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Seismicity and seismotectonics of the diffusive Iberian/African plate boundary: Horseshoe Abyssal Plain and Gorringe Bank

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In the area to the west of the Gibraltar Arc the plate boundary between Africa and Iberia is poorly defined. The deformation in the area is forced by the slow NW-SE convergence of 4 mm/yr between the oceanic domains of Iberia/Eurasia and Africa and is accommodated over a 200 km broad tectonically-active deformation zone. The region, however, is also characterized by large earthquakes and tsunamis, such as the 1969 $M_w=7.9$ Horseshoe Abyssal Plain earthquake and the November 1, 1755 Great Lisbon earthquake with an estimated magnitude of $M_w\sim 8.5$. The exact location of the source of the 1755 Lisbon earthquake is still unknown. Recent work may suggest that the event occurred in the vicinity of the Horseshoe fault, an oblique thrust fault. However, estimates of tsunami arrival times suggested a source near the Gorringe Bank, a ~ 180 km-long and ~ 70 km-wide ridge that has a relieve of ~ 5000 m. Deep Sea Drilling (DSDP) and rock samples indicated that the bank is mainly composed of serpentinized peridotites with gabbroic intrusions, perhaps being created by overthrusting of the Horseshoe Abyssal Plain onto the Tagus Abyssal Plain in NW direction. Further, the Horseshoe Abyssal Plain is marked by the presence of compressive structures with a roughly NE-SW orientation and E-W trending, segmented, crustal-scale, strike slip faults that extend from the Gorringe Bank to the Gibraltar Arc in the eastern Gulf of Cadiz, which were called "South West Iberian Margin" or SWIM faults. The fault system may mark a developing Eurasia-Africa plate boundary. Two local seismic networks were operated in the area. First, a network of 14 ocean-bottom seismometers (OBS) was operated between April and October 2012 in the vicinity of the Horseshoe fault between 10° W to 11° W, and $35^\circ 50'$ N to $36^\circ 10'$ N. From October 2013 to March 2014 a second network of 15 OBS monitored seismicity at the Gorringe Bank. Both networks benefitted from seismic stations operated in Portugal. The first network provided in the order of 100 locale earthquakes occurring with the network. Most earthquakes in the Horseshoe occurred at a depth of 40-60 km, either in oceanic or unroofed continental mantle. The large source depth of events observed in the Horseshoe Abyssal Plain supports the idea that large catastrophic earthquakes, like the Great Lisbon earthquake of 1755, may indeed occur in the area.