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Active seafloor deformation in the Gulf of Cadiz: new cruise results and the possible link to the source of the 1755 Lisbon earthquake and tsunami

M.A. Gutscher (1) and the DELILA Shipboard Party (1,2)

(1) CNRS, IUEM, Univ. Bretagne Occidentale, Plouzane, France, (2) Univ. Lisbon, Univ. Algarve, Univ. Parma, CMIMA Barcelona

The Great Lisbon earthquake of 1755 is the greatest natural disaster in European history and killed 60,000 people. The search for its source has stimulated an international effort to study the tectonics and deformation off SW Iberia. Recent geophysical results, reveal an east dipping subduction here, beneath the Straits of Gibraltar. As subduction zones worldwide produce 90% of all great earthquakes, this raises the question, Is the Gibraltar subduction system still active and does it pose a seismic risk?

New evidence supports continued activity. Numerous active mud volcanoes sampled in the Gulf of Cadiz indicate ongoing dewatering processes, common in accretionary wedges. High resolution seismic profiles across the deformation front image folding, thrusting and syn-tectonic sedimentation of the uppermost turbiditic layers. In-situ marine heat flow data acquired in Dec. 2003 also reveal a pattern indicative of active subduction. Finally, new bathymetric data from 5 recent cruises offer a complete image of the accretionary wedge, including a continuous horseshoe shaped deformation front. A basement high (Coral Patch Ridge) indents the deformation front, confirming the cinematics linked to regional E-W compression.

Thermal modeling suggests a potential seismogenic zone with a downdip width of 200 km. The absence of instrumentally recorded subduction interface earthquakes suggests a possibly locked zone (like Nankai or Cascadia). Available sedimentological data indicate a recurrence interval of about 1000-2000 yrs for great earthquakes in the Gulf of Cadiz region. Future studies within the EuroMargins program will provide valuable site survey data for drilling proposals submitted to the Integrated Ocean Drilling Program.