and acoustic backscatter, subbottom profiles TOPAS, high resolution seismic and CALYPSO giant piston cores.

Two high-resolution TOBI sidescan sonar mosaics were obtained covering the Marques de Pombal Fault area and the Cape San Vicente Canyon and Horseshoe Faults, totalling more than 550 nm of data. On the first area, we identified a NNE-trending lineament, corresponding to the rupture trace and escarpment of the 50 km long Marques de Pombal thrust fault, possible source of the 1755 Lisbon Earthquake and Tsunami (5, 6). Associated to this structure, we identified a large area (~260 km^2) of high acoustic backscatter in the southern half of the Marques de Pombal thrust front, which we interpret as the result of a recent complex submarine landslide. This landslide might have been generated during the last seismic event (1755?), and could have contributed to the devastating tsunami (7). High-resolution sub-bottom profiler sections across the toe of the landslide, allowed the identification of alternating seismic transparent units (interpreted as a landslides) and seismically well-stratified units (interpreted as pelagic sediments) suggesting cyclic activity of the Marques de Pombal fault (6).

On the second area, the TOBI and swath-bathymetry images show that the San Vicente Canyon is deeply carved into the seafloor, showing a clear asymmetry between its flanks. The linearity and sudden change of trend of these structures suggests that the canyon may be controlled by faults. The bottom of the canyon, barren of recent sediments, appears highly reflective with corrugated surfaces, which we interpret as corresponding to the outcrop of stratified Mesozoic rocks. At the southern end of the canyon, the NE-SW trending Horseshoe Fault is a steep east-dipping thrust below the eastern anticline which displaces the chaotic-seismic facies unit, of late Miocene age, referred to as the "giant chaotic body" (8). Tectonic activity has continued until the present, as evidenced by growth-strata deposits that are younger than late Miocene, and by steep escarpments along the thrust trace.

Four CALYPSO giant piston cores were recovered during the PICABIA cruise: Three along the Tagus and Horseshoe abyssal plains (MD03-2701, MD03-2703 and MD03-2704) and one on the footwall of the Marques de Pombal Fault (MD03-2702), to sample the most recent landslide deposits. Several turbidite events were distinguished based on sedimentological description correlated with MST data (magnetic susceptibility, p-wave and gamma-ray). The chronology of these events based on ^{210}Pb and ^{14}C AMS dating, relative paleointensities, will be used in the characterization of the past activity and recurrence rate of the SW Iberian Margin faults. Chronostratigraphy based on $\delta^{18}O$ and $\delta^{13}C$ will also be done and it will be compared to paleoceanographic records from the west Iberian Margin. We plan to correlate turbidites sampled near active faults, with the ones found at the neighboring abyssal plains, as regional and synchronous events are likely to be generated by large earthquakes. The identification and understanding of these active faults and associated deposits is fundamental for earthquake and tsunami hazard assessment in the SW Iberian Margin.

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