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High-Resolution Locations and Focal Mechanisms of Aftershocks of the September 5, 2012 Mw=7.6 Nicoya, Costa Rica Earthquake

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Subduction beneath the Nicoya Peninsula, Costa Rica generates the largest underthrusting earthquakes in the country with a recurrence interval of about 50 years. The most recent of these events occurred on September 5th 2012 (Mw 7.6). A vigorous aftershock sequence of more than 6400 earthquakes was recorded by a local seismic network within the first 4 months of the mainshock. We identify those aftershocks occurring on the mainshock fault plane and compare their locations to the 2012 mainshock slip distribution, the location of past interplate seismicity, and slow slip phenomena to better understand the mechanical behavior of this plate interface. Our focal mechanism determination includes all aftershocks occurring within the first nine days after the mainshock and aftershocks with magnitude greater than four occurring through the end of December 2012. We use the HASH (Hardebeck and Shearer, 2002) software package, based on first motion polarities, to obtain aftershock focal mechanisms. We are able to determine reliable focal mechanisms for 583 of the aftershocks and identify 264 of them as occurring on the plate interface. All of these are relocated using HypoDD (Waldhauser and Ellsworth, 2000) and their locations are compared with other plate boundary activity. We find no significant seismicity patterns as a function of time or magnitude, but confirm that deeper underthrusting events occur in the north compared to the south as revealed by previous studies (Newman et al., 2002). Most of the aftershocks occur in and around the updip part of the coseismic rupture zone. This suggests that the Nicoya mainshock released all of the accumulated strain in the deeper part of the plate interface, leaving none to occur as aftershocks. Previous interface seismicity in this region reveals a similar distribution to the aftershocks, however it extends to deeper depth and defines the entire seismogenic zone. The coseismic slip occurs even deeper than the background interface seismicity, suggesting that the mainshock ruptured into the conditionally stable part of the interface.