

Fine-Tuning the Seismic Potential of the Nicoya Gap in NW Costa Rica

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Abstract

The Nicoya seismic gap is a subduction segment along the Middle American Trench where the Cocos plate subducts under the Caribbean plate. This seismic gap, located under the Nicoya Peninsula in northwestern Costa Rica, has ruptured with large earthquakes in 1853, 1900 and 1950. Its strong coupling contrasts with the immediately adjacent weak segments: Nicaragua to the NW and central Costa Rica to the SE. The Nicaragua segment has a very high level of background seismicity with several earthquakes per year with magnitudes above 5.0; its most recent large event was an abnormally slow earthquake ($M_w=7.6$) that generated a destructive tsunami in 1992. The central Costa Rica segment also has a high level of background seismicity with very frequent events with magnitudes above 4.5; its last large event ($M_w=7.0$) occurred in 1990 just at the boundary with the Nicoya seismic gap. The aftershock areas of the Costa Rica, 1990 and Nicaragua, 1992 earthquakes allowed the geographic extent of the Nicoya seismic gap to be clearly defined. Evidences that support a strong coupling for the Nicoya segment are: a) very low background seismicity; b) the sudden end of aftershocks of the 1990 and 1992 earthquakes at its boundaries; and c) the fast NE motion (parallel to convergence) of the Nicoya Peninsula (nearly 30mm/yr.) observed with GPS.

Recent seismological and geodetic studies (Protti et al., 2001; Newman et al., 2002; Iinuma et al., 2004; Norabuena et al., 2004; DeShone et al., 2006) restrict the seismic coupling to 50 +/- 5% and the potential rupture area to 8000 +/- 1500 km². These values, together with a convergence rate around 88mm/yr and no significant seismic slip since 1950, give the Nicoya seismic gap a potential, for the following 5 years, to generate a earthquake with $M_w=7.8 \pm 0.1$ magnitude.