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Tectonics of the Gibraltar subduction and its relation to recent kinematics

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The Gibraltar region includes one of the most complex portions of the modern day Africa - Eurasia plate boundary. Geophysical data (seismic profiling, tomography, hypocenters and other seismological data) reveal a narrow subduction zone here, dipping steeply to the east. Recently acquired seismic refraction data offshore SW Portugal also indicate the presence of oceanic crust in the western Gulf of Cadiz. Slow, but ongoing activity of the subduction and the possible link to the Great Lisbon earthquake and tsunami of 1755 are the object of scientific debate which bears strongly on the overall hazard assessment for the area. The Betic-Rif mountain belt formed as a narrow E-W oriented corridor of oceanic lithosphere sank and rolled back to the W and WSW, causing extension in the Alboran Sea as a backarc basin. This history is recorded in tomographic images of the upper mantle as well as recent studies of mantle anisotropy documenting arc parallel "fast directions" in SKS splitting. The overall WSW transport direction is borne out by the W, NW and SW vergence of thrust anticlines in the accretionary wedge and by its general shape and symmetry axis. Furthermore, recent high resolution bathymetric mapping revealed an asymmetric embayment at the deformation front where a 2 km high basement ridge (Coral Patch Ridge) has recently collided and which confirms this WSW directed tectonic push. Today subduction has slowed significantly (v<1 cm/yr), but may have not altogether ceased. Recent GPS studies show SW motion of stations in N Morocco (in the SW Rif) at velocities of 3-4 mm/yr in a Nubia fixed reference frame and clearly document the presence of an independent block, a "Rif-Betic-Alboran" microplate, situated between Iberia and Africa. The current GPS displacement field near the straits of Gibraltar may reflect the interseismic phase between major mega-thrust earthquakes (the possible cause of the 1755 earthquake) and thus indicate locking of the shallow portion of the E-dipping subduction interface beneath the central and eastern Gulf of Cadiz. Further studies are necessary to confirm or disprove this hypothesis.