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Mechanism of 2003, 2007 and 2009 earthquakes (S. Vicente Cape) and implications for the 1755 Lisbon earthquake.

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The San Vicente Cape region (SW Iberia) is of great seismological interest due to its tectonic complexity and for the occurrence of the 1755 Lisbon mega-earthquake. A structure capable of generating such large earthquake has not been convincingly found but authors agree with the possible occurrence in the future of a similar earthquake offshore of San Vicente Cape. We have studied the mechanism of three earthquakes in this area: 29 July 2003 (Mw = 5.3), 12 February 2007 (Mw = 6.1) and 17 December 2009 (Mw = 5.5) which throw light on the dynamics of the region. These earthquakes are the largest occurred in the last 40 years at the western of San Vicente Cape. From inversion of body waves and kinematic slip distribution, we have obtained that the three shocks have similar characteristics (dimensions, maximum slip, stress drop, source time function, focal depth and rupture velocity), but we can observe differences on geometry of the rupture that reflect the great seismotectonics complexity of the zone. The 2003 and 2007 focal mechanisms are similar, corresponding to thrusting motion but the 2009 earthquake has dip-slip motion on a vertical plane. The ruptures planes for the three shocks, deduced from the slip distribution, show ruptures on NE-SW planes, with the released energy propagating to NE direction, compatible with the regional horizontal compression in the NW-SE direction produced by the convergence between the Eurasian and African plates. This direction of faulting may be applied to the generation of the 1755 Lisbon earthquake, in terms of a complex rupture along NE-SW trending thrust faults at the Gorringe Bank, the Horseshoe Scarp and the Marques de Pombal Fault, with rupture propagating in NE direction toward the coast of Portugal and which may explain the large damage at Lisbon city.