Aseismic Slip on the Makran Coast?

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In 2006 we measured the velocity of a continuous GPS point at Ormara on the Makran coast as 21 ± 3 mm/yr at N200E relative to the Indian plate (Figure 1). Three additional points on the Makran coast have not yet been re-occupied, and our provisional data have a duration of six months only, but we report this intriguing result since it suggests that almost steady-state creep may presently prevail in the region inferred to have slipped in the 1945 Mw=8.1 earthquake. Asia/Arabian plate convergence is estimated here at 30 mm/yr (Apel et al., 2006) with 3 mm/yr from motion on the Sonne Fault (Kukowski et al., 2003) leading to a probable Asia/Ormara plate convergence of 33 ± 3 mm/yr. A summation of vectors suggests that the north-south convergence rate between Ormara and the Ormarian Plate is 21.5 ± 4 mm/yr, almost 60% of the convergence velocity. Thus for planar northward dip the southern edge of a steady subsurface slip terminates offshore (Figure 2).
Two meters of uplift were observed at Ormara in 1945, an observation that led Byrne et al. (1996) to infer a coseismic rupture terminating near or slightly offshore. Our result suggests that interseismic slip terminates 10-20 km offshore. Thus one possible interpretation is that the current geometry represents steady afterslip on the 1945 rupture. Should the inferred locked geometry persist, the magnitude of any future earthquake in the region would limited to the release of energy from the locked offshore region whose width cannot much exceed 20 km (Mw<7.8). However, we note that the weak nature of the sediments, and pervasive high pore pressures imply that this region is inefficiently locked, permitting the intriguing conclusion that no elastic energy may be currently accumulating.

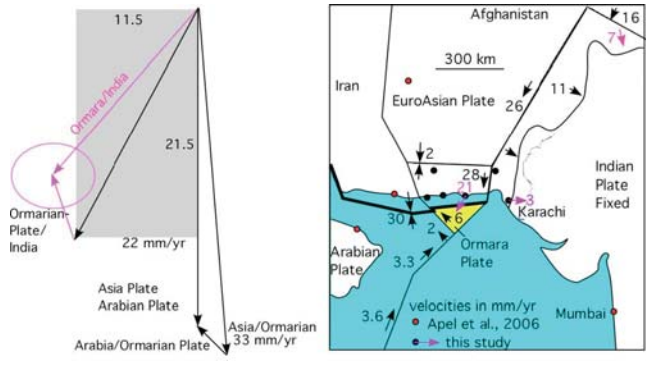

Figure 1. Vector reconstructions of convergence between the Ormara & Asian Plates and Ormara. We assume that convergence occurs normal to the coast resulting in a subduction rate at 33 ± 3 mm/year and convergence at the coast at Ormara at 21.5 ± 3 mm/year. Ormara is the dot with violet vector labeled 21.

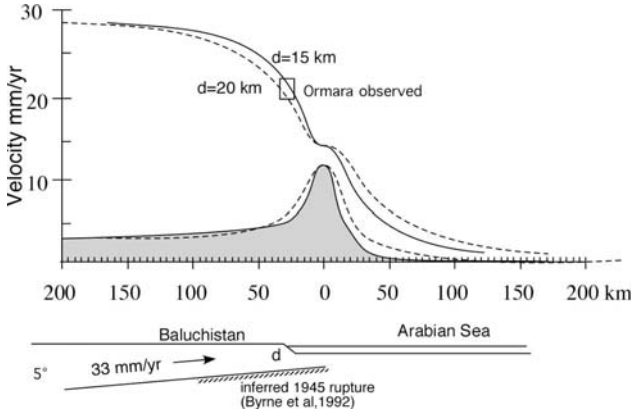

Figure 2. Theoretical horizontal and vertical (shaded) deformation fields for 33 mm/yr convergence between the Ormara Plate (Arabian Sea) and the Asian Plate (Baluchistan) shown for a 5 degree planar dislocation terminating at 15 km (solid lines) or 20 km depths (dashed lines). The hatched bar at 15 km indicates the preferred rupture plane for 1945 (Byrne et al, 1992) that terminates close to where we infer present interseismic slip also terminates. Were interseismic slip locked near the base of the 1945 rupture we should anticipate Ormara's velocity to be <5 mm/yr, instead of the 22 mm/yr observed.

References

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